INSTITUTO
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The Construction of Job Competency Model for Oncologists in Shanghai

HE Ke

Doctor of Management

Supervisors:
PhD Leandro Ferreira Pereira, Professor,
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PhD Carlos Hernandez Jerónimo, Assistant Professor,
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July, 2025

BUSINESS
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Marketing, Operations and General Management Department

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Abstract

This study focuses on the job competency of oncologists in Shanghai and develops a competency model that reflects the specific characteristics of oncology practice. Through literature review, expert interviews, and textual analysis, six key dimensions are identified: knowledge and skills, physician–patient communication, scientific innovation, ethics and law, team collaboration, and digital and intelligent healthcare. Based on these dimensions, a structured scale is developed, and 398 valid questionnaires are collected. Empirical analyses are conducted using Stata and SPSS. The findings indicate that the model demonstrates robust reliability and validity. Among the six dimensions, knowledge and skills, physician–patient communication, team collaboration, and digital and intelligent healthcare significantly and positively predict performance. Although scientific innovation and ethics and law do not exhibit direct effects on performance, they display moderating effects in interaction analyses. This suggests that these dimensions substantially influence the pathways through which other competencies are exercised in complex clinical settings. Hence, this study enriches the structure of job competency of oncologists.

Keywords: Oncologists; Job competency; Competency model; Job performance

JEL: I118; J24

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Resumo

Este estudo centra-se na análise das competências profissionais dos médicos oncologistas em Xangai e desenvolve um modelo de competências que reflete as características específicas da prática oncológica. Através da revisão da literatura, entrevistas com especialistas e análise textual, foram identificadas seis dimensões-chave: conhecimentos e aptidões, comunicação médico-doente, inovação científica, ética e legislação, colaboração em equipa, e saúde digital e inteligente. Com base nestas dimensões, foi desenvolvida uma escala estruturada, tendo sido recolhidos 398 questionários válidos. As análises empíricas foram realizadas com recurso aos softwares Stata e SPSS. Os resultados indicam que o modelo apresenta uma fiabilidade e validade robustas. Entre as seis dimensões, os conhecimentos e aptidões, a comunicação médico-doente, a colaboração em equipa e a saúde digital e inteligente revelam-se preditores positivos e significativos do desempenho profissional. Embora a inovação científica e a ética e legislação não apresentem efeitos diretos sobre o desempenho, evidenciam efeitos moderadores nas análises de interação. Tal sugere que estas dimensões influenciam de forma substancial os caminhos através dos quais outras competências se manifestam em contextos clínicos complexos. Assim, o presente estudo contribui para o enriquecimento da estrutura de competências profissionais dos médicos oncologistas.

Palavras-chave: Médicos oncologistas; Competências profissionais; Modelo de competências; Desempenho profissional

JEL: I118; J24

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摘 要

本研究聚焦“上海肿瘤医师岗位胜任力”，构建并检验具有肿瘤专科特征的胜任力模型。通过文献综述、专家访谈与文本分析，识别出知识技能、医患沟通、科研创新、伦理法律、团队协作与数智医疗六大维度。在此基础上，设计量表并回收有效问卷398份，采用Stata与SPSS进行实证检验。研究结果表明：该模型具有良好信效度，其中知识技能、医患沟通、团队协作与数智医疗四个维度显著正向预测绩效；科研创新与伦理法律虽无直接影响，但在交互分析中呈现调节效应，表明其在复杂医疗情境中显著影响其他能力发挥路径，丰富了肿瘤医师胜任力的结构内涵。

关键词：肿瘤医师；岗位胜任力；胜任力模型；工作绩效

JEL: I118；J24

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After years of climbing a winding and arduous path, I feel not only immense joy, but also a deep and quiet calm standing at the summit of my degree pursuit. I embarked on this journey at the very moment I transitioned to a teaching role in a clinical hospital, a deliberate challenge to test whether I could rise to the demands of leading an academic affairs office in a large public hospital. I have been working in standardized residency training for ten years. In this familiar field, I set out on a new exploration: to investigate how a job competency model for oncologists could be harnessed in medical education and talent development.

This path of growth would not have been possible without the guidance, encouragement, and support of many people along the way. To all who have walked beside me, I remain deeply and sincerely grateful.

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致 谢

历经数年如登山一样曲折的前进，而真正到达完成博士学位论文的“登顶”之时，我的内心非常喜悦，却也十分平静。曾记否博士入学期间的那份青春激情，已经尽洒在这些年的学习和研究之中，读博期间的难忘经历也将成为我这一生不可多得的宝贵财富。攻读博士学位，正是我从高校进入附属医院工作之时，面对崭新的工作岗位，给自己设定的一次挑战，挑战自己能否适应大型公立医院教学管理部门负责人的岗位要求；同时，攻读博士学位，也是我负责住院医师规范化培训工作的第十个年头，在熟悉的工作领域，给自己规划的一次探索，探索肿瘤医师岗位胜任力模型在人才培养中的应用，期待对自己认识更清晰，期待对职业认识更清晰，为今后的生涯规划打下坚实的基础。

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Chapter 1: Introduction

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1.1.1.1 Models of medical talent development in Europe and North America

The historical development of medical education systems in Europe and North America spans a long trajectory, which has profoundly shaped the structure of medical training in these regions and provides valuable models and insights for the advancement of medical education worldwide. Most countries today adopt a three-tiered structure for medical education, consisting of undergraduate education, postgraduate training, and continuing professional development. The U.S. medical education system follows this general framework. In the late 19th and early 20th centuries, particularly during the relatively unregulated 19th century, the medical education system in the United States was highly fragmented and inconsistent. Many medical schools at the time were privately operated by physicians and lacked standardized academic requirements and qualified faculty, resulting in wide disparities in educational quality. Instruction in these schools often occurred during physicians' spare time, with little emphasis on systematic learning, no unified curriculum, and no rigorous assessment of students' mastery of medical knowledge. It was not until 1910 that Abraham Flexner (Flexner, 1910), an American educator, published his landmark report *Medical Education in the United States and Canada*, which critically examined the prevailing conditions of medical education and proposed comprehensive reforms. In the report, Flexner highlights severe deficiencies in educational quality, particularly the overreliance on didactic teaching and the neglect of clinical training and research competence. He advocates for an integrated approach that emphasizes both basic biomedical sciences and hands-on clinical internships, aiming to prepare physicians capable of managing increasingly complex disease presentations. Flexner's report catalyzed sweeping reforms in American medical education and has served as a global reference for system-wide improvements, particularly in the domains of clinical training and the standardization of educational quality. Following the publication of the Flexner Report, medical education in the United States gradually became standardized, and the contemporary "4+4" model emerged. This model comprises two primary components: an undergraduate phase and the Doctor of

Medicine (M.D.) program. The undergraduate phase does not confer a clinical medical degree. Pre-medical students may pursue any major, but they are required to complete prerequisite courses in the biomedical sciences, such as biology and chemistry, before taking the Medical College Admission Test (MCAT) for entry into medical school. This undergraduate phase typically lasts four years, after which students progress to the M.D. program. The M.D. program usually spans another four years. The first two years focus primarily on foundational medical sciences, such as biomedical sciences, pharmacology, and pathology, while the final two years emphasize clinical rotations across various specialties, including internal medicine, surgery, obstetrics and gynecology, pediatrics, and psychiatry. Some medical schools require students to gain clinical exposure from the first year, enabling early patient contact and fostering skills in clinical reasoning and communication. During medical school, students are required to take the United States Medical Licensing Examination (USMLE). The USMLE consists of three steps: Step 1, Step 2, and Step 3. Step 2 is further divided into Clinical Knowledge (CK) and Clinical Skills (CS). Steps 1 and 2 are typically completed during medical school, while Step 3 is undertaken during the residency program. Step 1 assesses knowledge of basic medical sciences; Step 2 evaluates clinical practice and medical decision-making abilities; and Step 3 serves as the final assessment of whether a candidate is qualified to practice independently.

Upon completion of the Doctor of Medicine (M.D.) degree, medical graduates are required to undertake a minimum of three years of residency training. Residency training constitutes a critical component of postgraduate medical education in the United States and represents a pivotal phase in a physician's professional development. This stage equips trainees with comprehensive clinical knowledge and practical skills through structured rotations and hands-on experience. Residency is typically structured into three postgraduate years, with training content progressively advancing each year. First-year residents, often referred to as interns, focus primarily on inpatient care and routine clinical management. They rotate through hospital wards during on-call shifts and participate in surgical or outpatient rotations during non-call hours. This stage emphasizes the cultivation of systematic clinical thinking and diagnostic reasoning, often under intense time constraints. Second-year residents take on greater clinical autonomy. In addition to managing hospitalized patients, they conduct in-hospital consultations, assist in surgical procedures, and progressively engage in more complex clinical responsibilities. By the third year, some residents may be appointed as chief residents. In this role, they assume expanded responsibilities for surgical scheduling, patient care coordination, and peer instruction, while also initiating involvement in advanced medical management and academic research activities.

Upon completion of residency training, those aspiring to become specialists must undertake further subspecialty fellowship training aligned with their chosen discipline. Fellowship programs generally span three to eight years, depending on the specific field of specialization. For instance, internal medicine typically requires three years, neurology five years, and neurosurgery seven to eight years of training. In addition to intensive clinical training, fellowship programs emphasize research productivity. Trainees are expected to participate in scientific research and contribute to scholarly publications. This phase is often more demanding than residency, as fellows must balance clinical duties with laboratory research and academic writing. Upon completing fellowship training, physicians are awarded the title of attending physician, which confers full clinical privileges to practice independently within hospital settings. Attending status represents the highest clinical designation within the hospital hierarchy, encompassing broad authority over surgical procedures, clinical consultations, and patient management. To ensure lifelong learning and ongoing competence, the United States implements a recertification system for board-certified specialists. Certification from professional boards is typically valid for six to ten years, during which physicians undergo periodic assessments and continuing education requirement to maintain active status.

The standardization of medical education in the United States can be traced back to 1889, when Johns Hopkins Hospital pioneered the country's first structured residency training program under the leadership of renowned surgeon William Osler. This initiative marked a pivotal transition from classroom-based teaching to clinical education grounded in hospital-based, patient-centered care. In the following decades, however, residency training in the United States remained largely decentralized and inconsistent. The quality of training varied significantly depending on the individual institution or department, exhibiting clear features of non-standardization and heterogeneity (Ludmerer, 1999). To address this issue, the American Medical Association (AMA) began drafting and releasing the first set of guidelines for residency training sites in 1928, aiming to establish norms across institutions, faculty qualifications, curricula, and assessment systems. Meanwhile, from the 1920s to the 1940s, various medical specialties gradually established independent boards to certify specialists. One of the earliest examples is the American Board of Ophthalmology, founded in 1924. In 1933, the American Board of Medical Specialties (ABMS) was officially established to coordinate and oversee the certification processes of individual specialty boards. The ABMS focuses primarily on determining whether individual physicians meet the professional qualifications required for specialty practice. However, it did not yet impose a unified oversight system for residency programs themselves, such as curricular structure, rotation arrangements, or teaching

quality.

In an effort to strengthen oversight of the training process, the Liaison Committee on Graduate Medical Education (LCGME) was established in 1972, signaling a shift from fragmented specialty board governance toward more coordinated regulation. The LCGME was tasked with harmonizing the standards and implementation procedures across specialties. Yet, owing to its consultative nature and limited authority, the LCGME fell short of unifying training models and quality benchmarks. It was not until 1981, with the founding of the Accreditation Council for Graduate Medical Education (ACGME), that the residency system entered a new era of standardized governance. The ACGME was granted full authority to define national standards, conduct accreditation reviews, and monitor the quality of all residency training programs across the country. This move marked the first time that postgraduate medical education in the United States was governed by a system that is coordinated, mandatory, and objectively assessable (Nasca et al., 2012).

In its subsequent development, the ACGME continuously refined its evaluation system. In 2001, the ACGME introduced and implemented a training and evaluation framework based on six core competencies: Medical Knowledge, Patient Care, Professionalism, Interpersonal and Communication Skills, Practice-Based Learning and Improvement, and Systems-Based Practice (Swing, 2007). These six competencies collectively represent a multidimensional set of requirements for competent residents, encompassing knowledge, skills, attitudes, and behaviors, with a particular emphasis on shifting from procedural training to competency development. In practical training, physicians are expected not only to master diagnostic and therapeutic procedures, but also to demonstrate effective communication, ethical reasoning, interprofessional collaboration, and continuous improvement. This shift reflects a paradigm change in medical education from “doing well” to “being competent” and “sustainably competent”. To further specify evaluation criteria and enable dynamic monitoring of training outcomes, the ACGME introduced the competency-based Milestones Evaluation System in 2013 and fully implemented it in 2016. This system deconstructs the six competencies into multiple behavioral indicators and developmental stages, allowing program evaluators to assign quantitative ratings based on observed resident performance, while also providing trainees with feedback for self-assessment and professional development. The system enhances both the specificity and individualization of training and contributes to the establishment of a closed-loop evaluation mechanism integrating process, outcomes, and feedback.

In addition, the standardization of U.S. residency training relies heavily on the comprehensive integration of Evidence-Based Medicine (EBM) principles. EBM emphasizes

clinical decision-making grounded in the integration of high-quality research evidence, clinical expertise, and patient values, and serves as a core pillar of modern medical education. The ACGME encourages training institutions to widely implement clinical pathways, morbidity and mortality rounds, and journal clubs in routine instruction to ensure that physicians at all stages of training internalize a data- and evidence-driven clinical reasoning framework.

The structure of Canada's medical education system closely mirrors that of the United States, as both adopt a "post-baccalaureate medical education" model in which students must first complete an undergraduate degree before entering medical school. This model emphasizes academic foundation, diversity of background, and scientific literacy, aiming to select future physicians with strong academic competence, humanistic sensibility, and critical thinking skills. At the admission stage, most Canadian medical schools require applicants to have completed at least three years of undergraduate study, while some institutions, such as McGill University and the University of British Columbia, prefer candidates who already hold a bachelor's degree. In addition to academic performance, applicants are required to take the Medical College Admission Test (MCAT), which evaluates knowledge and analytical abilities in biology, chemistry, physics, critical reasoning, and psychology, thus serving as a key metric for pre-medical student selection. Moreover, most medical schools use the Multiple Mini Interview (MMI) format to assess interpersonal communication, ethical reasoning, and professional motivation, thereby enabling a more holistic selection process. Once enrolled, Canadian medical education typically spans four years and is divided into two main phases. The first two years constitute the pre-clerkship phase, during which students study foundational biomedical sciences in classrooms, including anatomy, physiology, pathology, pharmacology, behavioral sciences, and medical ethics. This phase aims to establish a solid theoretical foundation while cultivating introductory clinical communication and assessment skills through simulation centers and standardized patient systems. The final two years comprise the clerkship phase, during which students undertake clinical rotations in affiliated teaching hospitals or community healthcare settings across a range of specialties including internal medicine, surgery, pediatrics, psychiatry, obstetrics, and family medicine. This stage emphasizes experiential learning in authentic care environments, gradually developing students' clinical decision-making, diagnostic collaboration, and patient management capabilities. Upon earning their medical degree, graduates proceed to a residency program lasting between two and seven years. Residency programs are jointly administered by provincial health authorities and academic institutions and require application through the Canadian Resident Matching Service (CaRMS), a centralized national matching system. Residency constitutes the core of postgraduate medical

education, wherein trainees undergo structured clinical training and accumulate case experience within their chosen specialty, such as internal medicine, surgery, anesthesiology, or radiology, ultimately progressing toward independent clinical practice. Some residents pursue advanced subspecialty training through fellowships in fields such as cardiology, oncology, or interventional radiology; others opt for research careers or doctoral studies to advance along academic trajectories. Notably, Canada plays a pivotal role in shaping global medical education reform. In 1996, the Royal College of Physicians and Surgeons of Canada led the development of the CanMEDS competency framework—Canadian Medical Education Directions for Specialists—which systematically defines physician roles into seven core domains: Medical Expert, Communicator, Collaborator, Health Advocate, Leader, Scholar, and Professional (Frank et al., 2015). The impact of CanMEDS extends well beyond Canada, as it is widely adopted or adapted by numerous countries and regions as a theoretical foundation for designing medical curricula, licensing standards, and evaluation systems. Countries such as the Netherlands, Australia, New Zealand, and Singapore have incorporated CanMEDS as a core reference for both undergraduate and postgraduate medical training and assessment standards.

Medical education in the United Kingdom begins at the undergraduate level. Most medical schools offer undergraduate medical programs lasting five to six years, which are typically divided into two distinct phases: the first two years constitute the preclinical phase, during which students primarily engage in on-campus instruction in foundational biomedical sciences such as anatomy, physiology, biochemistry, pathology, pharmacology, and behavioral science, while also receiving introductory training in medical ethics, humanities, and professional values. The subsequent three years comprise the clinical phase, during which students undergo structured clinical rotations in teaching hospitals, with core placements typically including internal medicine, surgery, obstetrics and gynecology, pediatrics, psychiatry, and emergency medicine. Medical education in the UK places a strong emphasis on a patient-centered teaching philosophy, with students engaging in small-group case discussions, ward-based learning, outpatient clinics, and simulation-based training, focusing on the development of communication skills, clinical reasoning, and humanistic care. Importantly, the UK medical curriculum also places substantial emphasis on research training. Many institutions offer an intercalated degree opportunity during undergraduate study, which typically involves an additional year dedicated to research, leading to a BSc or MSc degree. This enables students to undertake substantive research projects, develop scientific skills, and complete a dissertation. This mechanism is designed to cultivate research literacy and evidence-based thinking in future physicians, thus laying the foundation for advanced clinical and academic careers.

Upon graduating, students must apply for provisional registration with the General Medical Council (GMC), which enables them to enter the two-year Foundation Programme. This training is administered by the National Health Service (NHS) and comprises two stages: Foundation Year 1 (FY1) and Foundation Year 2 (FY2). The primary goal of FY1 is to facilitate the transition from theoretical knowledge to practical competence, with training encompassing emergency assessment, clinical documentation, procedural skills, patient communication, and teamwork. Successful completion of FY1 leads to full registration with the GMC, granting doctors the legal authority to prescribe independently. During FY2, training focuses on the development of broader professional capabilities, particularly in managing acutely unwell patients, interdisciplinary teamwork, time management, interpersonal communication, and the use of clinical information systems. Trainees typically complete four to six clinical placements during FY2, exposing them to a range of specialties to inform their future career decisions.

After the Foundation Programme, doctors must apply for specialty training, either in General Practice (GP) or in a hospital-based Specialty Training (ST) pathway. For those pursuing general practice, a three-year GP training program is required, which includes primary care delivery, chronic disease management, preventive medicine, patient education, and community-based care, with an emphasis on autonomous practice and community service. Upon completion and successful attainment of Membership of the Royal College of General Practitioners (MRCGP), the practitioner is fully licensed to work as a general practitioner. For hospital-based specialties, applicants must enter specific ST programs, the duration of which varies by specialty, typically ranging from five to eight years. For instance, internal medicine takes approximately five years, surgery and radiology require six years, and neurosurgery may extend beyond eight years. The ST phase develops doctors into domain-specific experts, with competencies in advanced clinical reasoning, academic writing, leadership, and medical education. Each phase is accompanied by formal assessments and specialty-specific licensure examinations, such as the Membership of the Royal College of Physicians (MRCP) or the Membership of the Royal College of Surgeons (MRCS).

In terms of assessment and quality assurance, postgraduate training in the UK adopts a competency-based evaluation framework, incorporating tools such as mini-Clinical Evaluation Exercises (mini-CEX), Case-Based Discussions (CBD), Multi-Source Feedback (MSF), and the Annual Review of Competency Progression (ARCP), thereby ensuring that training objectives are met and that professional competence is progressively achieved. The General Medical Council (2015) defines detailed learning outcomes and assessment criteria, and monitors institutional and trainee performance via a national regulatory framework, thereby

ensuring consistency in training quality across the UK. In addition, the UK maintains a robust system for Continuing Professional Development (CPD). Following licensure, physicians are required to engage regularly in CPD activities, including continuing education modules, skills refreshers, and revalidation, to ensure the ongoing maintenance of professional competence and patient safety in clinical practice.

Germany's medical education system is deeply rooted in its historical tradition and characterized by a high degree of institutionalization. Its structural design and governance model have long been regarded globally as a benchmark for high-quality medical training. As early as the 19th century, Germany institutionalized the full integration of medical education into the university system, establishing a rigorous model that equally emphasizes foundational science and clinical training. This model profoundly influenced medical education in both Europe and North America. In the early 19th century, medical faculties in German universities were embedded within the faculties of philosophy. Medical education followed a "3+3" model: students first undertook three years of foundational coursework within the philosophy faculty, which focused on natural sciences, the humanities, and basic medical sciences to establish a solid knowledge base for subsequent clinical training. Upon meeting the academic requirements for advanced study, students proceeded to the medical faculty for three additional years of study, during which laboratory-based instruction was closely integrated with hands-on clinical experience. At the time, the German model was considered one of the most advanced globally, distinguished by the integration of scientific research with education and a strong emphasis on empiricism and standardization, features that laid the groundwork for modern medical education systems (Bonner, 2000). In the 21st century, Germany further refined its medical education into a coherent, content-rich, and tightly integrated curriculum. Currently, Germany adopts a six-year integrated medical education model entered directly after secondary school graduation, which merges undergraduate and postgraduate training without distinction between bachelor's and master's degrees. Students must first pass the national secondary school exit examination (Abitur), based on which they apply for medical schools. The medical curriculum spans a minimum of 6 years and 3 months and is generally divided into two main phases: the pre-clinical phase (Vorklinik) and the clinical phase (Klinik), supplemented by a practical year (Praktisches Jahr, PJ) and a series of national examinations (Staatsexamen).

The pre-clinical phase spans two years, during which students study core subjects such as anatomy, physiology, biochemistry, psychology, and medical ethics. This phase also includes laboratory coursework and early patient contact (Frühpatientenkontakt) to develop preliminary communication and documentation skills. At the end of this phase, students sit for the first

national examination—Physikum—which comprises both oral and written components and is widely considered one of the most challenging assessments in the curriculum. Data indicate that approximately 10–12% of students fail the Physikum on their first attempt and must retake the examination before advancing to the next phase. Upon passing the Physikum, students enter the clinical phase, which typically lasts four years and includes structured coursework as well as clinical rotations. Students are required to complete theoretical and bedside training across core specialties including internal medicine, surgery, pediatrics, obstetrics and gynecology, psychiatry, neurology, and general practice. They also participate in case-based seminars (Fallseminar) and interdisciplinary clinical conferences (Interprofessionelle Lehre). Toward the end of the third year of this phase, students sit for the second national examination (Zweiter Abschnitt der Ärztlichen Prüfung), which tests the integrative application of knowledge across disciplines. The final year—the Praktisches Jahr (PJ)—constitutes full-time clinical training. Students rotate for four months each in internal medicine, surgery, and a freely chosen specialty (e.g., general practice, pediatrics, anesthesiology), and actively engage in frontline patient care, case documentation, and basic diagnostic and therapeutic procedures. Upon completing the PJ, students take the third national examination (Dritter Abschnitt der Ärztlichen Prüfung), which includes both observed clinical performance and standardized assessments administered nationwide. Upon passing all three national examinations, students are granted the license to practice medicine (Approbation), thereby becoming fully registered physicians in Germany.

Upon obtaining a medical license, physicians enter the Assistenzarzt stage, which corresponds to the residency phase in other countries. At this stage, physicians work in hospitals while undergoing standardized specialty training governed by professional societies, such as the German Society of Internal Medicine or the German Society of Surgery. Unlike the centralized residency matching system in the United States, Germany does not implement a national allocation mechanism. Physicians apply independently for hospital positions and undertake training based on individual preferences and the qualifications of the institution.

The duration of specialty training varies by discipline, typically ranging from four to six years. Internal medicine and general practice generally require five years; general surgery takes six years, whereas complex specialties such as neurosurgery and cardiothoracic surgery may extend beyond seven years. Throughout the training, physicians must fulfill specified requirements in case volume, procedural skills, competency checklists, and continuing education modules. Regional medical councils conduct periodic evaluations and review training progress. During training, physicians are employed under labor contracts with their respective hospitals, and the training timeline allows for flexible scheduling aligned with individual career

trajectories (Nikendei et al., 2009). Upon completion of the training and successful assessment by the relevant specialty board, physicians are awarded the Facharzt title, which qualifies them to practice independently, establish private practices, or serve as attending physicians in their specialty area. It is noteworthy that the German medical system does not implement a national residency exit examination or mandatory rotational training. Instead, physician competency is assessed through a combination of task completion, quantitative evaluation, and certification, reflecting a longitudinal, competency-based approach to professional qualification.

Following Facharzt qualification, physicians may pursue further training in subspecialties and obtain a Zusatzbezeichnung (additional qualification), such as cardiology or endocrinology within internal medicine. Such advanced training is not mandatory, but rather reflects individualized career development pathways. The German Medical Association mandates that all licensed physicians engage in continuous medical education (Fortbildung) to maintain their licensure. Every five years, physicians must submit documentation of at least 250 credit hours, which may include academic conferences, online courses, and skills training.

In summary, global medical education systems exhibit three prevailing trends: a clear orientation toward competency and role definition; a focus on measurable and certifiable training processes; and an emphasis on continuing education and lifelong learning. These practices provide valuable reference points for the reform of domestic medical training systems.

1.1.1.2 Training Model of Physicians in China

China's medical education system has gradually developed a multi-tiered training pathway with distinct national characteristics. Its core model follows a staged "5+3+X" framework for cultivating medical professionals. This system builds upon undergraduate education, centers on standardized residency training, and advances through structured specialist training, thereby serving as the principal pathway for physicians to obtain professional qualifications and clinical competencies. The overarching aim is to enhance theoretical foundations, clinical skills, and professional competence through a rational structural design and standardized training processes, thereby meeting the nation's demand for a high-quality medical workforce.

Traditionally, the training of clinical physicians in China begins with a five-year undergraduate medical education, commonly referred to as the "5" stage. Following completion of secondary education and selection via the National College Entrance Examination, students enroll in various medical universities and undertake a five-year systematic curriculum. This phase covers foundational courses such as basic medical sciences, clinical medicine, preventive medicine, medical humanities, ethics, and psychology. The first four years focus primarily on

classroom instruction and laboratory training, while the fifth year emphasizes clinical clerkships and internships, typically conducted through rotations in core departments, including internal medicine, surgery, obstetrics and gynecology, pediatrics, and emergency medicine, within affiliated teaching hospitals (National Health and Family Planning Commission of the People's Republic of China et al., 2013). Upon completion of the five-year clinical medicine program, students are awarded a Bachelor of Medicine degree. Graduates are then required to pass the National Medical Licensing Examination, which comprises both a written theoretical test and a clinical skills assessment. Obtaining the physician license is a prerequisite for lawful clinical practice. It is important to note that while earning the bachelor's degree is a fundamental requirement for entering the subsequent standardized training stage, it is not the sole pathway. Graduates who initially do not receive the degree may still acquire it by completing supplementary coursework or passing designated examinations. In the conventional model, holding a bachelor's degree and a medical license merely marks the entry point to the profession and does not yet confer the ability to independently manage complex clinical responsibilities.

The subsequent "3" stage refers to the resident standardized training program (commonly known as "Zhupei"), which serves as a critical transitional phase in China's medical education system. It functions as the essential bridge from entry-level qualification to professional competence. Since the release of the *Regulatory Plan for Resident Standardized Training* in 2014, the system has been implemented nationwide. In 2015, it was formally institutionalized as a mandatory requirement preceding full licensure (National Health and Family Planning Commission of the People's Republic of China et al., 2013). The residency training program follows a nationally unified standard, jointly overseen by national and provincial health authorities. Training bases are established in Tertiary Grade A hospitals and eligible secondary hospitals with teaching accreditation. The three-year program integrates departmental rotation, mentorship, and continuous assessment. Under the supervision of attending physicians, residents rotate through core clinical departments, including internal medicine, surgery, obstetrics and gynecology, pediatrics, emergency medicine, intensive care, and anesthesiology, to systematically develop their competencies in medical documentation, basic procedures, diagnostic reasoning, and team-based care. The evaluation process spans the entire training cycle and includes departmental exit exams, theoretical tests, skills-based assessments, and longitudinal performance reviews. Upon successful completion of the three-year program and the final comprehensive examination, residents receive the Certificate of Completion for Standardized Training. This qualification is a prerequisite for applying for the attending physician title or enrolling in specialist training. It also signifies that the physician has acquired

the foundational competencies necessary for independent clinical practice.

To further enhance professional capacity and clinical precision, China has initiated pilot programs of Specialist Standardized Training (SST) in selected developed regions, building upon the foundation of the residency training system and forming the "X" component of the "5+3+X" training pathway. According to the *Guidance on Pilot Implementation of Standardized Training for Subspecialty Physicians* (National Health and Family Planning Commission of the People's Republic of China et al., 2015), SST serves as a continuation of medical training following successful completion of residency. The duration typically ranges from two to four years, determined by the complexity and structural requirements of the respective specialty. For example, general pediatrics requires two years, while more intricate fields such as cardiology or neurosurgery may require three to four years or more. SST curricula focus on core specialty knowledge, complex technical skills, disciplinary frontiers, and research competencies. It establishes advanced standards of professional competency and emphasizes process-oriented methods, including individualized mentorship, case-based discussions, multidisciplinary seminars, and research participation. Upon successful completion and assessment, trainees are awarded the Certificate of Completion of Specialist Standardized Training, which qualifies them for independent practice and advancement within their specialty.

Taking Shanghai's 2024 pilot implementation as a case in point, the local health authorities have designated key academic hospitals including Zhongshan Hospital, Huashan Hospital, and the Cancer Center affiliated with Fudan University as primary training sites. These institutions develop subspecialists in core disciplines while integrating the SST system with mechanisms for professional title evaluation, talent recruitment, and performance-based compensation management. Throughout the training period, physicians are required to complete a prescribed number of complex procedures, manage difficult cases, initiate research projects, and publish academic papers. This process fosters an integrated enhancement of clinical skills, research capability, and professional competence (Shanghai Municipal Health Commission et al., 2024).

It is important to note that, beyond the mainstream "5+3+X" pathway, the Chinese medical education system has explored multiple alternative training formats. One such model is the "integrated 5+3" program, primarily implemented in top universities designated under the Double First-Class Initiative. This model allows students to proceed directly from five years of undergraduate study into a three-year professional master's program, with curricula that integrate requirements of both standardized residency training and postgraduate education. Graduates earn a master's degree while concurrently fulfilling residency qualifications. Another format is the eight-year continuous "undergraduate-to-doctorate" track, piloted by institutions

such as Peking University Health Science Center and Shanghai Medical College of Fudan University. This model combines five years of undergraduate education with three years of doctoral training and places strong emphasis on research capability and scientific innovation.

In addition, Peking Union Medical College has implemented a “4+4” medical education model since 2011. This represents a localized adaptation of the U.S.-style M.D. education pathway. Students first complete four years of non-medical undergraduate education, then enter a four-year Doctor of Clinical Medicine program following a secondary admission process administered by the college. The curriculum is highly intensive, with a strong focus on interdisciplinary integration, research-oriented thinking, and humanistic competence. The goal is to cultivate high-level, multidisciplinary medical professionals. This model breaks from the conventional high-school-entry-based medical education track and introduces a diversified framework for talent development in China’s medical education landscape.

1.1.2 Status quo of medical talent development in China and abroad

1.1.2.1 Status quo of medical talent development in Europe and North America

The training systems for oncology professionals in Europe and North America are well established and highly institutionalized, reflecting a comprehensive and forward-thinking approach that spans from foundational instruction to subspecialty differentiation, and from competency-based evaluation to continuing education.

In the United States, the pathway to becoming an oncologist typically follows a sequential model of residency and fellowship training. After earning a Doctor of Medicine (MD) degree, candidates complete a three-year residency in internal medicine, followed by a three-year fellowship in hematology and medical oncology. The United States is among the earliest countries to develop formal subspecialty training in oncology, which encompasses internal medicine, surgery, gynecology, and pediatrics. Multidisciplinary treatment (MDT) is a central tenet of training, with curricula integrating medical oncology, pathology, and radiology. Trainees rotate across departments, participate in tumor boards, and engage in interdisciplinary collaboration to develop treatment plans (Matalon et al., 2019). The Accreditation Council for Graduate Medical Education (ACGME) establishes stringent training standards across all specialties, including oncology, and its international arm (ACGME-International) has launched affiliated accreditation initiatives in regions such as the Middle East and Southeast Asia. In terms of continuing education, the American Society of Clinical Oncology (ASCO) offers an extensive array of academic resources including annual meetings, online courses, clinical

practice guidelines, and research platforms. As of 2024, ASCO has more than 45,000 members across over 150 countries and regions, providing sustained support for professional development in oncology. Leading U.S. cancer centers such as MD Anderson and Memorial Sloan Kettering offer research-oriented fellowship programs that integrate scientific investigation with clinical practice, aiming to foster research capabilities and promote innovation among oncology specialists.

In contrast, oncology education in Europe presents a "diversified yet integrated" model. Initially, European countries differ significantly in the duration of internal medicine training and subspecialty oncology education, in their approaches to developing oncology-specific competencies, in their understanding of how to distinguish oncology from combined disciplines such as clinical or hematologic oncology, and in their mechanisms for program accreditation. With increasing globalization of healthcare and cross-border exchange of expertise and knowledge, the European Society for Medical Oncology (ESMO) and the American Society of Clinical Oncology (ASCO) recognized the necessity of establishing a set of international recommendations for clinical oncology training to qualify physicians as oncology specialists. All patients, regardless of their geographic location, deserve access to the highest quality of evidence-based care delivered by well-trained physicians. Against this backdrop, in 2004, a joint task force from ESMO and ASCO formulated the first edition of the Global Core Curriculum (GCC) for medical oncology training. The curriculum was disseminated to academic institutions and oncology societies and simultaneously published in *Annals of Oncology* and *Journal of Clinical Oncology* (Hansen et al., 2004). In 2010, acknowledging the variation in healthcare priorities, needs, and resources across countries, the term "Global Core Curriculum" was revised to "Global Curriculum". In 2011, the European Commission formally recognized medical oncology as a distinct specialty based on the ESMO/ASCO Global Curriculum, endorsing a minimum of five years of structured training, which comprises two years in internal medicine and three years in oncology specialization (Cufer & Kosty, 2023; Hansen et al., 2004). The GC has effectively become a transformative instrument, encouraging numerous countries to adopt a five-year medical oncology training model. In 2016, the third edition of the curriculum was released. Each version of the GC incorporates up-to-date knowledge and competencies essential for oncologists to apply in daily clinical practice. A global survey conducted in 2019 revealed widespread awareness and adoption of medical oncology and the GC (Cufer et al., 2021). According to this survey, 75% of participating countries define oncology as a distinct medical specialty, and 68% partially or fully adopt the GC framework. This initiative significantly enhanced international harmonization and

standardization in oncology education. The certification of medical oncology in Europe is coordinated by the Union Européenne des Médecins Spécialistes (UEMS) in collaboration with ESMO and the European Society for Radiotherapy and Oncology (ESTRO), through the formulation of *European Training Requirements* (ETRs). These standards specify the scope of training, clinical rotation requirements, and competency-based assessment frameworks. For instance, ESMO recommends a training duration of 5–6 years, with structural flexibility to accommodate national contexts. Countries such as Switzerland, Austria, and Slovenia incorporate the ESMO examination as part of their national certification standards for oncology specialists, which exemplifies the close alignment between curriculum content and competency evaluation. Under the UEMS Council for European Specialists Medical Assessments (CESMA) framework, oncology credentials are recognized across borders, facilitating workforce mobility and scholarly exchange. Moreover, Europe places substantial emphasis on continuing medical education for oncologists. The European School of Oncology (ESO), in partnership with ESMO, organizes an annual five-day Clinical Oncology Masterclass, offering a comprehensive, clinically oriented, multidisciplinary program in oncology. Participants are required to complete mandatory clinical case reports and self-assessment modules. In addition to ESO, various oncology societies and educational organizations contribute to training through core curricula, clinical guidelines, and grant-sponsored programs, creating opportunities to enhance the knowledge base, skill set, and career advancement of oncology professionals (Pavlidis et al., 2020).

In summary, Europe and the United States demonstrate distinct strengths in medical oncology education. The United States is characterized by a clearly structured training pathway, rigorous evaluation standards, and robust research resources; its fellowship system holds substantial global influence, whereas Europe stands out for its harmonized standards, international collaboration, and a flexible, open curriculum framework. Both regions prioritize the development of physician competency frameworks and the enhancement of lifelong learning systems. Amid the global trend toward standardization and internationalization of medical education, the experience of Europe and the United States offers valuable insights for China’s oncology workforce development, particularly in establishing vertical integration across residency, subspecialty training, and continuing education, constructing multidimensional assessment systems, and embedding digital healthcare competencies into training models.

1.1.2.2 Status quo of medical talent development in China

In recent years, China's oncology workforce training system has steadily evolved toward a more standardized, systematized, and practice-oriented model.

Driven by both national policy support and rapid disciplinary advancement, a multi-stage, tiered oncology training framework has taken shape, comprising undergraduate medical education, standardized residency training, specialist training, and continuing medical education. This emerging structure provides increasingly systematic coverage across all levels of medical institutions.

To begin with, oncology has been formally integrated into China's national standardized residency training system. Since its full implementation in 2015, residency training has served as a mandatory phase prior to clinical practice for all physicians. According to the *National Health Commission's Plan of Residency Training*, the residency period spans three years, with training primarily based in tertiary general hospitals and select oncology-specialized centers. For instance, the Cancer Hospital of the Chinese Academy of Medical Sciences and Fudan University Shanghai Cancer Center both operate mature training bases offering structured clinical rotations and academic supervision. Under the "5+3+X" model proposed by the National Health Commission and the Ministry of Education, which consists of five years of undergraduate study, three years of residency, and two to four years of specialist training, several leading institutions have initiated pilot programs in oncology specialist education.

In the next phase, standardized specialist training, also known as the "X stage", is progressively entering the phase of policy formulation and pilot implementation. Under the "5+3+X" model proposed by the National Health Commission and the Ministry of Education, which comprises five years of undergraduate study, three years of residency, and two to four years of specialist training, oncology-specific training is being piloted in selected leading institutions. For instance, Shanghai Jiao Tong University School of Medicine launched its oncology specialist program in 2016, integrating clinical modules across medical oncology, radiation therapy, pathology, and imaging. The training adopts a rotation-based, modular structure, supported by mentoring and research involvement, aiming to foster a comprehensive "clinical–research–teaching" development model. Regional centers, such as the Sichuan Provincial Cancer Disease Quality Control Center, have initiated zonal rotations, teaching rounds, and case-based quality control initiatives, laying the groundwork for subspecialty-specific oncology training.

In building multidisciplinary care capacity, China actively promotes training in

multidisciplinary teams (MDTs) to meet the growing demand for collaborative and individualized cancer care. Since 2018, the National Health Commission has implemented the "Spark Program", supporting the establishment of 50 oncology MDT pilot units and fostering standardized training infrastructure. Provinces and cities such as Beijing, Guizhou, and Shandong have held MDT bootcamps and case seminars for specific cancers, which significantly improve grassroots physicians' comprehension and application of coordinated care protocols. Nevertheless, MDT training remains concentrated in major cities, while rural or primary healthcare settings continue to face challenges in staffing, workflow organization, and evaluation mechanisms.

In the realm of continuing medical education and capacity-building for local talent, national initiatives such as the "Thousand-County Project" and "County-level Healthcare Co-development" aim to enhance oncology expertise at the grassroots level. Peking University School of Public Health, for instance, leads a nationwide program to strengthen standardized oncology diagnosis and treatment skills in primary care, offering hybrid courses on early cancer screening, evidence-based management, and doctor–patient communication, alongside curated case libraries, instructional videos, and teleconsultation platforms.

1.1.2.3 Challenges in the training of oncologists in China

Although a foundational framework for oncologist training has taken shape in China, significant gaps remain.

First, the standardized residency training system remains incomplete. To date, China has not established a comprehensive framework for the training of oncology specialists. The distinctive characteristics of oncology necessitate treatment approaches that involve multiple disciplines and technologies. However, the current training system fails to adequately integrate these elements, resulting in oncologists who exhibit gaps in professional competence, depth of knowledge, and capacity for interdisciplinary collaboration. The lack of a well-established standardized training system leads to uneven specialization and clinical competence among oncologists, hindering their ability to meet the increasing complexity of oncologic care and potentially impacting patient outcomes.

Second, oncology-specific knowledge is not being comprehensively or effectively covered in residency training. The duration of oncology rotations during residency training is typically limited to only a few weeks, which is far from sufficient for residents to fully grasp the complexity and full scope of oncology. As a discipline involving multiple physiological systems, oncology requires extensive clinical exposure and sustained learning to develop the necessary

depth of knowledge and treatment proficiency. However, the brief duration of oncology rotations in standardized residency training limits residents' opportunities for in-depth engagement, hindering their ability to master essential competencies—such as the epidemiology, pathological characteristics, and clinical manifestations of various cancers, the pharmacologic properties of antitumor agents, and the principles of individualized, standardized treatment through multidisciplinary collaboration (Fan & An, 2016). As residents face increasingly complex and heterogeneous oncology cases in clinical practice, they often lack sufficient theoretical grounding and clinical experience, which may compromise the quality of patient care.

Third, the development of the oncology workforce remains insufficient. The establishment of a qualified oncology specialist team has lagged behind, particularly in primary healthcare institutions, where there is a notable shortage of specialized personnel. Given the complexity and diversity of oncology, physicians are expected to possess systematic professional knowledge and extensive clinical experience. However, the current training pipeline fails to meet this demand, with both the quantity and quality of oncology specialists falling short. The underdevelopment of a specialized oncology workforce continues to impede the effective dissemination of advanced technologies and the overall elevation of clinical standards. This limitation is particularly pronounced in primary care institutions, where patients frequently lack access to advanced therapies and personalized treatment strategies, thereby hindering the equitable improvement of cancer care across the country.

1.2 Research limitations

A fundamental reason underlying the aforementioned challenges in standardized residency training for oncologists in China is the absence of clearly defined clinical competencies. The lack of a structured competency assessment tool—such as a job competency model—has created substantial barriers to effective training, impeded the development of physicians' professional proficiency, and ultimately limited the overall progress of the oncology discipline. Competency refers to the underlying personal attributes and behavioral characteristics that directly influence an individual's job performance (McClelland, 1973). Given the high complexity of oncology patients in terms of physiological condition, psychological needs, and disease progression, and the diversity and dynamic evolution of treatment strategies, therapeutic outcomes often involve substantial uncertainty. This necessitates that oncologists possess not only comprehensive and systematic medical expertise and rigorous clinical reasoning, but also

a high level of humanistic competence and exceptional skills in communication and coordination, thereby ensuring the evidence-based development of treatment plans and the effective establishment of therapeutic relationships with patients. At the same time, reforms in healthcare delivery models have had a significant impact on the training requirements for oncologists. However, the competency standards for oncologists in China remain ill-defined, and there is no standardized competency framework to guide the training and evaluation of residents. This has resulted in multiple challenges within the current training system. First, China currently lacks a unified standardized residency training curriculum and assessment system for oncologists. This results in considerable variation in the training content and emphasis among hospitals in different regions, leading to substantial discrepancies in the competencies of oncologists across the country. Second, due to the lack of a clear understanding of the training objectives and their own competency expectations, residents often experience ambiguity in their learning direction throughout the training process. As a result, their development in both theoretical knowledge and practical skills remains insufficient, limiting their ability to effectively manage complex oncology cases. Third, the treatment of cancer typically requires coordination across multiple disciplines, including surgery, internal medicine, radiology, pathology, and imaging. Although multidisciplinary collaboration and personalized care are core features of contemporary oncology, the lack of a clearly defined job competency model means that residents are often not adequately exposed to interdisciplinary teamwork during training, limiting their ability to coordinate effectively in clinical settings.

Existing research has explored job competency issues in various healthcare domains, such as competencies required of general practitioners and traditional Chinese medicine physicians. However, there is a notable paucity of research specifically focused on developing a job competency model specific to oncologists. As previously noted, oncology differs markedly from other clinical disciplines in its scope and complexity. The question of how to develop a high-quality oncology workforce therefore warrants further investigation. Specifically, a job competency model that reflects the distinctive features of oncology must be established and validated, so as to ensure its practical applicability and effectiveness. On this basis, targeted strategies for enhancing oncologists' job competencies should be explored.

1.3 Research questions

What core competencies are essential for oncologists in China to fulfill their professional roles? This study develops a job competency model for oncologists based on a review of existing

literature and an analysis of interview transcripts using specialized text analysis software. To assess the model's structural validity and practical utility, further investigation is required to determine whether the model correlates with physicians' job performance. As one of China's major medical hubs, Shanghai possesses robust oncology treatment resources and research infrastructure. Its well-established standardized residency training system and the relatively high degree of internationalization in its medical institutions provide a valuable context for investigating the job competencies of oncologists. Moreover, the author is based at a hospital in Shanghai, which makes it more feasible to access relevant data and to recruit local oncologists as the study population. Accordingly, this study seeks to explore the following questions:

(1) What are the job competencies that constitute the competency profile of oncologists in Shanghai?

(2) What are the internal relationships among the various job competencies of oncologists in Shanghai?

(3) How can the job competencies of oncologists in Shanghai be assessed?

(4) What is the internal relationship between the job competencies and job performance of oncologists in Shanghai?

(5) What are recommendations can be proposed for improving the training of oncologists?

1.4 Definition of the study population

To establish a comprehensive competency model for oncologists, this study adopts a broad conceptualization of oncologists to reflect oncology's inherently multidisciplinary nature and to elucidate shared and distinct competency structures across specialties, thereby informing the development of a generalizable framework. Specifically, this study includes oncologists from tertiary, secondary, and non-public hospitals, working across departments of medical oncology, surgical oncology, radiation oncology, diagnostic imaging, pathology, and palliative care. Participants include core clinical physicians, clinical department heads, and physicians with administrative responsibilities. The competency profile of oncologists encompasses not only clinical skills and diagnostic capabilities but also research innovation, ethical decision-making, interdisciplinary collaboration, and effective communication with patients. In Shanghai, a city where oncology resources are highly concentrated, oncologists are increasingly required to meet rising demands in cancer care while managing complex clinical conditions. To do so effectively, they must possess advanced skills in precision medicine, strong interdisciplinary

collaboration competencies, and a strong foundation in palliative care. This study seeks to establish a job competency model that provides empirical evidence to guide the enhancement of oncologists' professional competencies and to support the continuous improvement of cancer care delivery.

1.5 Research implications

1.5.1 Theoretical implications

This study focuses on the development and empirical validation of a competency model for oncologists and offers important theoretical contributions. First, situated within the broader framework of competency theory, the study integrates the CanMEDS Core Competency Framework, the ACGME Core Competencies, and the context of China's medical education system to construct a model tailored to oncologists, thereby enriching the existing theoretical system. Second, by examining how various dimensions of oncologists' competencies influence performance outcomes, the study reveals the underlying mechanisms linking competencies to performance and strengthens the internal structure within the competency model, providing a systematic and structured explanatory framework for future theoretical research. Third, the study further extends the applicability of competency assessment tools and introduces a validated measurement scale designed for oncology competency assessment, offering a valuable empirical reference for subsequent research in the field.

1.5.2 Practical implications

This study provides practical guidance for the selection, training, and performance management of oncologists. First, by developing a competency model tailored to oncologists, the study offers a scientific foundation for recruitment and promotion decisions in healthcare institutions, ensuring that selected physicians possess the core competencies necessary for cancer diagnosis and treatment. Second, the study identifies the critical moderating roles of ethical sensitivity and research literacy in the manifestation of professional competencies, providing practical insight for the design of targeted training programs and laying a foundation for enhancing both the professional integrity and research capacity of oncologists. Third, by constructing an empirically based evaluation framework for oncologist competency, the study facilitates the systematic assessment of current competency levels, the identification of areas for improvement, and the optimization of performance appraisal systems and training resource allocation—

ultimately contributing to the overall advancement of the oncology workforce.

1.6 Research framework

The specific research content and methodological approaches are presented as follows and are structured in alignment with the overarching research questions (see Figure 1.1).

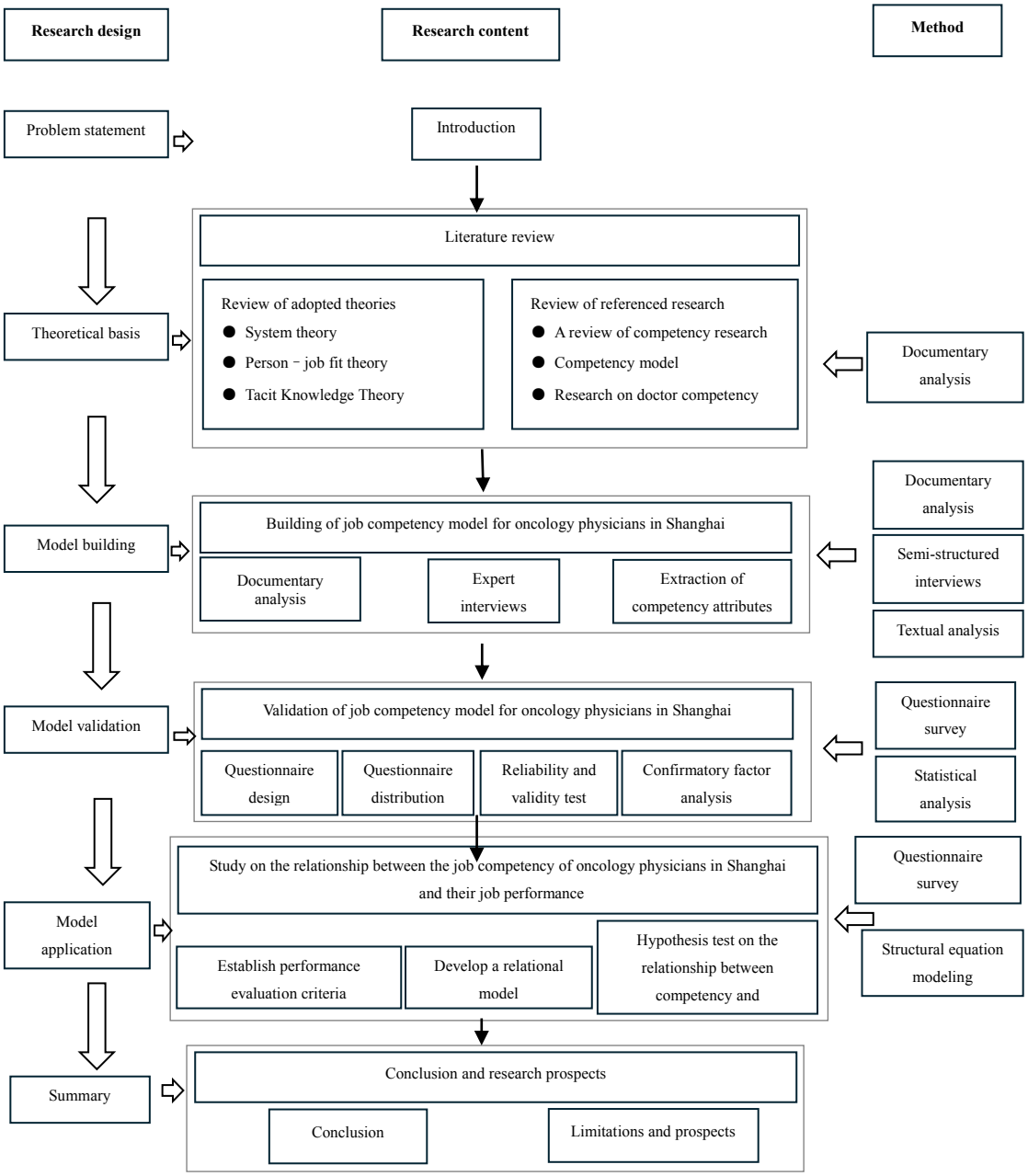

Figure 1.1 Research framework

Chapter 2: Literature Review

2.1 Relevant concepts

2.1.1 Oncology

Oncology is the branch of medicine that studies tumors, particularly malignant ones, which arise when genetic alterations cause abnormal cells to divide and proliferate uncontrollably. Tumor cells originate from normal cells but differ significantly in terms of structure, function, and metabolism. Unless otherwise specified, the term “tumor” typically refers to a malignant tumor. In general, tumors without metastasis are considered benign, while those that exhibit metastatic potential are classified as malignant. Clinically, assessments of tumor malignancy are based on multiple parameters, including macroscopic characteristics, histological architecture, cytological features, the frequency of mitotic figures, and ultrastructural attributes. Tumors are classified and named according to the organ systems and tissues from which they originate. Clinical approaches to tumor treatment encompass surgical interventions, medical oncology, radiation therapy, biological therapy, and multidisciplinary treatment modalities.

Regarding the historical evolution of oncology, Hajdu (2016, 2017) systematically outlines the origins and development of cancer diagnosis and treatment from antiquity to the early 19th century by examining physicians who made significant contributions to the field. The earliest pioneer is the Egyptian physician Imhotep, whose description of breast tumors on papyri from the Pyramid Age represents the first known medical record of cancer (Hajdu, 2011a). Hippocrates coined the terminology for cancer, observing that tumors resemble crabs in the way they spread, and thus introduced the terms “carcinos” (tumor), “carcinoma” (malignant tumor), and “cancer” (non-healing malignant ulcer) (Hajdu, 2004). At the time, cancer was believed to result from an imbalance of bodily humors, and treatments aimed to restore this equilibrium. Later, Roman surgeon Cornelius Celsus and his successor Claudius Galen advocate for the surgical removal of diseased tissue as a therapeutic strategy (K öckerling et al., 2013). However, the medieval Islamic physician Rhazes argues that drug therapy—what is now termed chemotherapy—was more effective than surgery for treating advanced malignancies. Toward the late Middle Ages, French physician Guy de Chauliac asserts that, when feasible, surgeons should proceed with excision or even amputation to treat tumors. In the 16th century, the onset

of religious wars and colonization hinders medical advancement, and oncology lagged behind other fields, with only a handful of physicians making notable progress (Hajdu, 2011b). Paracelsus, a Swiss physician with familial roots in both medicine and chemistry, pioneered clinical chemistry and early chemotherapy, introducing foundational concepts of chemical carcinogenesis. Jean Fernel introduced the terms “physiology” and “pathology” into the medical lexicon and classifies cancers based on anatomical location (Hajdu, 2004). During the Renaissance, one of the greatest surgeons of the 17th century, Marco Aurelio Severino, publishes De Recondita Abscessum Natura in 1632, providing a systematic classification of surgical oncology. German surgeon Johannes Scultetus illustrates surgical procedures with detailed drawings and depicts step-by-step breast cancer excision, producing what is considered the first illustrated surgical textbook.

In the rapidly advancing 18th century, oncology also progressed as pathologist Giovanni Morgagni offers detailed descriptions of primary and metastatic tumors based on autopsy cases, demonstrating the central role of pathology in medicine, including oncology (Hajdu, 2017). With the advent of the Victorian era in the 19th century, the discovery of X-rays introduced new diagnostic and therapeutic tools for oncology, and radiotherapy becomes increasingly recognized and adopted by physicians worldwide. Chemotherapy emerges as a viable cancer treatment in 1942, when Yale University researchers demonstrate that nitrogen mustard may induce regression of lymphoma (DeVita & Chu, 2008). Today, more than 200 agents are used in cancer therapy (Crane & Selanders, 2017). Over time, cancer chemotherapy has transitioned toward targeted therapy, as conventional drugs often destroy not only replicating cancer cells but also normal cells. Targeted therapy addresses this issue by selectively attacking molecular targets specific to cancer cells (American Cancer Society, 2004).

Throughout the evolution of oncology, it is the contributions of historical medical pioneers that have laid the foundation for each milestone in the field. Their work has progressively advanced the clarity and comprehensiveness of oncological understanding, enabling safer and more effective diagnosis and treatment of cancer patients, thus contributing profoundly to human health and wellbeing. According to epidemiological data from the United States, the national cancer incidence rate (cases per 100,000 population) declined significantly between 1999 and 2012, dropping from 484 cases per 100,000 in 1999 to 434 in 2012, representing an overall reduction of 10%, or approximately 0.8% annually (Singh et al., 2016). Nevertheless, cancer remains the second leading cause of death worldwide, accounting for approximately one in six deaths, or around 9.6 million fatalities, in 2018 (World Health Organization, 2018). Breast cancer, lung cancer, colorectal cancer, and prostate cancer are the most prevalent cancer types,

constituting a substantial proportion of newly diagnosed cases (American Cancer Society, 2024a). According to the *Community Health Needs Assessment* published by the San Francisco Health Improvement Partnership (San Francisco Health Improvement Partnership, 2024), these four most common cancers collectively account for approximately 46% of new cancer cases and contribute to nearly 45% of cancer-related mortality. Beyond its substantial impact on overall survival, cancer and its various treatment-related side effects also significantly compromise patients' quality of life.

2.1.2 Oncologist

2.1.2.1 The concept of oncologist

Johnson (2014) categorizes the core responsibilities of oncologists into six domains: professionalism, patient care, resource management, continuous knowledge acquisition, effectiveness, and the implementation of mentorship. According to the definition proposed by Starr, medical professionalism first entails that physicians regulate their professional conduct through standardized training and collective disciplinary mechanisms. Second, oncologists must possess solid professional expertise and clinical knowledge, while adhering to an ethical code that prioritizes the delivery of high-quality healthcare services over profit motives (Cruess & Cruess, 2020). Enhancing patient care remains one of the foremost obligations and goals of physicians. Medical organizations, including the American Society of Clinical Oncology (ASCO), consistently emphasize the need to reaffirm the centrality of patient-centered care (Berwick et al., 2008). This responsibility requires oncologists to adopt a patient-centered therapeutic approach, in which treating the disease alone is insufficient; the patient's personal experience and the healing process must be addressed concurrently. In this context, resource management refers to the principle outlined in the *Charter on Medical Professionalism*, which states that physicians must provide care that is both responsive to individual patient needs and grounded in the prudent, cost-effective stewardship of finite clinical resources. Against the backdrop of global population aging, oncology represents a major component of overall healthcare expenditures. Among all disease categories, cancer imposes one of the greatest clinical, social, and economic burdens, as measured by cause-specific disability-adjusted life years (DALYs) (Mattiuzzi & Lippi, 2019). Accordingly, oncologists must exercise sound judgment in managing therapeutic and interventional strategies. Johnson further asserts that physicians are obligated to maintain up-to-date professional competence, noting that traditional models of continuing medical education are insufficient for preserving clinical knowledge. As

such, oncologists must engage in ongoing learning and periodic reassessment of their clinical expertise. The fifth obligation—effectiveness—refers to the physician's ability to manage time efficiently to enhance personal productivity. The sixth obligation concerns the implementation of mentorship, whereby a more experienced and knowledgeable oncologist is expected to guide and support a junior doctor with less clinical exposure. Such mentorship relationships are instrumental in fostering the professional development of early-career oncologists under structured guidance (Johnson, 2014).

Beyond oncologists, cancer care involves a multidisciplinary network including social workers, non-oncology clinicians, nursing teams, and family caregivers. Nevertheless, oncologists occupy a position of ultimate authority within cancer care teams and thus exert the most significant influence on patients (Cohen et al., 2018). For one thing, this is attributable to their advanced clinical expertise, which confers a level of authority that fosters patient adherence to therapeutic recommendations. For another, the sustained physician–patient interaction over time contributes to the development of a strong and trusting therapeutic alliance.

2.1.2.2 Multiple roles of oncologists

(1) Provider of preventive information

Oncologists provide patients with preventive information, including cancer-related risk factors, behavioral control strategies, and screening for high-risk populations. Both primary and secondary prevention help patients avoid the onset or progression of disease, thereby reducing medical costs and alleviating the physical, psychological, and socioeconomic burden associated with cancer treatment. Recent detailed estimates from France, the United Kingdom, and Germany indicate that approximately 40% of cancers in Europe are preventable if current knowledge of risk and protective factors is translated into effective primary prevention. Cancer screening conducted by oncologists constitutes a critical component in reducing the cancer burden. Cancers that typically progress slowly can often be detected at a premalignant or early malignant stage, thereby reducing the incidence of late-stage disease (Loud & Murphy, 2017). For instance, following the widespread implementation of the Pap smear for cervical cancer screening, the mortality rate in the United States has declined by more than 80% (Pinsky, 2015). According to the American Cancer Society's 2018 report, adults who undergo recent cancer screening often do so upon physicians' recommendation (Smith et al., 2018); hence, the provision of preventive guidance by oncologists to high-risk individuals is particularly vital for effective cancer prevention.

(2) Diagnostic evaluator

Accurate staging of cancer by oncologists is essential, as cancer stage not only reflects disease progression but also serves as a key reference for treatment planning and clinical decision-making. The diagnostic stage is a strong predictor of cancer mortality, and growing evidence suggests that the interval from symptom onset to diagnosis is closely associated with disease stage at diagnosis and subsequent survival (Dobson et al., 2014). In response, the United Kingdom introduced the *National Awareness and Early Diagnosis Initiative* (NAEDI) in 2008 to improve recognition of early cancer symptoms among both patients and healthcare professionals (McPhail et al., 2015). When diagnostic delays, defined as more than one month from initial consultation to histopathological confirmation, occur, cancer incidence and mortality outcomes often worsen (Abu-Helalah et al., 2016). Overdiagnosis, which is frequently the result of the screening of asymptomatic individuals, also represents a detrimental aspect of cancer diagnostics. Overdiagnosis refers to the identification of cancers in patients who would never have experienced symptoms or died from the disease during their lifetime. It increases the cancer burden by prompting unnecessary treatments, thereby subjecting patients to avoidable suffering and imposing additional healthcare costs. Accurate diagnosis by oncologists is therefore indispensable for effective cancer control and appropriate therapeutic intervention.

(3) Therapeutic provider

Oncologists tailor treatment strategies to specific cancer types, guided by established protocols, and employ a variety of antineoplastic therapies such as surgery, chemotherapy, radiotherapy, targeted therapy, immunotherapy, hormone therapy, and stem cell or bone marrow transplantation. Some treatments are localized, such as surgery and radiotherapy targeting specific tumors or anatomical regions, while others, like systemic pharmacotherapy, affect the entire body. Oncologists are responsible for selecting the most appropriate and optimal treatment regimens based on individual patient profiles, ensuring care that is both specialized and comprehensive (American Cancer Society, 2024b). Cancer care provided by oncologists extends beyond antitumor therapies to encompass psychological interventions. Psychotherapy refers to a theory-based, therapist-facilitated process aimed at modifying patients' behaviors, cognitions, and emotions, and it requires specialized training. Cancer patients often experience profound physical and emotional fatigue throughout treatment. Effective pharmacologic management of depression during cancer care requires comprehensive assessment, patient education, monitoring of adherence and adverse effects, evaluation of therapeutic efficacy, and appropriate dose titration. By providing psychological support, oncologists not only safeguard patients' emotional well-being but also foster trust in the physician–patient relationship, thereby

facilitating coordination throughout the continuum of care (McFarland & Hlubocky, 2019).

(4) Communicator

Research indicates that when oncologists discuss screening results instead of other healthcare providers, patients are over 2.5 times more likely to recognize the late-stage nature of their disease (Cohen et al., 2018). This finding underscores the critical role of oncologist–patient communication in helping patients understand their illness, rooted in both the clinical authority of oncologists and the trust cultivated through ongoing care.

Communication between oncologists and patients typically involves four stages: disclosure of diagnosis, pre-treatment discussion, communication during treatment, and post-treatment follow-up. The first phase involves breaking bad news (BBN), namely, informing patients of a cancer diagnosis. UK-based research shows that 87% of patients wish to receive all available information, both good and bad, and 98% prefer to be informed whether their illness is cancer (Jenkins et al., 2001). Following diagnosis, oncologists engage in detailed conversations to determine treatment plans, a process known as pre-treatment communication. Providing accurate information on treatment benefits, risks, and goals at this stage significantly enhances patient engagement in later, more complex phases of therapy (Lin et al., 2014). When complications and side effects arise, clear communication with patients and their families facilitates more informed and patient-centered decision-making, particularly given that treatment options vary in their risk of mortality. In-treatment communication refers to the physician's ability to respond appropriately to patients' emotional and psychological needs during therapy. A patient-centered, three-stage communication model may be used to address emotional distress in cancer patients (Dean & Street, 2014). The first stage involves identifying emotional distress, whereby clinicians detect negative emotions such as anxiety or fear through active listening, facilitative dialogue, and rapport-building, supported by psychological techniques. The second stage, exploring distress, encourages patients to articulate their concerns through guided, empathic engagement aimed at emotional relief. The final stage involves therapeutic communication, often incorporating psychotherapeutic strategies to alleviate distress and improve coping. In survivorship, patients frequently experience side effects and require ongoing support, which makes post-treatment communication essential (Truant et al., 2017). Oncologists may use in-person consultations, digital platforms, or traditional media to deliver tailored prognostic information. All these methods enable both patients and caregivers to adopt appropriate post-treatment strategies and improve long-term outcomes.

(5) End-of-Life caregiver

Clinicians managing cancer are well-versed in the needs of patients approaching the end of life, making the provision of end-of-life care a central responsibility of oncologists. There is a growing trend toward continuous, proactive cancer care provided by oncologists during the final month of life. Advanced cancer, typically defined as incurable and non-responsive to treatment aimed at remission, is often managed with end-of-life strategies to slow disease progression and address emotional burden. At this stage, oncologists focus on helping patients achieve personal goals while maximizing comfort and preserving functional capacity. Specific approaches include dignity therapy, meaning-centered psychotherapy, and supportive pharmacotherapy, all designed to enhance patients' quality of life (Emerson et al., 2022). Evidence shows that cancer patients receiving hospice care for more than 30 days experience care more aligned with their preferences, greater comfort, and better-reported caregiver satisfaction compared to those enrolled for fewer than three days (Kumar et al., 2017).

According to the 2006 working definition by the UK National Council for Palliative Care, end-of-life care includes: i. supporting all individuals with advanced, progressive, incurable illnesses to live as well as possible until death; ii. identifying and meeting the supportive and palliative needs of patients and their families in the final stage of life; iii. managing pain and other symptoms while providing psychological, social, spiritual, and practical support. Although often used interchangeably, hospice care and palliative care differ in scope and application. Hospice care is typically initiated when two physicians certify that a patient has a prognosis of six months or less if the disease follows its natural course. In contrast, palliative care can begin at any stage of illness and is not limited to terminal phases; its initiation depends on the shared decisions of patients and their healthcare providers (Swami & Case, 2018).

(6) Interdisciplinary collaborator

Interdisciplinary collaboration plays a crucial role in advancing oncological research and enhancing clinical outcomes. Oncological progress is deeply interwoven with other scientific disciplines; for instance, advancements in radiation oncology rely heavily on collaboration among radiation oncologists, biologists, and physicists (Burmeister et al., 2018). As supportive care continues to evolve, interdisciplinary cooperation in clinical oncology becomes increasingly integral. Supportive care addresses patients' physical, emotional, social, spiritual, and informational needs across the disease trajectory, requiring oncologists to coordinate services such as palliative care, social work, rehabilitation, psycho-oncology, and integrative medicine (Hui et al., 2021). For example, palliative care in oncology adopts a comprehensive, team-based approach to meet the physical, emotional, practical, and spiritual needs of patients and caregivers. These services are typically delivered by interdisciplinary teams comprising

clinicians, nurses, social workers, chaplains, and others. Palliative teams may also include or collaborate closely with specialists such as physiotherapists, occupational therapists, psychologists, dietitians, acupuncturists, music therapists, and massage therapists (Swami & Case, 2018). Such models necessitate that oncologists not only possess core clinical expertise in oncology but also an understanding of principles of psychology, sociology, and interprofessional collaboration to work effectively within a multidisciplinary care framework.

2.2 A review of competency research

2.2.1 Origins of competency research

The origins of competency research can be traced back to the post-Industrial Revolution era of the 19th century, when growing productivity and increasing labor specialization gave rise to a progressively diversified occupational structure. During this transformation, noticeable differences in individual performance across occupational groups created a demand for systematic assessment and selection of professional abilities, leading to the emergence of competency-based evaluations. Over time, the definition of "occupation" evolved from a static notion rooted in social status to a dynamic perspective centered on whether individuals possess the capabilities required to fulfill specific job responsibilities.

The systematic development of competency theory began in the late 1960s. At the time, the U.S. Department of State discovered that traditional reliance on intelligence tests and academic performance failed to effectively predict real-world job performance in its selection of diplomats. Many candidates who performed well on standardized assessments fell short of expectations once in professional roles. Against this backdrop, renowned psychologist David C. McClelland was invited to develop a new selection mechanism for the Department of State. In the course of his research, McClelland (1973) found that traditional cognitive ability tests are significantly limited in their ability to predict occupational success. He advocates moving beyond an overreliance on IQ tests and similar tools, and instead focusing on identifying behavioral traits and personal attributes grounded in actual workplace demands. That directly influence job performance.

In 1973, McClelland (1973) published his landmark work *Testing for Competence Rather Than Intelligence* in *American Psychologist*, formally introducing the concept of "competency". McClelland (1973) argues that academic achievement and intelligence tests fail to reliably predict job performance and often carry systemic bias against individuals from minority or non-

mainstream backgrounds. McClelland (1973) emphasizes that true occupational success is determined by observable, measurable behavioral traits and deeper personal qualities commonly found in high-performing employees in specific roles, such as motivation, values, role perception, self-concept, and skill combinations. These characteristics form the foundation of the competency framework and serve as key indicators for predicting an individual's likelihood of success in real-world job performance.

McClelland's research approach emphasizes extracting first-hand data from the actual work of top performers, utilizing methods such as situational interviews and Behavioral Event Interviews (BEI) to identify key competencies and build job-specific competency models. This performance-driven, practice-oriented research paradigm lays both the theoretical and methodological foundation for subsequent competency studies in fields such as business management, human resource development, and medical education. McClelland's seminal paper not only heralds the rise of the "competency movement" but also initiates a paradigm shift in modern human resource assessment from intelligence-based to competency-based evaluation.

2.2.2 Advances in competency research

The concept of "competency" originates in the field of jurisprudence, where it is initially used to determine whether an individual possesses the mental capacity to bear legal responsibility. The term later enters clinical psychology, where it describes individuals' capacities in mental health and social functioning, such as emotional regulation, interpersonal relationships, and care for self and others. In the 20th century, the notion of competency extends into vocational counseling and educational psychology, serving as a critical standard for assessing whether individuals possess the necessary knowledge, skills, and behavioral attributes required in specific professional settings. With the advancement of industrial psychology and organizational behavior, competency increasingly emerges as a key theoretical framework for evaluating occupational performance and predicting employee effectiveness. Broadly, three major research paradigms shape the academic development of competency theory: the differential psychology approach, the educational and behavioral approach, and the industrial-organizational psychology approach.

First, the differential psychology approach emphasizes stable individual differences in cognition, personality, emotion, and motivation, focusing on how these traits contribute to professional competence. Pioneers of this paradigm, such as Francis Galton and James McKeen Cattell, applied scientific methods to measure cognitive abilities and sensory responses in the

late 19th and early 20th centuries, laying the foundation for modern psychometrics (Jensen, 2011). From the 1950s onward, research into individual differences expands to include intelligence structures, information processing, motivational mechanisms, and personality traits. Despite methodological diversity, the core aim remains the classification and quantification of behavioral performance to identify underlying personal attributes that influence effectiveness. This paradigm lays the theoretical and technical groundwork for subsequent competency assessment tools, particularly emphasizing deep-seated traits that are not easily trainable.

Second, the educational and behavioral approach highlights the malleability of behavior and the potential of educational interventions. Rooted in behaviorist psychology and educational measurement theory, this tradition seeks to improve performance through structured learning and training. Researchers within this paradigm, often with educational backgrounds, stress the formative roles of environment and experiential learning. A prominent example is Bloom's Taxonomy, which classifies learning objectives into cognitive, affective, and psychomotor domains, each accompanied by actionable behavioral indicators (Chandio et al., 2016). This behaviorally oriented framework profoundly influences the development of competency models, particularly in domains such as educational assessment, curriculum design, and the formulation of behavioral standards.

Third, the industrial-organizational psychology approach synthesizes insights from the other two paradigms and concentrates on work behavior, performance criteria, and personnel selection within organizational contexts. Researchers adopting this approach conduct systematic job analyses and behavioral observations to identify core competencies of high-performing employees, which then inform the construction of job competency models. Key human resource management tools, such as job descriptions and job specifications, emerge from this tradition. Among its most influential methodologies is the Assessment Center Method, first implemented by AT&T in the early 20th century for managerial selection and subsequently adopted by the military during both World Wars for leadership assessment. Studies show that assessment centers across different organizations consistently identify similar competency dimensions, indicating that managerial and leadership behaviors exhibit cross-organizational and cross-cultural generalizability (Thornton III & Byham, 2013). These dimensions, such as decision-making, interpersonal influence, and problem-solving form the conceptual foundation of modern competency research.

2.3 The concept and connotation of competence

2.3.1 The concept of competency

As a concept closely linked to individual job performance, competency has served as a foundational theoretical construct in fields such as organizational behavior, human resource management, and educational training since its first introduction by McClelland in the 1970s (McClelland, 1973). Its conceptual meaning and scope have undergone multiple stages of refinement and expansion, with researchers defining the core of competency from various disciplinary perspectives.

The term “competency” originates from the Latin word “competere”, meaning “to be suitable” or “qualified”. In practical usage, the terms “competence” and “competency” are often used interchangeably. In his seminal work, McClelland (1973) argues that traditional intelligence tests and educational background fail to effectively predict job performance; instead, superior performance is better explained by “competency attributes”, which include knowledge, skills, abilities, personal characteristics, and motivation.

Building on this, McLagan (1980) defines competency as a set of knowledge, skills, and abilities required to perform specific tasks. Boyatzis (1991) further expands the concept by framing it as a set of underlying individual characteristics such as motivation, self-image, social roles, knowledge, and skills, which are causally related to effective job performance. Spencer and Spencer (1993) emphasize that competency comprises “deep-seated personal attributes”, which include motivation, traits, self-concept, and behavioral skills. It is these attributes that distinguish high performers from average ones. This conceptualization underpins the “iceberg model”, which categorizes competencies into observable and less observable dimensions.

Subsequently, scholars from behavioral science, cognitive psychology, and human resource management further classify and refine the construct of competency. Christianne and Brian (1994) divide competencies into three major categories: technical skills, interpersonal skills, and conceptual skills. Ledford Jr (1995) proposes that competencies must meet three criteria: they must be observable traits, verifiable attributes, and predictors of future performance. Cockerill et al. (1995) stress the relative stability of competent behavior, arguing that such behavior enables individuals to adapt to evolving organizational contexts. Byham and Moyer (1996) classify competencies into behavioral dimensions, knowledge, and motivation, facilitating structured talent assessment and development.

In subsequent developments, scholars continue to expand the perspectives and components

used to measure competency. Mirabile (1997) and Parry (1996), among others, argue that competencies are measurable sets of capabilities associated with high performance and are both trainable and developable. Green (1999) suggests that competencies should be quantifiable behaviors and skills directly linked to performance objectives. Sandberg (2000) contends that true competency does not encompass all knowledge and skills, but rather the subset that is applied in real work settings. In the Chinese context, scholars such as Wang and Chen (2002) and Zhong and Shi (2003) emphasize that competencies are relatively stable psychological and behavioral traits that distinguish high performers from average ones.

In recent years, with advances in training science, job design, and strategic management, definitions of competency increasingly highlight its practical and dynamic nature. From a training-oriented perspective, Hackney et al. (2023) define competency as the knowledge, skills, and attitudes required to achieve organizational goals. Škrinjarić (2022) adopts a broader interpretation, viewing competency as a multifaceted capacity including practical skills and social personality traits, which enables individuals to handle complex work scenarios.

In summary, despite variations in definition, the academic community broadly agrees on the following:

(1) Competency serves as a predictor of future job suitability and can differentiate between varying levels of performance.

(2) Competency is multidimensional, encompassing both explicit knowledge, skills, and behaviors, as well as implicit factors such as motivation, attitudes, values, and personality traits.

(3) Competency is context-dependent and closely tied to job tasks and organizational objectives.

(4) Competency is not static but learnable and malleable, and it can be enhanced through continuous training and professional development.

Competency forms the foundation for talent selection and performance evaluation, and constitutes a key pillar for achieving strategic goals and enhancing human capital quality. Its systematic identification, classification, and measurement have become critical research and practice imperatives in contemporary organizational management.

2.3.2 Distinctions between competency, ability, and quality

In the domains of human resource management and organizational behavior, ability, quality, and competency are frequently employed as core constructs. Although they often intersect in articulating the foundational bases of individual performance, a nuanced analysis of their theoretical definitions, domains of application, and functional implications reveals distinct

conceptual boundaries and a clear hierarchical structure.

(1) Ability: the latent psychological and physiological conditions for task performance

In psychology and education, ability is among the earliest and most extensively studied constructs, typically referring to the fundamental psychological and physiological conditions that enable an individual to perform specific tasks or activities—such as perception, attention, memory, reasoning, language proficiency, and motor coordination. Ability emphasizes inherent or relatively stable individual traits that are either innate or acquired, serving as essential prerequisites for task execution (Chouhan & Srivastava, 2014; Grant & Baden-Fuller, 2018). For instance, an individual with strong logical reasoning abilities may be particularly well suited for roles involving data analysis or strategic planning.

Ability is fundamentally conceptualized as a "static trait", predominantly evaluated through standardized assessments or skill-based tests. Such evaluations often fall short in capturing the dynamic and contextual nuances of actual job performance (Corbett, 2023; Xu et al., 2014). Consequently, ability assessments tend to address whether an individual possesses the necessary conditions to undertake a task, rather than determining the level of proficiency with which the task can be executed.

(2) Quality: enduring personality and psychological traits

The concept of quality, rooted in the disciplines of education and philosophy, generally refers to the relatively enduring personality traits, moral dispositions, and value orientations cultivated through sustained processes of socialization (Edgerton et al., 2012). Traits such as a sense of responsibility, integrity, dedication, and teamwork exemplify deeply embedded psychological attributes that are inherently latent and not readily observable.

Oriented strongly toward ethical and characterological dimensions, quality serves as a fundamental criterion for assessing an individual's holistic development. However, its abstract nature renders it conceptually robust yet operationally limited and difficult to quantify (Cohen & Morse, 2014). While traditionally positioned as a central objective within educational paradigms, quality alone often proves insufficient as a standalone metric for position-specific evaluation or performance management within contemporary human resource practices.

(3) Competency: job-oriented, multidimensional behavioral expression

In contrast to ability and quality, competency—a concept rooted in applied management theory—refers to the composite set of observable, assessable, and cultivable behaviors that an individual demonstrates in specific job-related contexts (Zhang & Zhang, 2023). Competency integrates both the foundational capabilities necessary for task execution and the deeper personal dispositions of the individual. Critically, it is explicitly oriented toward performance

in real-world occupational settings, reflecting both contextual specificity and goal-directed functionality.

As articulated in Spencer and Spencer's (1993) seminal "iceberg model", competency comprises both surface-level and deep-level dimensions: the surface layer includes knowledge and technical skills that are readily teachable and modifiable, while the deeper layer encompasses motivational drivers, personal values, and personality traits—elements that are less visible yet fundamentally determine behavioral consistency and performance sustainability.

This structural model synthesizes the constructs of ability and quality, while positioning job performance as the principal criterion of validation, thereby establishing competency as a foundational framework for talent assessment, professional development, and organizational effectiveness.

The conceptual interrelationships among ability, quality, and competency are summarized in Table 2.1.

Table 2.1 Distinctions between competency, ability, and quality

Dimensions	Ability	Quality	Competency
Definition	Psychological and physiological conditions for task performance	Enduring personality traits	Performance-relevant behavioral attributes that are observable and measurable within job contexts
Attributes	static, testable	stable, abstract	integrative, dynamic, and developmental
Trainability	moderate	low	high
Assessment methods	standardized tests, skill-based examinations	behavioral observation, longitudinal evaluation	behavioral interviews, performance analysis, 360-degree feedback.
Application scenarios	initial screening, psychological assessment in recruitment	educational training, values-based guidance	job-person fit, performance evaluation, talent development

Consequently, competency emerges as a refined and reconceptualized construct built upon ability and quality, distinguished by its central attributes of performance orientation, behavioral expression, and person–job fit. This framework and its associated practical instruments embody both the measurability characteristic of ability and the deep motivational substrates inherent in quality, positioning competency as the most comprehensive and pragmatically relevant concept within organizational human resource management. Within scholarly inquiry, the precise demarcation of competency from ability and quality facilitates the construction of robust competency models and enhances the reliability of organizational job analyses. From a managerial standpoint, it underpins the development of competency-based systems

encompassing talent selection, education and training, performance appraisal, and career progression, thereby optimizing person–job fit and ultimately elevating both organizational effectiveness and the caliber of professional development.

2.3.3 Typology of competency

Scholars develop various competency classification frameworks from diverse perspectives to systematically elucidate the compositional logic and functional mechanisms underlying competency. Based on the level of manifestation and functional attributes, competency can be delineated into “threshold competency” and “core (or differentiating) competency”. From a structural standpoint, Spencer and Spencer (1993) propose the seminal five-layered “Iceberg Model”, which serves as a foundational theoretical framework and analytical tool in competency research.

(1) Threshold competency and core (or differentiating) competency

Competency is commonly categorized into threshold competency and core (or differentiating) competency, based on its hierarchical contribution to job performance (Spencer & Spencer, 1993). Threshold competency refers to the fundamental behavioral or capability standards that an individual must attain to be considered qualified for a given job. It typically encompasses essential domain knowledge, technical skills, and communication proficiency, constituting the minimum requirements for satisfactory task execution. For example, a physician’s capacity for clinical diagnosis and a nurse’s mastery of emergency procedures are both representative of threshold competency.

By contrast, core competency refers to the critical behavioral capabilities that distinguish high performers from average ones, serving as a determining factor in attaining superior performance and sustaining an organization’s competitive edges. It typically encompasses a strong sense of accountability, advanced problem-solving capacity, leadership, systems thinking, and the ability to collaborate effectively within teams. For instance, in clinical contexts, healthcare professionals who exhibit strong humanistic values and interdisciplinary integration skills frequently demonstrate exceptional performance in managing complex cases and coordinating multidisciplinary care. Core competency reflects not only the individual’s advanced professional aptitude, but also an organization’s cultural orientation and its strategic approach to talent development.

(2) Based on structural hierarchy: Spencer’s five-level iceberg model

Drawing upon behavioral event interviews across hundreds of jobs and thousands of high-performing individuals, Sanghi (2003) refines the widely recognized iceberg model of

competency.

The model delineates competency into five hierarchical levels, arranged from the deepest to the most surface-level dimensions:

i. Motives: the intrinsic psychological forces that drive behavior, representing the most profound mechanism underlying sustained individual performance.

ii. Traits: relatively enduring personal characteristics, such as self-confidence, resilience, and emotional stability.

iii. Self-concept: the individual's self-perception, internalized values, and role identification within both social and organizational contexts.

iv. Skills: the technical and cognitive abilities that are learnable and applicable in practical work settings.

v. Knowledge: the theoretical and factual information necessary for effective job performance.

In this model, the top three levels — motives, traits, and self-concept — are categorized as deep-level competencies. These elements are not easily cultivated through short-term training, yet they exert a decisive influence on long-term job performance. The bottom two levels — knowledge and skills — are classified as surface-level competencies, which are more readily observable and amenable to development, and thus traditionally form the core content of standard training and assessment practices. This model emphasizes the critical role of deep-level competencies in shaping individual behavioral patterns and differentiating performance outcomes. It further underscores that talent selection and professional development should not be limited to surface-level attributes such as knowledge and technical skills.

(3) Applications and distinctive features of competency in the healthcare sector

In the healthcare sector, the taxonomy of competency serves not only as a construct of theoretical significance but also as a pivotal framework for informing clinical practice (Zou et al., 2022). Medical practice is inherently characterized by high levels of risk, intensity, and ethical complexity. As such, the constitution of competency in this field must encompass multilayered dimensions—extending beyond domain-specific knowledge and technical proficiencies (e.g., diagnostic acumen, surgical skill) to include deeper motivational drivers and ethical dispositions. Specifically, attributes such as a strong sense of responsibility, empathy, collaborative orientation, and effective physician–patient communication are regarded as critical determinants of both care quality and team performance (Epstein et al., 2002; Rogers & Schill, 2021).

For example, the CanMEDS framework—developed by the Royal College of Physicians

and Surgeons of Canada—conceptualizes the core competency of medical professionals across seven essential roles: medical expert, communicator, collaborator, health advocate, manager, scholar, and professional. Functionally, this model offers a structured and multidimensional articulation of core competencies in the clinical setting, integrating domain-specific knowledge and technical skills with deeper personality traits and values (Frank et al., 2015; Thoma et al., 2023). Competency-Based Medical Education (CBME), a paradigm in contemporary medical training, is fundamentally informed by this stratified classification logic. It prioritizes assessable behavioral performance as central to the milestone-based evaluation of learning outcomes (Wong & Moni, 2014). This shift marks a transition away from the traditional emphasis on theoretical knowledge acquisition toward a more comprehensive approach to professional development in terms of competencies. It foregrounds the cultivation of non-technical attributes such as professional ethics, emotional regulation, and interdisciplinary collaboration.

In summary, the classification system of competency not only elucidates the hierarchical structure of behavioral attributes but also serves as a systematic and structured tool for organizations in recruitment, performance assessment, and career development. The distinction between threshold and core competency clarifies criteria for talent identification and developmental pathways. Furthermore, the five-tier structural model deepens the understanding of the intrinsic-extrinsic dynamics that shape workplace behaviors, thereby articulating the theoretical linkage between individual competency and job performance. In highly specialized sectors such as healthcare, this multidimensional framework not only enriches the theoretical foundation of competency studies but also directly addresses societal expectations for advanced humanistic healthcare delivery. It thus provides a solid foundation for the effective implementation of competency-based approaches in both professional education and applied practice.

2.4 Competency model

2.4.1 Definition

The competency model (CM) refers to a structured set of competencies required for superior performance in a specific job. It comprises an integrated framework of job-relevant knowledge, skills, behaviors, and individual attributes (Shet et al., 2019). Importantly, the competency model is not confined to job demands; it also anticipates future requirements, making it widely

utilized in practice as a strategic tool for personnel selection, evaluation, training, and motivation. At its core, a competency model functions as a success profile, designed to systematically represent the constellation of capabilities that distinguish high performers in a given job (Marrelli, 1998). When effectively developed, it can clarify the competency architecture necessary for occupational success, thereby providing both a theoretical foundation and practical roadmap for targeted individual development and capacity building (Zhu & Yang, 2023). Moreover, it significantly advances both the theory and application of contemporary human resource management.

Competency models are typically structured into two levels: (1) observable capability traits such as domain-specific knowledge and technical skills, which are relatively easy to identify, measure, and enhance through formal education and training, (2) implicit, deeper personal characteristics—such as attitudes, motivation, self-awareness, and values, which are more predictive of actual performance and long-term potential in the workplace. To facilitate a more systematic understanding of competency structure, two widely recognized theoretical frameworks are the iceberg model and the onion model. These models share a high degree of conceptual and structural alignment, differing primarily in their modes of representation (see Figures 2.1 and 2.2). Together, they offer a theoretical foundation for the layered analysis and visualization of competencies, while also serving as a conceptual basis for the development of competency-based assessment tools.

(1) The iceberg model

The iceberg model conceptualizes competency as comprising five distinct categories, hierarchically arranged across two domains: explicit (surface-level) and implicit (deep-level) characteristics (McClelland, 1973). The categories are presented in Table 2.2.

Table 2.2 Categories of competencies according to the iceberg model

Category	Definition	Domain
Knowledge	Domain-specific knowledge possessed by an individual within a defined professional field	explicit
Skill	The ability to systematically apply knowledge to accomplish specific physical or cognitive tasks	explicit
Self-concept	The outward manifestation of one's attitudes, values, or self-concept	implicit
Traits	An individual's physiological characteristics and habitual patterns of responding to situations or stimuli	implicit
Motives	An enduring internal drive that compels an individual to act in pursuit of a valued goal or stimulus	implicit

Source: McClelland (1973)

Drawing an analogy to an iceberg, the model depicts the visible portion above the waterline—including knowledge and skills—as explicit competencies. These elements are

readily observable, assessable, and responsive to enhancement through short-term training and experiential learning. Accordingly, they are regarded as the foundational requisites for fulfilling occupational responsibilities and achieving threshold performance. Conversely, the submerged portion of the iceberg encompasses deeper constructs such as motives, personal traits, and self-concept, which constitute implicit competencies. These attributes are inherently latent, resistant to direct measurement, and less amenable to rapid development. Nevertheless, they exert a profound influence on individuals' behavioral patterns and long-term performance at work. Given their foundational impact on workplace conduct, these components are often classified as core, differentiating competencies—that is, critical attributes that distinguish high performers from their average counterparts. In sum, the iceberg model not only elucidates the hierarchical organization of competency but also highlights the indispensable role of implicit factors in forecasting and enhancing individual job performance.

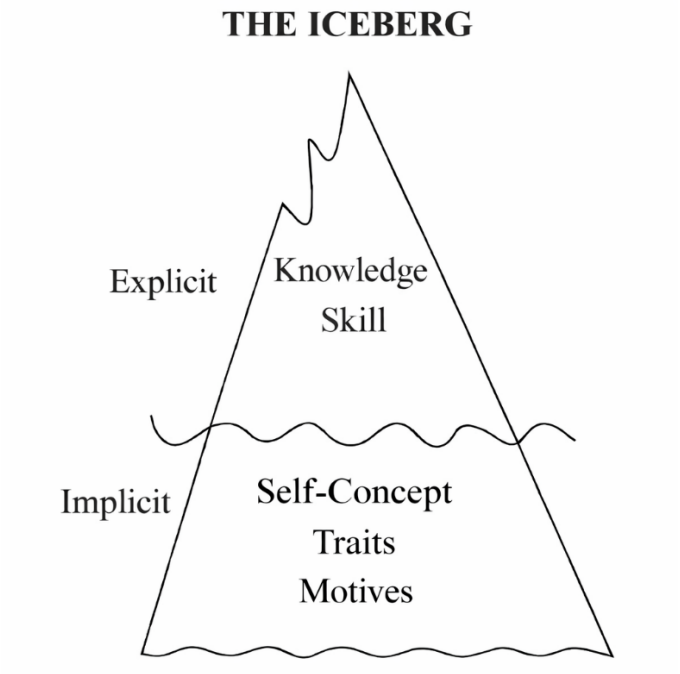

Figure 2.1 Iceberg model of competency

Source: McClelland (1973)

(2) The onion model

The onion model of competency, developed as an extension of the iceberg model, employs a concentrically ringed framework to vividly illustrate the gradations in observability and trainability of various competency elements. The model delineates competencies into multiple concentric layers from the periphery to the core. The outermost layer comprises knowledge and skills—explicit competencies that are observable, readily measurable, and rapidly enhanced through short-term training and practice (Spencer & Spencer, 1993). The innermost layer encompasses deep-level elements—motives, personal traits, and self-concept—which are

implicit, difficult to quantify directly, and resistant to short-term intervention. Compared with the iceberg model, the onion model places greater emphasis on the concentric structure and dynamic interplay among competency characteristics, highlighting the progressive decrease in assessability and learnability from the periphery to the core. This model not only facilitates a systematic understanding of the composition of capabilities required for specific jobs but also provides a logical and analytical framework for the identification, development, and assessment of competencies.

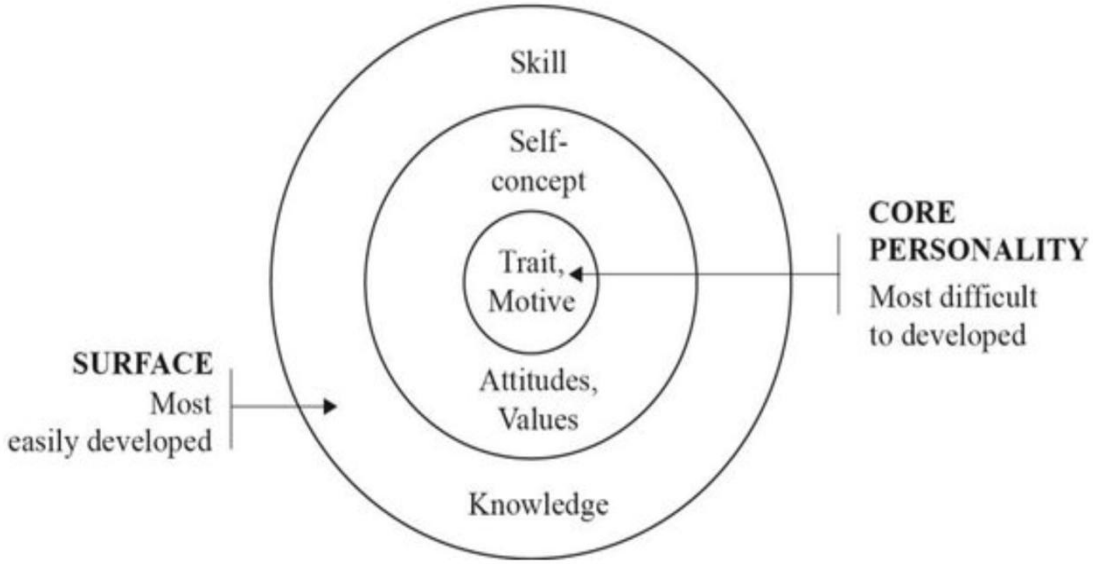

Figure 2.2 Onion model of competency

Source: Spencer & Spencer (1993)

2.4.2 Construction

The competency model serves as a systematic framework for identifying and integrating the critical behaviors and attributes that underlie superior performance in a specific job. Its development hinges upon the rigorous, systematic collection and synthesis of competencies that are closely correlated with high levels of job performance. To date, the academic community primarily employs the following methods to construct competency models:

(1) Behavioral Event Interview (BEI)

The Behavioral Event Interview is a structured, open-ended interviewing technique based on retrospective accounts of actual work experiences and is widely regarded as a method with high validity and reliability in competency model development. This method emphasizes an in-depth exploration of individuals' past critical work situations by guiding interviewees to describe in detail the behaviors they exhibit in specific contexts to identify their underlying competency attributes. Interview protocols typically adopt a double-blind or semi-structured

format, requiring participants to recall and narrate at least three examples of outstanding (positive) and three of suboptimal (negative) performance. During the interview, researchers systematically document the contextual triggers, event progression, task outcomes, event duration, roles of involved personnel, as well as the interviewee's cognitive processes, behavioral responses, and emotional experiences. Through systematic analysis of the interview transcripts, researchers can distill the deep-level competencies that distinguish high-performing individuals—particularly those personality traits that are not directly observable. By further comparing the competency profiles of high performers with those of average performers, a job competency model can be developed. While this method enables the acquisition of rich and in-depth behavioral data, it is also characterized by several limitations, including procedural complexity, demanding analytical requirements, the necessity for extensive training of interviewers, and elevated implementation costs.

(2) Questionnaire-based survey method

The questionnaire-based survey method offers a convenient and efficient approach to competency model development, typically involving the assessment of job-related competencies through structured questionnaires. Researchers design the questionnaire content based on the specific job characteristics and disseminate it through paper-based, electronic, or online formats. This method facilitates the collection of large-scale data within a relatively short time frame and is well suited for gathering broad-ranging information, with a high degree of standardization in data analysis. In the construction of competency models, researchers typically integrate questionnaire surveys with statistical techniques such as factor analysis to systematically identify the key competency attributes required for specific positions. Its primary limitation lies in the demand for survey designers to possess solid domain expertise and extensive experience in measurement; moreover, the reliability and validity of the questionnaire heavily depend on the quality of its design and the representativeness of the sample.

(3) Interview-based application of the critical incident technique

This approach adapts interviewing strategies from the behavioral event interview (BEI), while focusing specifically on critical incidents occurring in actual job contexts. In contrast to BEI, it typically does not differentiate between high- and average-performing samples; interviews are conducted directly once the target group has been identified. Respondents are prompted to recount personally experienced success or failure events and are guided to provide detailed descriptions of the incident's context, sequence, personnel involved, and outcomes. By analyzing the behavioral features embedded within these incidents, researchers can identify the core competencies that significantly influence job performance. However, the absence of

performance-based sample differentiation may introduce a risk of analytical bias.

(4) The Delphi method

The Delphi method is a structured, consensus-oriented technique for forecasting and decision-making, frequently applied in the identification and selection of competencies. It entails multiple rounds of anonymous consultation with experts, wherein feedback is systematically aggregated after each round to iteratively promote convergence of opinion. This approach effectively synthesizes diverse expert judgments while mitigating conformity bias arising from the general public, thereby enhancing the methodological rigor and objectivity of conclusions. The Delphi method is particularly advantageous in the early stages of model development, especially in contexts where empirical evidence is limited or unavailable. Nonetheless, it is not without limitations: expert assessments may be influenced by subjective bias, and the iterative nature of the process can be time-intensive.

(5) Job analysis method

The job analysis method entails a systematic examination of the tasks and responsibilities intrinsic to a given job. Through the comprehensive collection and organization of job-related information—including job content, duties, qualification requirements, and working conditions—it aims to delineate competency characteristics that are strongly correlated with superior job performance. This approach prioritizes analysis of the "job" itself rather than direct evaluation of individual behavioral manifestations, and is widely utilized within human resource management for purposes such as job design and specification of selection criteria. Its advantages include operational simplicity, cost-effectiveness, and the ability to provide comprehensive and detailed job information. Nevertheless, a notable limitation lies in its relatively limited focus on employees' behavioral processes, which constrains its capacity to capture nuanced individual differences and underlying latent competencies.

In summary, a variety of methodologies exist for competency model development, each distinguished by unique characteristics and specific scopes of application. In practical implementation, researchers are advised to exercise methodological flexibility by selecting approaches that align with job attributes, available resources, and defined research objectives. To uphold the reliability and enhance the practical relevance of competency models, this study advocates the integrative use of multiple methods, harnessing their complementary advantages to improve both reliability and validity. This study employs semi-structured interviews. The methodological advantages and implementation procedures are detailed in Chapter 3, "Research Methods."

2.4.3 Validation

A competency model that has not undergone thorough empirical validation lacks a robust scientific foundation to support its application in human resource management practices and cannot reliably guarantee the anticipated outcomes; it may even lead to misleading conclusions. Therefore, a systematic and multidimensional evaluation of the model is an essential procedure to ensure that it accurately captures the core job requirements, effectively discriminates among performance levels, and provides a sound basis for managerial decision-making. Consequently, following the development of a competency model, rigorous validation is imperative to confirm its practical applicability and reliability, thereby furnishing a theoretical underpinning for subsequent personnel selection, training, and performance management. At present, the commonly employed approaches for model validation can be broadly categorized into the following three types:

(1) Interview method

The interview method is conventionally applied following the preliminary construction of a competency model, aiming primarily to evaluate whether the competency characteristics incorporated in the model can reliably discriminate among distinct performance levels through structured interviews conducted with an independent validation cohort. The procedure involves selecting a new cohort of high-performing and average-performing individuals based on the existing competency model, administering structured interviews to elicit behavioral indicators and critical incidents manifested in their actual work settings, and organizing the interview data and subjecting them to statistical analysis to compare the distribution of competency attributes across performance groups, thereby assessing the model's generalizability and discriminant validity. Although this approach offers relatively direct insights into the association between model constructs and actual job performance, it demands rigorous interview design and high-level analytical expertise.

(2) Testing method

The testing method primarily involves the empirical assessment of key competencies defined within the model using instruments such as situational judgment tests and assessment centers, followed by application validation on an independent sample. Typically, standardized assessment tools are developed based on the model's framework, with candidates exhibiting the targeted competencies identified through testing. These candidates' subsequent job performance is then monitored and evaluated to determine the model's predictive validity and job fit. The principal advantage of this approach lies in its ability to link the model to actual job

performance; however, this is contingent upon the assessment instruments possessing robust reliability and validity, and the evaluation process generally necessitates an extended time frame.

(3) Questionnaire method

The questionnaire method is a widely utilized approach for validating the structure and content of a competency model based on large-sample datasets. Researchers translate the competency attributes delineated in the model into operationalized questionnaire items, and conduct statistical analyses on the responses collected from the sample to rigorously assess the model's psychometric properties, namely reliability and validity. This process ultimately substantiates the model's applicability and predictive validity within specific organizational settings.

i. Reliability analysis

Reliability serves as a critical indicator for assessing the consistency and stability of a measurement instrument across repeated measurements; a higher reliability coefficient indicates lower measurement error and greater data credibility (Wu, 2009). In social science research, reliability is commonly categorized into three types: inter-rater reliability, internal consistency reliability, and test-retest reliability (Ma, 2005). Among these, internal consistency reliability is the most widely used in empirical studies and is typically evaluated using Cronbach's alpha coefficient. This coefficient ranges from 0 to 1, with higher values indicating greater internal consistency among items in the scale and a more stable internal structure. According to Nunnally and Bernstein (1994), a Cronbach's alpha of 0.70 is generally regarded as the minimum acceptable threshold in the social sciences. Specifically, $\alpha \geq 0.90$ indicates excellent reliability; $0.80 \leq \alpha < 0.90$ reflects good reliability; $0.70 \leq \alpha < 0.80$ is considered acceptable; whereas $\alpha < 0.70$ suggests insufficient reliability and limits the scale's suitability for inferential analysis. Moreover, during item analysis and exploratory factor analysis, retained items should demonstrate a corrected item-total correlation (CITC) greater than 0.35 to ensure satisfactory item-dimension correlation and structural coherence (Li, 2004). These benchmarks offer critical guidance for researchers conducting reliability assessments and thereby ensure the statistical robustness of the measurement instruments.

ii.Validity analysis

a. Content validity

In the initial phase of model validation, the evaluation of content validity holds primary importance. This process is designed to ensure that the competency items and their associated behavioral descriptors comprehensively and accurately capture the core responsibilities and essential requirements of the target job. Typically, a panel of subject matter experts (SMEs)—

individuals with in-depth knowledge of the job—is invited to independently and systematically assess each component of the model, ranging from broad competency dimensions to specific behavioral indicators, in terms of representativeness, clarity, necessity, and completeness (Ye, 2010). A model lacking a robust foundation of content validity will render subsequent statistical validations devoid of their intended meaning and explanatory power.

b. Construct validity

The assessment of construct validity focuses on whether the constructs measured by the model align with the underlying theoretical assumptions—that is, whether the model authentically and accurately captures the dimensional structure of the constructs it purports to measure. This validation process typically relies on large-scale empirical datasets and involves sophisticated statistical procedures. In the early stages of model development—or when theoretical foundations remain underdeveloped—researchers often apply exploratory factor analysis (EFA) to explore latent structural relationships among competency indicators, identify common factors, and refine the model's dimensional configuration (Chen et al., 2023). When the model is grounded in established theoretical frameworks or informed by prior empirical studies, confirmatory factor analysis (CFA) becomes the standard tool to assess the degree of alignment between the hypothesized model and the observed data (Bentler & Bonett, 1980; Browne & Cudeck, 1993; Hu & Bentler, 1999; Jöreskog, 1969; Nunnally & Bernstein, 1994). By systematically evaluating a range of model fit indices—such as the chi-square to degrees of freedom ratio (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) —researchers can rigorously evaluate the structural soundness of the model and the extent to which each observed variable meaningfully reflects its corresponding latent construct. A robust construct validity is fundamental to ensuring the model's internal coherence and theoretical rigor.

c. Criterion-related validity

Criterion-related validity constitutes a central metric for evaluating a model's predictive capability and its real-world applicability. It reflects the statistical strength of the association between assessment outcomes derived from the model and individuals' actual job performance or other externally established criteria (Hsu, 2023). This form of validity is generally categorized into two principal types: concurrent validity and predictive validity. Concurrent validity is assessed by gathering competency evaluation data from current employees alongside their contemporaneous performance outcomes, thereby examining the immediate correlations between the two. In contrast, predictive validity adopts a prospective orientation. Taking a

competency model as an example, during personnel selection, competency assessment data are first collected from job applicants prior to their employment. After they have been employed and have performed their duties for a certain period, their actual job performance is evaluated. The analysis then focuses on determining the extent to which the initial competency assessment can predict future job performance. Although the implementation of predictive validity requires a longer evaluation cycle, it provides stronger empirical justification for the forward-looking nature of the model. Ultimately, the magnitude of criterion-related validity directly determines the model's practical effectiveness in critical human resource functions, including personnel selection, performance evaluation, training and development, and career planning.

In conclusion, the validation of a competency model is a systematic undertaking that spans the entire research process and integrates multiple dimensions and methodological approaches. It requires researchers to uphold the spirit of inquiry fundamental to scientific disciplines and to apply rigorous psychometric techniques in conducting a thorough and multifaceted evaluation of the model—specifically in terms of its content validity, construct validity, criterion-related validity, discriminative power, and measurement reliability. Only through such a comprehensive and methodologically robust validation process can a competency model for oncologists in Shanghai be established—one that is both theoretically sound and practically applicable within the complexities of clinical settings. Ultimately, such a model serves as a foundational tool for advancing healthcare quality and strengthening the development of medical human resources.

2.5 Theoretical foundations of competency

2.5.1 Systems theory

Systems theory, as a philosophically grounded and methodologically robust paradigm with wide-ranging applicability, offers a powerful conceptual lens for the comprehension and analysis of complex phenomena. Its core proposition holds that any object of study, whether it be an ecological system in nature, a social organization, or individual behavior, can be viewed as an organic whole in which various internal components interact and depend on one another (Friedman & Allen, 2011). Systems theory emphasizes the necessity of understanding phenomena through the dimensions of wholeness, interconnectedness, dynamism, and hierarchical organization, and explicitly opposes viewing problems in an isolated, static, or fragmented manner (J. D. Wen, 2005). Applying the principles of systems theory to competency

research—particularly within the context of oncologists in Shanghai, a professional group characterized by high specialization and considerable role complexity—offers significant theoretical value and practical relevance.

First, the principle of holism within systems theory suggests that an oncologist's competency is not merely the linear sum of knowledge, skills, or traits; rather, it constitutes a structurally cohesive and functionally integrated organic whole. Each competency element, such as clinical decision-making, research innovation, physician–patient communication, teamwork, and professional ethos fulfills a specific role within this whole, and is defined in its efficacy by its interdependence, mutual reinforcement, or constraint with other elements. For example, an oncologist may exhibit exceptional clinical skills (a skill-based element), yet if this is not complemented by effective physician–patient communication (a behavioral element) and a strong sense of responsibility (a motivational/trait-based element), their overall clinical competency and patient outcomes may be substantially diminished. Therefore, the construction of a competency model must transcend the mere enumeration of individual competency elements and instead emphasize how these elements are organically integrated and synergistically interact to drive superior performance (Shet et al., 2019). This demands that, during model development, researchers identify the critical competency building blocks and further elucidate their internal logical interrelations and structural hierarchy, thereby establishing a scientific framework that manifests the emergence of competencies in job performance.

Second, the principle of interrelatedness in systems theory accentuates the intricate interdependencies and dynamic interactions among elements within a system as well as between the system and its external environment. The competency system of oncologists does not operate in isolation; it is continuously influenced by the organizational context, such as hospital culture, departmental climate, and management policies; the industry environment, such as healthcare policies and technological advancements; and the state of cutting-edge academic research, as well as the broader sociocultural milieu. For instance, the rapid development of health information technologies imposes new demands on oncologists' information literacy and their capacity for lifelong learning; likewise, ongoing healthcare system reforms may affect competency requirements related to resource allocation, cost management, and operational efficiency. Conversely, improvements in the overall competency level of oncologists can in turn positively drive enhancements in healthcare service quality, medical research progress, and public health and wellbeing. Therefore, when constructing competency models, it is essential to situate oncologists' competencies within an open and dynamic system, thoroughly

considering the interactive effects between individual competencies and multi-level environmental factors, so as to ensure the ecological validity of the model and its adaptability to future developments.

Third, the principles of dynamism and adaptability in systems theory highlight that a system is a continuously evolving process endowed with self-regulatory capacities and the ability to adapt to external environmental changes. Given the rapid advancements in medical knowledge, ongoing innovations in oncology diagnostic and therapeutic techniques, and increasingly diverse patient needs, oncologists' competencies must demonstrate dynamic development and considerable plasticity. A static and inflexible competency model is inadequate to meet the demands of such a rapidly evolving environment (Song, 2010). Systems theory therefore suggests that the development of a competency model should prioritize the development potential and plasticity of competencies, not only identifying the essential capabilities required by the current role but also anticipating novel demands arising from future trends. Furthermore, the model itself should possess flexibility and openness, allowing for timely modification and refinement in response to empirical feedback and environmental shifts, thereby ensuring its enduring validity and practical relevance.

Last, the principle of hierarchy within systems theory suggests that complex systems are typically composed of multiple layers of subsystems. In competency research, individual competency can be viewed as a system in itself, further divisible into specific dimensions and components; at the same time, it functions as a subsystem within a broader system including team-level, departmental, and even hospital-wide organizational capabilities. This hierarchical perspective facilitates a systematic analysis of competency structures and their functional mechanisms across various organizational levels. Within the competency model for oncologists, different layers or types of competencies can be identified—such as core generic competencies, professional competencies, and leadership competencies—and their relative importance and patterns of expression can be analyzed across different stages of career development or across transitions in professional roles.

In sum, systems theory offers a macro-level and integrative theoretical framework for this study. It encourages researchers to move beyond the simple listing of competency components and instead undertake a deeper investigation into their internal structures, dynamic mechanisms, and complex interactions with the broader environment, thereby supporting the development of a more comprehensive, insightful, and practically applicable competency model. Throughout subsequent stages—including research design, data collection and analysis, and model interpretation and application—a systems-theory-informed approach based on systems theory

should be consciously and consistently employed, so as to ensure both the scientific reliability and systemic coherence of the research process. Ultimately, this approach aims to generate valuable theoretical contributions and practical solutions that enhance the overall quality of oncologists in Shanghai and advance the standard of cancer care services across the region.

2.5.2 Person–job fit theory

Person–job fit theory, a longstanding and influential conceptual cornerstone in the fields of organizational behavior and human resource management, provides essential theoretical grounding for understanding the interaction between individuals and their work environments, and how such alignment shapes individual attitudes, behaviors, and organizational outcomes. At the heart of this theory lies the assertion that when an individual's characteristics—such as knowledge, skills, abilities, values, and personality traits, collectively referred to as KSAOs (Knowledge, Skills, Abilities, and Other Characteristics)—are well-aligned with the requirements, rewards, and cultural attributes of a job, the individual is more likely to experience greater job satisfaction, stronger organizational commitment, lower quit intentions, and enhanced job performance (Bui et al., 2017; Memon et al., 2015; Mensah & Bawole, 2020; Oehley, 2007). Within the context of developing a competency model for oncologists, Person–job fit theory not only offers a clear and logical foundation for the model's practical implementation, but also illuminates a critical pathway for enhancing the quality of oncology care and the effectiveness of workforce development through improved alignment between physicians' competencies and job demands.

From its theoretical lineage, the concept of person–job fit can be traced back to early vocational psychology studies on individual differences and occupational choice. In its modern evolution, the theory has diversified into two principal dimensions: needs–supplies fit and demands–abilities fit (Caplan & Van Harrison, 1993). Needs–supplies fit posits that when an organization effectively meets an individual's needs, motivations, and preferences, such as opportunities for growth, autonomy, and meaningful work, the employee is more likely to exhibit positive workplace attitudes and behaviors (Abdelmoteleb, 2020; Greguras & Diefendorff, 2009). Demands–abilities fit, in contrast, focuses on how well an individual's knowledge, skills, and abilities align with the demands and challenges of the job, which in turn fosters a sense of accomplishment and supports high levels of performance (Greguras & Diefendorff, 2009; Trautmann et al., 2011). A competency model, at its core, is a systematic representation of the demands specific to a given job. It outlines the specific constellation of capabilities required for oncologists to achieve outstanding performance in this highly

specialized domain. Therefore, the process of constructing a competency model for oncologists represents not only a deepened understanding of job-specific demands but also a critical step toward enabling a more refined and effective demands–abilities fit.

Within the highly specialized career of oncologists, the importance of person–job fit becomes particularly pronounced. Oncological practice is marked by high complexity, uncertainty, and risk, demanding not only advanced medical knowledge and clinical acumen but also research capacity, communication proficiency, ethical integrity, and psychological resilience (Hlubocky et al., 2016). A significant mismatch between a physician's competencies and the job's demands may result in professional burnout and reduced effectiveness, and, more critically, compromise patient safety and outcomes. Conversely, when physicians possess competencies that closely align with job requirements, they are more likely to demonstrate accurate judgment and make effective decisions in complex clinical settings, communicate empathetically with patients and their families, actively engage in medical research and innovation, and derive greater professional fulfillment (Xu, 2021). Therefore, the scientific construction and effective implementation of a competency model for oncologists can empower healthcare institutions to select talent whose capabilities demonstrate strong alignment with job requirements based on clearly defined competency standards, thereby enhancing person–job fit at the recruitment stage.

Furthermore, the theory of person–job fit serves not only as a guiding principle in talent selection, but also in subsequent stages of talent development, deployment, and retention. A well-defined competency model for oncologists can provide in-service physicians with clear goals and direction for development and training, assist them in identifying gaps in key competencies, and enable the formulation of individualized learning and improvement plans. In the realm of performance management, a competency-based evaluation framework offers a more holistic and objective reflection of physicians' contributions beyond what is captured by conventional quantitative metrics, thereby encouraging physicians to pursue comprehensive competency growth (Lin, 2001). With regard to career planning, a competency model can delineate a clear professional development pathway and a stepwise competency advancement framework, motivating physicians to continuously strive for excellence (Oyetunde & Oluwafunke, 2015). Thus, the construction and application of competency models constitute an organizational approach to systematically enhancing person–job fit, with the broader aim of unlocking individual potential, optimizing team collaboration, and ultimately improving overall organizational performance.

It is important to note, however, that person–job fit is not a static construct, but rather a

dynamic and evolving process. As medical knowledge rapidly expands, diagnostic and therapeutic technologies advance, and models of care continue to evolve, the competency requirements for oncologists are also undergoing continual transformation. Therefore, when applying person–job fit theory to guide the construction of a competency model, it is essential to take this dynamic nature into full account. Attention should be given not only to the present person–job fit (P–J fit), but also to the potential fit in the future, including the one between individuals and more advanced jobs they may assume in the future (person–future job fit). Moreover, beyond the match between the individual and the specific job, the alignment between the individual and the broader organizational culture and values (person–organization fit, or P–O fit) is also a critical factor that influences work behavior and organizational effectiveness. These higher-level demands for fit should be meaningfully reflected in the conceptual framework of the competency model or at least be thoughtfully considered in its practical application.

In summary, the person–job fit theory provides this study with a robust theoretical foundation and a clear practical orientation. By underscoring the importance of identifying and fulfilling job demands for individual capabilities, as well as aligning personal needs with organizational provisions, this theory serves as a central mechanism for enhancing individual performance and overall organizational effectiveness. The scientific construction and effective application of a competency model for oncologists enables the systematic enhancement of the level of person–job fit within the oncology workforce, thereby injecting strong momentum into the sustained and healthy development of specialized oncology services in Shanghai. This study, grounded in person–job fit theory, is committed to developing a model that accurately captures the core competency requirements of oncologists and effectively informs human resource management practices.

2.5.3 Tacit knowledge theory

Tacit knowledge theory, a foundational construct in cognitive psychology and knowledge management, offers profound insights into the complex structure of human knowledge—especially the “tacit” knowledge that is difficult to articulate or formalize (Hadjimichael & Tsoukas, 2019; Zuo, 2000). This theory is first systematically articulated by Michael Polanyi, a Hungarian-born British physical chemist and philosopher, in his seminal work *Personal Knowledge: Towards a Post-Critical Philosophy* and further elaborated in his later book *The Tacit Dimension*. Polanyi’s core ideas are encapsulated in the iconic dictum: “We know more than we can tell”, positing that a vital component of human knowledge resides beyond what

can be fully expressed through language. Such knowledge is deeply embedded in an individual's experiences, intuition, insights, and practice, and resists full and precise transfer via explicit channels such as language, formulas, or procedures, yet plays a critical role in guiding an individual's judgment, decision-making, and performance in specific situations. In the construction of a competency model for oncologists, a deep understanding of tacit knowledge offers irreplaceable theoretical and practical benefits for uncovering the core competencies of outstanding physicians and building a competency framework capable of discriminating among different performance levels.

Tacit knowledge stands in contrast to explicit knowledge, which refers to information that can be clearly articulated and communicated through structured formats such as language, writing, and diagrams—examples include textbook theories and standardized clinical guidelines. Yet in highly complex and constantly evolving fields like clinical oncology, explicit knowledge alone is often inadequate to meet the full spectrum of professional demands. What enables outstanding oncologists to make accurate diagnoses, devise personalized treatment strategies, manage difficult and unpredictable cases, and demonstrate deep empathy in patient communication is, to a significant extent, the tacit knowledge they have cultivated through extensive hands-on clinical experience. This tacit knowledge may take the form of the rapid recognition of complex disease patterns—commonly referred to as "clinical intuition" or a "sixth sense" —, the capacity to weigh competing factors and make sound decisions even in the face of incomplete information, a keen sensitivity to emotional nuances in patients and their families, paired with strong empathic responsiveness, and the ability to collaborate effectively within multidisciplinary teams. These forms of context-embedded "know-how" and embodied understanding are typically difficult to transmit through conventional medical training, yet they constitute a critical marker distinguishing exceptional clinicians from their average peers.

Competency research—particularly the approach advocated by McClelland (1973), which is grounded in the Behavioral Event Interview (BEI) method, —seeks to articulate and systematically structure the individual traits and abilities that critically influence job performance, yet often exist in tacit form (Jacobs, 2016). By guiding participants to recall and narrate specific behaviors, thought processes, emotional responses, challenges, and outcomes in key professional situations, researchers can progressively decode the tacit knowledge and deep-seated competencies underlying those experiences, such as motivational drivers, cognitive strategies, self-concept, and context-dependent skills acquired through practice. Tacit knowledge theory thus offers both a theoretical rationale and methodological guidance for developing more in-depth and robust competency models. It underscores the importance of

looking beyond explicit knowledge and technical expertise to uncover the hidden dimensions that underpin exceptional performance.

Uncovering and articulating tacit knowledge is particularly critical in the process of developing a robust and contextually grounded competency model for oncologists. These deeply embedded, experience-based insights play an indispensable role in shaping clinical excellence, especially in complex, emotionally charged, and ethically nuanced situations. For instance, when delivering bad news to patients facing a poor prognosis, physicians must maintain a highly sensitive equilibrium between presenting objective clinical facts with clarity and providing empathetic emotional support, all while preserving a realistic yet compassionate sense of hope. This complex communicative act cannot be reduced to technical skill alone; it fundamentally relies on implicit communication strategies, intuitive emotional intelligence, and mature ethical judgment—all of which are hallmarks of tacit knowledge. Likewise, during multidisciplinary team (MDT) consultations, oncologists are expected to integrate divergent expert opinions, navigate interpersonal dynamics, and guide the team toward a shared treatment decision. Such tasks demand not only advanced cognitive synthesis and collaborative reasoning, but also interpersonal acumen and tacit leadership cultivated over time through experiential learning. In diagnostic scenarios involving rare or atypical cases, physicians are often required to move beyond standardized diagnostic pathways and instead apply accumulated clinical intuition, pattern recognition, and heuristic reasoning to formulate innovative and accurate clinical judgments. These dimensions of professional competence, being intrinsically situated, experiential, and context-dependent, cannot be effectively assessed through conventional means such as knowledge-based tests or checklist-driven procedural evaluations. Rather, they necessitate the use of in-depth, qualitative methodologies—such as Behavioral Event Interviews (BEI), the Critical Incident Technique (CIT), or expert-based cognitive task analyses—to elicit, interpret, and systematize the tacit elements of expert oncology practice.

However, uncovering and applying tacit knowledge remains a significant challenge. Because tacit knowledge is inherently unspoken and highly context-dependent, —the question of how to extract it from personal experience and how to express and assess it in ways that are objective, understandable, and teachable remains a key challenge that researchers must address (Juan, 2025). This often requires combining various research methods, applying rigorous coding and analysis, and validating findings through expert consensus. It is also important to recognize that some aspects of tacit knowledge may never be fully made explicit. Still, identifying its key traits and how it manifests in practice can offer valuable guidance for talent development and organizational learning.

Taken together, tacit knowledge theory offers a rich and multifaceted theoretical lens through which to interpret the complex, layered, and often unarticulated nature of human knowledge, particularly as it relates to professional expertise developed through sustained, real-world practice. It serves as a critical conceptual foundation for uncovering the deep cognitive, behavioral, and value-driven mechanisms that underpin core competencies in high-performing oncologists. Drawing meaningfully on this theoretical paradigm, the present study strategically adopts tailored research approaches and analytic techniques to identify, extract, and synthesize the embedded clinical insights and experiential know-how that physicians acquire through years of immersive oncology work. This process informs the construction of a competency model that is not only more robust in its theoretical grounding and empirical validity, but also more contextually relevant, diagnostically sensitive, and practically applicable in differentiating levels of professional performance. Ultimately, such a model enhances both scientific rigor and practical guidance, offering more precise and effective support for the training, selection, and ongoing development of oncologists in Shanghai's healthcare system.

2.6 Physician competency research

International research on competency, as a key subfield of human resource management and organizational behavior, has evolved into a well-established domain. Its theoretical advances and practical applications have significantly shaped talent development and evaluation in professional sectors such as medicine. The field originated from a critical rethinking of traditional talent assessment criteria. In his seminal paper, McClelland (1973) asserts that organizations should focus on the deeper personal attributes—referred to as competencies—that reliably distinguish superior performers from average ones, rather than relying solely on intelligence tests or academic performance. This proposition lays the groundwork for the development of competency theory and has stimulated a broad wave of subsequent research. Building on this foundation, Boyatzis (1991) articulates a systematic framework for modeling managerial competencies, outlining their essential components and structures. Later, Spencer and Spencer (1993) expand the conceptual scope of competency theory through extensive empirical studies. They introduce a structured and actionable framework of competency constructs, along with a widely applicable method for model development—contributions that have played a crucial role in competency-based practices worldwide.

The adoption and advancement of the competency-based approach in medical education and clinical practice are closely linked to the global focus on healthcare quality, patient safety,

and ongoing reforms in medical training (Liu & Cao, 2022). Several internationally recognized physician competency frameworks have emerged, offering valuable guidance for the training and certification of medical professionals worldwide. Among them, the CanMEDS framework, developed by the Royal College of Physicians and Surgeons of Canada and refined through multiple iterations, has become a widely accepted gold standard for defining and assessing core physician competencies (Hall et al., 2023). It defines physician competency through seven key roles: Medical Expert, Communicator, Collaborator, Leader, Health Advocate, Scholar, and Professional. These roles encompass not only the clinical knowledge, technical expertise, and research capability essential to medical practice, but also underscore the importance of communication, teamwork, ethical decision-making, and professional conduct. This framework aligns closely with the core dimensions emphasized in the competency model for oncologists proposed in this study, including medical knowledge, clinical proficiency, research and innovation, ethics and law, interprofessional collaboration, and patient-centered communication and care.

Meanwhile, the core competency framework established by the Accreditation Council for Graduate Medical Education (ACGME) serves as a foundational standard for residency training programs across the United States (Batalden et al., 2002; Swing, 2007). This framework delineates six essential domains of physician competency: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice. The framework places particular emphasis on physicians' ability to integrate resources and function effectively within complex healthcare systems. For instance, "practice-based learning and improvement" requires physicians to engage in lifelong learning and to apply emerging medical technologies in clinical practice, which resonates strongly with the competency expectations proposed in this study for oncologists in the domains of intelligent healthcare and novel therapeutic technologies. Likewise, "systems-based practice" underscores the importance of coordinating healthcare resources, collaborating across interdisciplinary teams, and complying with institutional policies and regulatory frameworks.

In addition to these broad and general competency frameworks for physicians, international scholars have also engaged in more refined investigations of competency models tailored to specific medical specialties. Although a widely recognized international standard model specifically for oncologists is still lacking, existing competency studies in major disciplines such as internal medicine and surgery offer valuable insights for this study (Epstein et al., 2002). At the methodological level, well-established approaches such as the Behavioral Event

Interview (BEI), expert panels, and the Critical Incident Technique (CIT) are widely employed to identify, define, and assess the relative importance of key competency elements. Notably, the effective assessment and development of physician competencies, especially those deep-seated attributes that are not readily observable—such as clinical judgment, ethical decision-making, and professionalism—remain central challenges and focal points of international research. In recent years, Entrustable Professional Activities (EPAs) have emerged as a promising approach for translating abstract competencies into concrete clinical tasks suitable for assessment. By emphasizing holistic performance in real-world clinical settings, EPAs have gained significant traction and adoption in both academic and clinical practice communities (Ten Cate, 2013; Ten Cate et al., 2021).

Viewed holistically, recent international studies on competency increasingly highlight its dynamic nature and contextual adaptability. There is growing recognition that physicians' competencies are not static attributes, but instead evolve over time in response to advances in medical knowledge, technological innovation such as the use of AI in imaging and pathology, and shifts in healthcare delivery models (Leach, 2002). Scholars are also placing increasing emphasis on the integrative nature of competency and the physician's ability to collaborate across disciplines, particularly in settings like oncology multidisciplinary teams (MDTs), where collaborative decision-making and effective teamwork are essential. The rise of patient-centered care further underscores the importance of strong communication skills, empathic engagement, and respect for patient autonomy in clinical decision-making. At its core, competency serves as a practical guide for clinical work. Its value lies in whether it leads to better clinical outcomes, improved patient quality of life, and higher satisfaction with care. This aligns closely with the present study's inclusion of "clinical outcomes" and "patient management and communication" as essential dimensions of oncologists' core competencies. Accordingly, drawing on the theoretical and empirical advances of international competency research offers valuable theoretical grounding and practical insight for developing a scientifically robust, contextually appropriate, and forward-looking competency model for oncologists in Shanghai.

China's engagement with competency theory, particularly in a systematic and research-oriented manner, began relatively late compared with that in Western countries, with notable developments emerging in the late 1990s. During this early phase, Chinese scholars primarily focused on introducing, translating, and interpreting foundational competency theories, models, and case studies from international literature (Shi, 2006). Such efforts laid a critical theoretical foundation for the later development of localized research and brought initial awareness to both

academic and business communities of the potential value of competency frameworks in enhancing organizational effectiveness and professionalizing talent management. As China's market economy continues to evolve and the demand for more sophisticated human resource management practices increases, competency research has gained significant traction domestically, gradually shifting from theoretical importation to exploration and practical application.

Since the beginning of the 21st century, Chinese scholars have increasingly drawn on established international theories and methodologies to explore the development of competency models tailored to China's cultural context and organizational realities. Initially focused on corporate managers and government officials (Shi et al., 2002), research has gradually expanded to encompass a broader range of professions, including educators, engineers, and healthcare practitioners. In the medical field, the concept of competency has gained increasing recognition, becoming a focal point in medical education reform and the development of clinical training systems. Some studies have adopted internationally recognized physician competency frameworks, such as CanMEDS and ACGME, and adapted them to the specific conditions of China's healthcare system. These efforts have led to preliminary attempts to construct and validate competency models for clinical physicians, specialists (such as those in pediatrics and emergency medicine), and nursing staff (Wei et al., 2022). Such studies help to address existing gaps in domestic research on healthcare competencies and lay important groundwork for more in-depth and refined investigations in the future.

In terms of method, Chinese scholars also draw on and apply mainstream international techniques for developing competency models. The Behavioral Event Interview (BEI), valued for its ability to uncover core attributes that differentiate high performers from average ones, is frequently employed in domestic model-building efforts (Ren & Zhao, 2021). Techniques such as expert panel discussions, the Delphi method, questionnaire surveys, and the Critical Incident Technique are often used in combination to enhance the reliability and validity of the models. At the analytical level, in addition to conventional content analysis, advanced statistical methods, such as Structural Equation Modeling (SEM), are increasingly applied to test the structural validity and theoretical soundness of competency models (Jiang, 2022). However, it is important to note that some domestic studies reveal a limited understanding or inconsistent application of classical methods, which may undermine the reliability and practical applicability of the models.

Despite notable advances and valuable practical experience in certain domains, competency research in China still lags behind global developments in several important respects. To begin

with, theoretical innovation remains limited. Much of the existing work focuses on introducing, adapting, or applying established international frameworks, while the development of original, contextually grounded theories with broader applicability in China is still in its early stages. In addition, both the depth and scope of research need to be expanded, particularly in building refined, systematic competency models for specialized roles such as oncologists. High-quality empirical studies in these areas remain relatively scarce. Moreover, current models often lack mechanisms for dynamic revision and outcome evaluation. Once established, most are not regularly reviewed or updated, making it difficult to assess their real impact on organizational performance in a measurable way. Finally, the ways in which cultural factors shape the meaning and expression of competencies, and how models can be developed to genuinely reflect the Chinese sociocultural context remain a key issue requiring deeper and sustained academic inquiry (Wang & Xu, 2019). Against this backdrop, this study focuses on oncologists in Shanghai and aims to develop a competency model that is both contextually relevant and professionally tailored. Grounded in rigorous empirical research, the model is intended to strengthen the professional capacity and service quality of China's oncologist workforce.

2.7 Challenges and gaps in physician competency research

Although competency theory has seen significant development both globally and in China since its introduction, and has proven highly valuable in human resource management, a close examination of existing research and practical implementation reveals several critical issues that remain to be addressed. These challenges have constrained the continued theoretical refinement of the concept and limited the broader impact and effectiveness of competency models in real-world organizational settings.

First, the boundaries between the core meaning and practical scope of the competency construct remain poorly defined, making it difficult to establish a coherent link between theoretical formulation and empirical application. While there is broad scholarly consensus on the central premise of competency—that it refers to the individual attributes that differentiate high performers from average ones (McClelland, 1973; Spencer & Spencer, 1993)—differences persist regarding its specific components, the hierarchical structure among them, and how to precisely distinguish among related terms such as ability, quality, and skill. As a result, researchers often present inconsistent terminologies and divergent interpretations (Campion et al., 2011). This conceptual lack of alignment hampers meaningful comparison and synthesis across studies, and complicates efforts to develop competency models that are both

broadly applicable and contextually grounded.

Second, while a wide range of methods exist for constructing competency models, balancing scientific rigor, generalizability, and practical feasibility remains a persistent challenge. The Behavioral Event Interview (BEI), as a classic method, offers valuable insights into latent or implicit competencies, yet it demands a high level of expertise from both interviewers and data coders, and is often time-consuming and labor-intensive, which makes it difficult to scale in studies involving large samples or constrained research resources (Shippmann et al., 2000; Stevens, 2013). By contrast, approaches such as expert panels or questionnaire surveys are relatively easy to administer, but they may fall short in uncovering deeper-level competencies, in mitigating subjective bias, and in ensuring content validity. Selecting or integrating the most appropriate modeling strategies based on organizational context and role-specific characteristics, while also improving efficiency without compromising methodological rigor, remains an ongoing area of inquiry for competency researchers.

Third, many competency models lack adequate dynamism and foresight, which undermines their ability to respond effectively to rapidly evolving organizational contexts and job requirements. Once established, these models are often treated as fixed standards rather than evolving systems, with little emphasis placed on dynamic updating or iterative refinement. However, in the era of the knowledge economy, emerging technologies, business models, and organizational paradigms continuously reshape the competency demands placed on individuals (Shippmann et al., 2000). In the medical field in particular, rapid advancements in diagnostic and therapeutic technologies, shifts in disease patterns, and changes in health policy create ongoing challenges for physician competency. Existing research pays insufficient attention to the development of competency models that are forward-looking and capable of anticipating future job demands, as well as to the design of systematic mechanisms for their regular evaluation and revision.

Fourth, the identification, measurement, and development of deep-level competencies remain an underdeveloped area in current research. Deep-level competencies, such as motives, traits, self-concept, and core values, reside beneath the surface in the iceberg model of competency and exert a more fundamental and enduring influence on individual behavior and performance (Spencer & Spencer, 1993). However, these attributes are difficult to identify, lack standardized tools for accurate measurement, and pose considerable challenges for effective training and developmental intervention. Accurately capturing these core elements during model construction and designing robust tools for their evaluation and development are

essential to improving the discriminant validity and practical utility of competency models.

Fifth, the evaluation of competency models' effectiveness in organizational practice, as well as the mechanisms for translating these models into meaningful action, remain insufficiently developed. Although many organizations invest substantial resources in developing competency models and implementing them across areas such as recruitment, training, and performance management, there is often a lack of systematic and objective evidence to assess whether these efforts lead to the anticipated improvements in organizational performance or justify their return on investment. Moreover, one of the most persistent challenges in practice lies in translating abstract competency models into specific managerial actions and employee development initiatives, so as to ensure they are not only implemented but also lead to measurable outcomes.

Last, there remains considerable and urgent room for expanding localized, fine-grained empirical research that is tailored to the distinct characteristics of specific professional domains and embedded within relevant socio-cultural and institutional contexts. While much of the existing literature has concentrated on broad-based competency models, which are often geared toward generic managerial roles or designed for cross-sectoral applicability, there has been a relative lack of focused inquiry into the nuanced, domain-specific competencies required by highly specialized, cognitively demanding, and ethically complex professions such as oncology. Oncologists, in particular, operate at the intersection of high clinical risk, rapidly evolving scientific knowledge, emotionally intense patient interactions, and complex ethical decision-making. The competencies required to function effectively in such environments are not only multifaceted but also deeply situated in practice, demanding a level of professional capacity that far exceeds general managerial or clinical proficiency. However, the direct transplantation of foreign-developed competency frameworks into the Chinese healthcare setting frequently proves inadequate. These models often fail to capture the culturally embedded norms, communication practices, hierarchical dynamics, and regulatory conditions that shape professional behavior and expectations within China's healthcare institutions. Consequently, a pressing responsibility for Chinese researchers is to identify, validate, and systematize the core elements of occupational competency that are both reflective of China's unique professional realities and capable of guiding practical improvements in workforce development. This includes constructing competency models that are empirically grounded, culturally attuned, and operationally effective—models that not only inform the selection, evaluation, and training of professionals but also serve to advance the broader goals of quality, equity, and sustainability in China's healthcare system.

In summary, although the field of competency research has made substantial theoretical strides and generated a wealth of practical applications across various sectors, it continues to grapple with a number of unresolved challenges, both conceptual and methodological. This study focuses on oncologists in Shanghai, with the aim of addressing some of these challenges through rigorous empirical investigation, particularly by systematically refining competency models tailored to the demands of highly specialized professional domains, and by enhancing the contextual relevance, cultural alignment, and real-world applicability of these models within the complex and evolving institutional settings of the local healthcare system.

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Chapter 3: Research Method

A rigorous methodological approach is essential to ensure the reliability and validity of the study's findings. This chapter outlines the methodological framework of the study and is organized into three sections. The first section presents the overall research objectives and study design. The second details participant selection, instrument development, and data collection procedures. The third describes the specific techniques used for textual and statistical analyses.

3.1 Research objectives and study design

3.1.1 Research objectives

First, the expert interview method is used to collect the competency characteristics of oncologists and to identify the dimensions of their job competency, thereby providing a theoretical basis and structural framework for the subsequent design of the oncologist competency questionnaire. Second, based on the identified competency dimensions of oncologists, the content of interview transcripts is synthesized, and established scales are consulted to develop the *Questionnaire on Shanghai Oncologists' Job Performance*. A large-sample survey is conducted, and reliability analysis and confirmatory factor analysis are used to examine the structural validity of the model and to assess the effectiveness of the competency model constructed in this study. From a theoretical perspective, competency theory highlights the critical role of individual characteristics in driving job performance. Only those forms of knowledge, skills, motivation, personality traits, and self-awareness that consistently support high performance in practice are defined as competencies. The construction of a competency model aims to identify the essential capabilities and their behavioral expressions required for a specific role, thereby clarifying how these factors are intrinsically linked to superior performance. To ensure the criterion-related validity of the competency model developed for oncologists in Shanghai, this study further examines the relationship between competencies and job performance. In doing so, this study ensures that the model is not only theoretically robust but also responsive to the practical demands of the clinical setting.

3.1.2 Study design

This study adopts a sequential research design encompassing theory building, instrument development, empirical validation, and application-oriented analysis, and adopts a mixed-methods approach integrating qualitative and quantitative research.

In the initial phase, a systematic literature review is conducted to trace the development of competency theory, review international research on physician competency, and examine the current status and challenges in oncologists training, thereby establishing a theoretical foundation for model construction. Building on this, semi-structured interviews are conducted with experts in oncology-related diagnosis and treatment. The interview data are analyzed using KH Coder, including word frequency analysis, co-occurrence network analysis, and cluster analysis, to identify preliminary dimensions and characteristics of oncologists' job competency.

In the second phase, informed by the text analysis results and established international competency frameworks, two instruments are developed: *the Questionnaire on Shanghai Oncologists' Job Competency Self-Assessment* and *the Questionnaire on Shanghai Oncologists' Job Performance*. The survey is administered via Wenjuanxing to resident physicians undergoing standardized residency training and to physicians within three years of completing such training at a tertiary Grade A cancer hospital in Shanghai.

In the final phase, SPSS and Stata are employed to conduct descriptive statistical analysis, reliability and validity testing, correlation analysis, and hierarchical regression analysis. These analyses are undertaken to assess the structural, convergent, discriminant, and criterion-related validity of the competency model, and to examine the mechanisms through which different competency dimensions influence job performance. Finally, based on the findings, the theoretical contributions and practical implications of the model are discussed, and recommendations for improving oncologists training are proposed.

3.2 Research design and procedures

3.2.1 Selection of participants

On the one hand, this study conducts interviews with 30 oncologists and experts from various tertiary Grade A hospitals in Shanghai, as well as practitioners related to this study (not limited to medical institutions, as detailed in Appendix A), covering a range of subspecialties including medical oncology, surgical oncology, radiation oncology, pathology, imaging, and anesthesiology, thereby ensuring both the representativeness and diversity of the data. The

specific criteria were as follows:

(1) Experts in hospital management, higher medical education, or human resources.

(2) A minimum of five years of professional experience in a hospital or related managerial setting.

(3) Nomination by at least two experts in the oncology field.

The inclusion of experts in education and hospital management allows the systematic requirements of oncologist competence to be examined from a broader, system-level perspective of talent development and workforce management, rather than being confined to the clinical or technical domain, thereby enhancing the ecological validity of the model.

On the other hand, in terms of questionnaire respondents, the sample primarily consists of physicians who are either currently enrolled in standardized residency training (SRT) or have completed it within the past three years at a tertiary Grade A tumor hospital in Shanghai. Although this survey does not employ random sampling of all in-service oncologists across Shanghai, the selection of current residents and recent SRT graduates constitutes a methodologically sound and contextually appropriate sample. First, this group represents the emerging core of the oncology workforce and occupies a formative stage in professional development. They tend to exhibit heightened awareness of the competencies required for oncological practice and are well-positioned to provide accurate reflections on how the proposed model's core components align with real-world clinical demands. Second, physicians at this stage are transitioning from theoretical training to independent clinical practice. This transition affords them a clear conceptual and experiential understanding of multifaceted competencies such as clinical knowledge, communication, teamwork, and research ethics. Such insights allow them to offer meaningful validation of the model's scientific rigor and practical relevance. Third, in contrast to more senior clinicians, SRT physicians are typically more centralized in organizational settings, which enhances the efficiency of survey distribution and collection. This contributes to higher data quality and strengthens the operational feasibility of the study. Finally, given the model's intended use in medical education and competency-based workforce evaluation, the choice of residents and early-career physicians as the validation sample is not only methodologically sound but also aligned with the study's objective to inform practice-oriented competency development. Therefore, while structural limitations in sampling do exist, the representativeness of the selected population, the alignment with research aims, and the feasibility of implementation together ensure that the resulting data possess strong explanatory power and practical reference value.

3.2.2 Instruments

To elicit the experts' perspectives on the job competencies that oncologists should possess, this study develops an interview guide and conducts semi-structured interviews with each participant based on that framework. This study employs semi-structured interviews to elicit expert perspectives, a methodological choice justified by the following considerations. First, semi-structured interviews offer both depth and flexibility. They combine the structured framework of predefined questions with the openness of unstructured inquiry, allowing researchers to cover core topics while retaining the flexibility to probe and delve deeper based on respondents' answers. This approach is particularly well suited to exploratory research on competency model construction, as it facilitates the elicitation of tacit knowledge and individualized insights (Boyatzis, 1991). Second, semi-structured interviews enable the capture of rich contextual detail. Through techniques such as probing, clarification, and paraphrasing, researchers can guide respondents to recall specific behavioral examples from real work situations, including event background, decision-making processes, and outcome feedback. Such behavior-based recall of critical incidents provides rich qualitative data for identifying competency characteristics (Spencer & Spencer, 1993). Third, semi-structured interviews facilitate the full elicitation of expert knowledge. The participants in this study—including hospital managers, senior oncologists, and medical education experts—represent highly specialized groups. This method respects respondents' discursive agency, which allows them to introduce perspectives beyond the predefined topics and the researchers' expectations, thereby enhancing the comprehensiveness and originality of competency identification.

The interview focuses on a series of predefined thematic areas:

(1) "From your perspective, what competencies should oncologists possess, and what do these competencies entail?"

(2) "Which key competency characteristics do you consider essential for oncologists?"

(3) "Do oncologists currently meet the healthcare service demands of specialized oncology hospitals? If not, in which areas are the gaps most evident?"

(4) "Compared with traditional internists and surgeons, what unique competencies are required of oncologists?"

(5) "What are your insights and suggestions for developing a competency framework for oncologist roles?"

To make ensure that no relevant information is overlooked, all interviews are audio-recorded with respondents' consent.

To examine the job competency profile of oncologists in Shanghai, this study designs and administers the *Questionnaire on Shanghai Oncologists' Job Competency Self-Assessment.* The following section outlines the development process of the questionnaire.

(1) Definition of the competency assessment scope for Shanghai oncologists

Based on the established competency model for Shanghai oncologists in this study, a total of 19 competency attributes are incorporated into the assessment. These include: mastery of fundamental theories, precision treatment capability, multidisciplinary collaboration awareness, proficiency in cutting-edge technologies, emotional support, medical information communication, cultural adaptation and communication, research design and publication, academic frontier monitoring, interdisciplinary research, ethical judgment, research ethics compliance, legal and regulatory compliance, multidisciplinary collaboration, teaching and mentorship, resource coordination and management, data and AI-assisted diagnosis and treatment, information systems management, and telemedicine practice.

(2) Development of initial items for the *Questionnaire on Shanghai Oncologists' Job Competency Self-Assessment*

To ensure the scientific validity and contextual relevance of the assessment, this study identifies 19 core competency attributes using KH Coder 3.0 and further integrates established international competency frameworks—such as ACGME and CanMEDS—along with domestic empirical research in China. Drawing on both structural dimensions and behavioral expressions of professional competence, 38 items are developed to comprehensively reflect these attributes. In designing the items, the study systematically analyzes role-specific behavioral expectations outlined in the CanMEDS framework—including Medical Expert, Communicator, Collaborator, and Scholar—and aligns them with ACGME's six core competencies: patient care, medical knowledge, communication skills, professionalism, systems-based practice, and practice-based learning. This ensures that each attribute is theoretically grounded and internationally benchmarked. To enhance contextual fidelity, the study extracts representative language and task descriptions that capture real-world manifestations of competence and translates them into behaviorally anchored, measurable items through an in-depth analysis of transcripts of 30 expert interviews. Moreover, considering China's unique cultural and institutional context, and in contrast to the Western communication ethics model that emphasizes "individual agency and direct expression", Chinese medical culture exhibits a communication structure characterized by "family involvement and indirect expression". This high-context culture (Hofstede et al., 2010) significantly shapes how physicians demonstrate their competencies. Accordingly, within the physician–patient

communication dimension, this study incorporates culturally embedded assessment items such as "communication skills with family members" to reflect the contextual specificity of competency behaviors in the Chinese setting. In terms of item allocation, the number of items is matched to the complexity and conceptual breadth of each competency domain. For instance, competencies such as "mastery of fundamental theoretical knowledge", which involve multiple dimensions including knowledge and skills, are measured using two items to enhance reliability. In contrast, for competencies with relatively singular behavioral manifestations, such as "keeping up with academic frontiers", only one item is included to capture the construct.

(3) Item selection and questionnaire finalization

Upon completion of the preliminary design of the measurement items, experts in psychology are invited to assess the accuracy and clarity of item phrasing. In response to their feedback, items that are ambiguously worded, cognitively demanding, or potentially misleading are revised or removed. A total of 29 items are retained, covering 19 distinct competency dimensions. As shown in Table 3.1, these items form the *Questionnaire on Shanghai Oncologists' Job Competency Self-Assessment*. This questionnaire serves as the second section of the composite questionnaire.

Table 3.1 Relationship between questionnaire items and key competency elements

Items	Core competency elements
I have a full grasp of tumor biology and molecular biology.	Basic knowledge
I can comprehend and apply principles of diagnosis and treatment of common malignant tumors.	
I can make tailored therapeutic regimen based on genetic test results.	Ability to deliver targeted treatment
I have a deep understanding of Multidisciplinary Therapy (MDT) and can effectively engage in decision-making process.	Multidisciplinary teamwork cognition
I am familiar with newly developed treatment technology such as CAR-T and mRNA vaccine.	Grasp of cutting-edge technologies
I can perform or participate in treatment decisions making based on the latest guidance and research.	
I can offer patients with mental support to ease their anxiety and depression.	Emotional support
I can give a patient sufficient informational and emotional support in the face of palliative care.	
I can articulate a patient's condition and therapeutic regimen to his or her family.	Interpersonal communication
I can adopt different ways of communicating with patients from different cultural backgrounds.	Cultural adaptation
I am adept at statistical analysis of data and interpreting research results.	Research design and paper publishment
I can compose theses and have them published in SCI journals to apply clinical research results to practices.	
I can track and comprehend the latest progress made in oncology.	Awareness of cutting-edge research

I can strike a collaborative tone with artificial intelligence and bioinformatics to conduct interdisciplinary research.	Interdisciplinary Research
I can solve the ethical dilemma of extending life and improving life quality when engaging with terminal-stage patients.	Ethical judgement
I respect the decision-making right of patients and avoid excessive care when making plans for palliative care.	
I guarantee full protection of the legitimate rights of subjects in clinical research.	research ethics regulations
I know well and act on medical laws and regulations, and my therapeutic regimen is under the legal framework.	Application of rules and laws
I stand for the legitimate rights and interests of doctors and patients when dealing with medical disputes.	
I can effectively cooperate with other departments related to tumor diagnosis and treatment to make the optimal therapeutic regimen.	Multidisciplinary teamwork
I can articulate my opinion from professional perspectives while respecting the views of other departments in a group discussion.	
I can shoulder the responsibility of teaching and training young doctors in my department.	Teaching and mentoring
I can channel such medical resources as referral and access to medicine, making medical care more available.	Resource coordination and management
I can continuously improve healthcare security and quality management and reduce malpractice.	
I can optimize decisions on tumor treatment by using medical big data analysis.	Data and AI treatment
I am adept at AI-assisted diagnosis systems such as AI image interpretation and intelligent pathological analysis.	
I can understand and assess the latest progress made by AI in oncology and apply these achievements to practices.	
I can effectively manage patients' electronic medical records (EMR) and ensure that there is no missed information or unsafety.	Information system management
I can provide targeted treatment advice in an online group consultation through telemedicine.	Telemedicine practice

As previously noted, this study also explores the relationship between competency and performance; therefore, the third section of the questionnaire incorporates the *Questionnaire on Shanghai Oncologists' Job Performance*. Specifically, this study constructs a job performance questionnaire for oncologists based on the multidimensional nature of their clinical roles, encompassing task performance, adaptive performance, and relational performance. The task performance domain captures core clinical outcomes, including disease control, improvements in survival rates, enhanced quality of life, and the management of treatment-related adverse events. The adaptive performance domain reflects physicians' engagement in scientific innovation, such as participation in clinical research, academic contributions, and the translation of research findings into clinical practice. The relational performance domain assesses competencies in patient management and communication, including effective information delivery, support for informed consent, patient satisfaction, and the provision of psychosocial care. The final scale comprises 14 items across these three domains. The detailed items and their sources are presented in Table 3.2.

Table 3.2 Measurement items and sources for oncologists' performance

Task Performance	Source
1. My patients have a high disease control rate after receiving treatment (such as stable or reduced tumor sizes). 2. Patients', especially terminal-stage patients', survival rate is improved with my therapeutic regimen. 3. My treatment approach boosts patients' life quality. 4. Side effects are under my control.	EORTC QLQ-C30(European Organization for Research and Treatment of Cancer Quality of Life Questionnaire) (Aaronson et al., 1993; Groenvold et al., 2006)
Adaptive Performance	Source
5. Clinical trials in which I take the lead or participate make significant contributions to the refinement of treatment approaches. 6. My research results are frequently quoted by my colleagues and wildly acknowledged in academic conferences on oncology. 7. Results of clinical trials in which I participate significantly contribute to the innovation of tumor treatment. 8. Outcomes of scientific research which I conduct are applied clinically, improving treatment regimen or patients' life quality. 9. Scientific research in which I take the lead is of vital importance to the long-term development of tumor treatment.	H-Index (Hirsch, 2005)
Relational Performance	Source
10. I can explain the therapeutic regimen and its expected effect clearly to patients. 11. Patients find the treatment information that I offer easy to understand. 12. I can help patients make well-informed decisions and make sure that they fully understand the therapeutic regimen. 13. My patients have a high level of satisfaction with the treatment results. 14. I can help patients manage and treat side effects and give them timely psychological support during the process.	Communication Assessment Tool (CAT) (Makoul et al., 2007)

To sum up, the first section of the composite questionnaire collects participants' demographic and professional background information, including gender, age, years of clinical experience, professional title, level of education, and academic discipline. The second section comprises of the *Questionnaire on Shanghai Oncologists' Job Competency Self-Assessment*. The third section comprises the *Questionnaire on Shanghai Oncologists' Job Performance*. Both the second and third sections of the full questionnaire use a five-point Likert scale for self-assessment, with response options ranging from 1 to 5 to indicate increasing levels of agreement or alignment. Specifically, the scale is defined as follows: 1 = "strongly disagree", 2 = "disagree", 3 = "uncertain/neutral", 4 = "agree", and 5 = "strongly agree".

3.2.3 Data collection strategy

(1) Data collection strategy for interviews

Prior to each interview, researchers coordinate the time and place with the experts, allowing them to arrange the details independently. At the start of the interview, the purpose, overall process, and expected duration are clearly explained, and confidentiality is emphasized to

ensure that participants feel comfortable and secure throughout the discussion. Throughout the interviews, researchers uphold principles of respect and attentive listening, making concise written notes while audio-recording the entire session. Questions are flexibly adapted to participants' responses to keep the discussion focused on the study objectives. The conversation remains open while being subtly guided to encourage experts to express their genuine perspectives and practical insights. To minimize redundancy and avoid respondent fatigue, interviews are limited to approximately 30 minutes each. Interviews are concluded when no new information emerges, ensuring efficient and high-quality data collection. After each interview, the research team reviews and synthesizes the data gathered from audio recordings and field notes, providing a robust foundation for subsequent analysis.

(2) Data collection strategy for questionnaires

The questionnaire data for this study are collected via Wenjuanxing, a widely used online survey platform in China, and distributed to the target population in the form of electronic questionnaires. As previously noted, the survey targets physicians currently enrolled in, or within three years of completing, residency training at a tertiary Grade A tumor hospital in Shanghai. A non-probability snowball sampling approach is employed, with questionnaire distribution and collection facilitated through hospital administrative departments, academic leaders, and professional physician communities. The hospital is one of the core institutions for cancer diagnosis and treatment in Shanghai and is broadly representative. The participants span multiple subspecialties, including medical oncology, surgical oncology, radiation oncology, pathology, and radiology. To enhance data quality, a time limit is imposed on completion to eliminate invalid responses. The survey strictly adheres to the principle of informed consent; all participants are informed in advance about the purpose of the study, the intended use of the data, and the measures in place to ensure anonymity and confidentiality. A total of 455 questionnaires are distributed, and 420 are returned, yielding a response rate of 92.3%. After excluding 22 invalid responses, 398 valid samples are retained, which meet the sample size requirements for structural equation modeling and regression analysis, and provide a sound basis for subsequent analyses of representativeness, reliability, and validity.

3.3 Analytical techniques

3.3.1 Text analysis techniques

(1) Instruments selection

To systematically and rigorously extract keywords and their semantic relationships from interview transcripts, KH Coder 3.0 is used for text analysis in this study. First, KH Coder is an open-source text mining tool developed in R, widely applied in the social sciences, education, and medical research. It supports functions such as frequency analysis, co-occurrence analysis, cluster analysis, and correspondence analysis, making it well suited for large-scale systematic coding and quantitative content analysis. For another, KH Coder is particularly appropriate for the exploratory nature of this study, as its clustering function can automatically identify semantic clusters without prior theoretical assumptions through unsupervised machine learning based on measures such as the Jaccard coefficient and cosine similarity.

(2) Text organization and preprocessing

To improve the accuracy and rigor of the analysis, the text is preprocessed before being imported into KH Coder, including:

(i) removing stop words and non-informative colloquial expressions such as “that”, “just”, and “then”;

(ii) standardizing terminology by grouping terms like “precision medicine” and “targeted therapy” under the umbrella term “precision treatment”;

(iii) using the built-in segmentation and morphological analysis functions to process the Chinese texts. A custom medical dictionary is incorporated to ensure accurate tokenization of domain-specific terms such as “multidisciplinary team (MDT),” “image interpretation,” and “genetic testing”.

(3) Word frequency analysis

Word frequency analysis is conducted using the “basic statistics” function of KH Coder to identify frequently occurring terms and expressions in the transcripts of expert interview. This analysis facilitates the preliminary identification of salient competency-related terms, such as “communication”, “standards”, “collaboration”, and “judgment”, which serve as conceptual cues for subsequent dimension development.

(4) Co-occurrence network analysis

The “co-occurrence network” function is employed to construct a semantic co-occurrence map based on the probability of words appearing together within sentence segments. By visualizing the strength of associations and centrality among key terms, this network reveals the semantic clustering of core competency-related words in real-world contexts and often serves as a structural reference prior to cluster analysis.

(5) Cluster analysis

Following the generation of high-frequency terms and the co-occurrence network, cluster

analysis is conducted to explore similarity patterns among terms. KH Coder automatically classifies related terms based on Jaccard coefficients or cosine similarity measures. For example, terms such as “research”, “literature”, and “clinical trials” are grouped under “scientific innovation”, while “comfort”, “listening”, and “informed consent” are clustered into “physician–patient communication”. This step lays the empirical foundation for constructing the dimensional structure of job competency.

KH Coder primarily performs lexical-level analysis and has limited capacity for semantic interpretation. To address this limitation, a series of manual verification procedures are conducted following the KH Coder analysis. First, keyword combinations generated by the cluster analysis are traced back to the original interview context to examine their semantic coherence on an item-by-item basis, and spurious associations driven by high co-occurrence but weak semantic linkage are eliminated. Second, two researchers with experience in qualitative research are invited to independently assign thematic labels to the revised clustering results. Third, inter-rater agreement between the two researchers is calculated, and discrepancies are resolved through discussion to reach consensus. Ultimately, the identification of competency dimensions is based on an integration of KH Coder’s quantitative analysis, the results of manual verification, and theoretical support from the literature.

3.3.2 Statistical analysis techniques

(1) Descriptive statistical analysis

Descriptive statistical analysis serves primarily to provide a preliminary overview of the sample data and to reveal its fundamental characteristics. In this study, it is used to examine the basic demographic information of the oncologist sample (e.g., gender, age, professional title) and the distribution of variables across different dimensions. Commonly applied descriptive indicators include:

(i) frequency and percentage, to describe the distribution of categorical variables (e.g., gender, professional title);

(ii) mean and standard deviation, to capture the central tendency and dispersion of continuous variables (e.g., dimension scores);

(iii) maximum and minimum values, to reflect the range of variable values.

(2) Reliability analysis

Reliability serves as a key indicator for evaluating the consistency, stability, and soundness of a measurement instrument, directly affecting the accuracy and generalizability of research findings. This study evaluates the internal consistency reliability of each dimensional scale by

calculating Cronbach's alpha (α) and examining item-total correlations. The Cronbach's α coefficient ranges from 0 to 1, with higher values indicating stronger internal consistency among the scale items. If α is relatively low ($\alpha < 0.7$), modifications to the scale should be considered, such as adding or removing items, or adjusting the dimensional structure. In addition, the corrected item-total correlation (CITC) should exceed 0.3 or 0.4; items falling below this threshold should be removed.

(3) Validity testing

This study evaluates the validity of the oncologist competency scale through assessments of content validity, construct validity, and criterion-related validity, thereby ensuring the overall quality of the data employed.

i. Content validity

Content validity refers to the extent to which a measurement instrument captures all relevant dimensions of the target construct, with a primary focus on the representativeness and appropriateness of the item content. Content validity testing determines whether the scale comprehensively covers the intended construct. To ensure content validity, three strategies are adopted:

(i) expert panel review;

(ii) careful localization of the original English-language scale;

(iii) item-by-item review and refinement by the researcher.

ii. Construct validity

Construct validity assesses the extent to which individual items accurately represent their underlying latent constructs. It typically includes three key dimensions: confirmatory factor analysis (CFA), discriminant validity, and nomological validity. Among them, CFA is employed to test whether the hypothesized factor structure aligns with the actual data. Through CFA, the researcher can assess whether the measurement model for each dimension fits the data, thereby determining whether the dimensions effectively represent the multifaceted nature of oncologist job competency. CFA is conducted within the measurement component of structural equation modeling (SEM), and model fit is evaluated using indicators such as the chi-square to degrees of freedom ratio, comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Convergent validity reflects the high intercorrelation of items within the same construct, indicating that they collectively explain a substantial proportion of the variance in the latent variable. It is evaluated using standardized factor loadings, average variance extracted (AVE), and construct reliability (CR). Discriminant validity assesses whether distinct constructs are

statistically distinguishable from each other. It requires that the square root of each construct's AVE exceeds the squared correlation coefficients between that construct and all others.

iii. Criterion-related validity

Criterion-related validity refers to the model's predictive power and practical applicability, assessed by the statistical strength of association between the model's evaluation results and an individual's actual job performance or other key external criteria. This study systematically examines the structural relationships between the dimensions of oncologists' job competency and their job performance in the hypothesis testing section, thereby evaluating the criterion-related validity of the proposed competency model.

(4) Correlation analysis and regression analysis

To further investigate how different competency dimensions influence oncologists' job performance, this study employs Pearson correlation analysis and multiple regression analysis. Pearson correlation analysis is used to assess the linear relationships among the dimensions of job competency as well as between each dimension and job performance. Multiple regression analysis is applied to examine how these dimensions jointly predict oncologists' job performance. In the regression model, job performance serves as the dependent variable, while knowledge and skills, physician–patient communication, scientific innovation, ethics and law, team collaboration, and digital and intelligent healthcare are treated as independent variables. The model further examines both the direct effects of these dimensions and their potential interaction effects on performance.

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Chapter 4: Data Results and Analysis

4.1 Text analysis and model construction

4.1.1 Word frequency and clustering results

(1) Word frequency analysis

The results of the keyword frequency analysis of the interview data generated using KH Coder are summarized in Table 4.1.

Table 4.1 Findings from the frequency analysis

Ranking	Keyword	Frequency	Context
1	Patient	153	Addressing patients' anxiety requires physicians to engage in attentive listening and sustained companion.
2	Treatment	129	Treatment planning should be informed by clinical guidelines while also adapted to individual patient characteristics.
3	Communication	92	Clear and effective communication reduces the risk of misunderstanding and helps prevent medical disputes.
4	Team	84	In multidisciplinary team (MDT) settings, close communication with surgical and radiation oncology colleagues is critical to decision-making.
5	Research	63	Research competence is a key pathway for early-career physicians to distinguish themselves.
6	Ethics	54	Palliative care decisions often involve ethical deliberations and trade-offs.
7	Artificial Intelligence	33	Artificial intelligence is already being incorporated into interventional workflows—for example, in pathology interpretation and radiological decision support.

The most frequent keywords underscore the centrality of a "patient-centered" approach in oncologists' work, while also emphasizing the recurrent co-occurrence of key competency terms such as "multidisciplinary collaboration", "humanistic communication", "clinical research", "ethical awareness", and "artificial intelligence".

(2) Co-occurrence network analysis

To investigate the semantic relationships among key terms, this study employs co-occurrence network analysis using KH Coder 3.0. The findings are as follows:

i. The term "patient" shows strong co-occurrence with "communication", "emotional support", "prognostic decision-making", and "family communication", highlighting the central role of clinician–patient interaction and psychological support in managing serious illnesses.

ii. "Treatment" frequently co-occurs with "guidelines", "precision", "CAR-T",

“multidisciplinary”, and “imaging”, indicating that modern oncology care relies not only on foundational knowledge but also on the integration of advanced technologies and multidisciplinary approaches.

iii. “Research” forms a dense co-occurrence network with “data analysis”, “clinical trials”, “translation”, and “interdisciplinary collaboration”, highlighting key dimensions of scientific innovation.

iv. “Ethics” is associated with “palliative care”, “autonomy”, “overtreatment”, and “quality of life”, reflecting the pervasive role of ethical considerations throughout the care continuum.

v. “Team” is connected with “resource coordination”, “training responsibilities”, and “collaborative communication”, underscoring the increasing importance of organizational and interdisciplinary competencies among physicians.

(3) Cluster analysis

High-frequency keywords are grouped using Ward’s hierarchical clustering method, KH Coder initially identifies a set of keyword clusters. After parameter optimization, a total of 29 stable clusters are obtained. To ensure the semantic validity of the clustering results, further manual verification is conducted. First, two researchers are invited to independently assign thematic labels to all 29 clusters, yielding an initial inter-rater agreement of 83.5% (24/29). For the five clusters with inconsistent labeling, consensus is reached through discussion. Second, the clustering results are mapped back to the original interview context for item-by-item examination to identify and eliminate misclassifications arising from high-frequency co-occurrence patterns with weak semantic associations. A total of six such cases are identified and removed, resulting in 23 valid revised clusters. Finally, based on thematic similarity, the 23 revised clusters are further integrated into six core competency clusters. These clusters are named with reference to relevant literature (see Table 4.2), and the detailed results of the cluster analysis are presented in Table 4.3.

Table 4.2 Sources for thematic clustering of core themes

Dimensions	Theoretical Sources
Knowledge and skills	ACGME Medical Knowledge(Accreditation Council for Graduate Medical Education, 2025), National Standard for Resident Training of China (Chinese Medical Doctor Association, 2022)
Clinician–patient communication	CanMEDS Communicator (Frank et al., 2015), Calgary-Cambridge Model (Kurtz et al., 2003)
Scientific innovation	GMA research competency framework (Accreditation Council for Graduate Medical Education, 2025; Frank et al., 2015)
Ethics and law	Beauchamp and Childress’s Four Principles of Biomedical Ethics (Beauchamp & Childress, 2013; Frank et al., 2015)
Team	IPEC Competency Domains (Frank et al., 2015; Interprofessional Education

collaboration	Collaborative, 2023)
Digital and intelligent healthcare	WHO Digital Health Framework (World Health Organization, 2022), DHT Competency Model (Medical Device Innovation Consortium, 2025)

Table 4.3 Results of cluster analysis

Cluster	Keywords	Core Themes	Competency Reflected
A	guidelines, precision, imaging, biology	professional knowledge and clinical techniques	knowledge and skills
B	communication, family members, emotions, prognosis	emotional support and physician–patient communication	physician–patient communication
C	trials, data, artificial intelligence, translation	research capability and technology integration	scientific innovation
D	palliative care, autonomy, ethics, disputes	clinical ethics and legal awareness	ethics and law
E	collaboration, organization, resources, education	team management and organizational coordination	team collaboration
F	intelligence, data, tools, emerging technologies	digital intelligence and clinical decision-making	digital and intelligent healthcare

4.1.2 Identified competency dimensions

Based on the preceding literature review and the aforementioned text analysis, the competencies of oncologists can be systematically summarized into six core dimensions: knowledge and skills, clinician–patient communication, scientific innovation, ethics and legal issues, team collaboration, and digital and intelligent healthcare. To further clarify the specific competencies of oncologists, this study conducts an in-depth analysis within each cluster. Keywords reflecting similar behavioral implications are grouped together, and specific actions are abstracted into broader competency constructs—for example, “interpreting diagnostic tests”, “developing treatment plans”, and “applying clinical guidelines” are integrated into the domain of “precision diagnostic and therapeutic capability”. In total, 19 distinct competency attributes are identified. Each dimension and its associated competency attributes are elaborated in the following sections.

(1) Knowledge and skills

Knowledge and skills serve as the foundational dimension of the oncologist competency framework, integrating core theoretical understanding with its application in practice. This includes, first, a firm command of fundamental disciplines such as tumor biology and molecular biology, which provide essential insight into the nature of cancer. Second, the ability to interpret molecular testing results and design personalized treatment strategies is key to meeting the growing demand for precision in oncology care. Third, a strong capacity for multidisciplinary collaboration, along with active participation in MDT discussions, is essential for improving

diagnostic accuracy and treatment coordination. Finally, staying current with cutting-edge therapeutic innovations, such as CAR-T cell therapy and mRNA-based vaccines, demonstrates the importance of continuous learning and technological adaptability.

(2) Physician–patient communication

Effective communication in oncology requires not only linguistic clarity but also a deep sense of humanistic care. Emotional support is fundamental. Physicians must be able to respond with empathy and provide psychological reassurance when patients experience distress, anxiety, or fear. Equally important is the ability to communicate medical information clearly and accessibly, helping patients understand their diagnosis, treatment options, and expected outcomes. Cultural adaptability is also essential. Physicians should be able to tailor their communication to patients from diverse cultural, religious, or linguistic backgrounds, thereby fostering mutual trust and minimizing the risk of misunderstanding or conflict.

(3) Scientific innovation

Scientific innovation serves as an essential driver of both professional growth and progress in the field of oncology. Oncologists are not only consumers of knowledge but also active contributors to the generation of medical evidence. Competent oncologists demonstrate scientific literacy and critical thinking and are able to identify clinical problems, formulate research questions, and explore them through approaches such as epidemiological studies, clinical trials, and basic research. They must stay attuned to the evolving scientific landscape, actively following global research trends to enhance their scholarly acuity. Interdisciplinary collaboration is also essential. Oncologists should be prepared to engage with fields such as artificial intelligence and bioinformatics to facilitate the integration of emerging technologies and advance clinical innovation.

(4) Ethics and law

Oncologists must possess robust ethical and legal competencies to navigate the complex challenges that arise in both clinical care and research. This includes the ability to exercise sound ethical judgment to make balanced decisions between life-prolonging treatments and quality of life, while honoring patient autonomy. It also entails strict adherence to research ethics, ensuring that patient rights, informed consent, and ethical oversight are fully upheld throughout clinical studies. In addition, physicians must be well-versed in relevant healthcare laws and regulations to respond appropriately and lawfully to medical disputes or policy changes.

(5) Team collaboration

Oncology treatment relies heavily on a multidisciplinary team (MDT) model that integrates

surgery, medical oncology, radiation therapy, pathology, imaging, nursing, and other specialties. Consequently, team collaboration skills have become indispensable competencies for oncologists. Physicians need to communicate effectively across diverse specialties and participate in shared decision-making, often serving as coordinators and facilitators within team discussions to enhance overall treatment outcomes. Furthermore, as healthcare systems grow more complex and structured, oncologists are expected to possess management and leadership skills, including overseeing operations, ensuring quality control, supporting departmental development, and training staff.

(6) Digital and intelligent healthcare

Digital and intelligent healthcare captures oncologists' capacity to adapt and thrive in a digitally driven, AI-enhanced clinical environment. This encompasses three key areas: first, foundational data literacy, enabling the interpretation of both structured and unstructured data, such as from big data platforms, pathological images, and clinical metrics. Second, proficiency in utilizing intelligent tools, including AI-assisted diagnostic systems, advanced imaging analysis software, and electronic health records, to improve decision-making speed and care quality. Third, a clear understanding of the ethical risks and practical boundaries of digital healthcare, including issues like algorithmic bias and data privacy, ensuring that technology is applied responsibly and a patient-centered manner. Physicians with competencies in digital and intelligent healthcare are well-equipped to navigate the evolving healthcare landscape and enhance clinical outcomes.

Overall, the competency framework for oncologists should be systematically developed and enhanced within a comprehensive structure encompassing solid foundation, effective communication, robust research, ethical integrity, collaborative teamwork, and technological proficiency. These six components are both independent and interrelated, jointly constituting the core capabilities essential for delivering high-quality oncology care in the modern era. It should be noted that "health advocacy", identified as one of the core roles in the internationally recognized CanMEDS framework, does not emerge as an independent semantic cluster in the present text analysis. The reasons for its exclusion from the model, as well as the implications for future research, are discussed in Chapter Five ("Limitations and Future Directions").

4.2 Validation of the competency model

4.2.1 Descriptive statistics of the sample

The composition of the sample is shown in Table 4.4. In terms of gender composition, female oncologists represent a substantially larger proportion of the sample (64.32%) compared to their male counterparts (35.68%). This distribution pattern may reflect the current gender profile within the medical profession, particularly in the field of oncology. Alternatively, it may be associated with the convenience of sample access in the study context.

With respect to years of professional experience, the sample demonstrates a markedly concentrated distribution. A substantial majority of respondents (97.24%) report 0–5 years of clinical experience, while only 2.76% have been in practice for 6–10 years. This distribution indicates that the study cohort predominantly comprises early-career oncologists. While this composition provides valuable insight into the specific competency demands and developmental challenges encountered in the early stages of oncology practice, it also limits the generalizability of the findings to more experienced practitioners, thereby necessitating cautious interpretation when extending the conclusions to senior oncologists. Future research may benefit from expanding the sampling scope to include a broader range of career stages, thereby offering a more comprehensive understanding of the oncologists' competency profiles across different stages of professional development.

In terms of professional title distribution, physicians with no professional title (41.71%) and those holding junior professional titles (52.01%) constitute the vast majority of the sample, together accounting for 93.72%. Only a small proportion of participants (6.28%) hold intermediate professional titles, and no physicians with senior professional titles are represented. This title composition closely aligns with the distribution of years in practice, further confirming that the sample is largely composed of early-career oncologists. This is particularly meaningful for understanding their competency development needs in areas such as clinical skill enhancement, professional role formation, and research capacity building.

Table 4.4 Descriptive statistics of the sample

Category		Number of Respondents	Proportion
Gender	Male	142	35.68%
	Female	256	64.32%
Years of Professional Experience	0-5 years	387	97.24%
	6-10 years	11	2.76%
Professional Title	No professional title	166	41.71%
	Junior professional title	207	52.01%

	Intermediate professional title	25	6.28%
	Bachelor's degree	87	21.86%
Educational Attainment	Master's degree	133	33.42%
	Doctoral degree	178	44.72%
Major of Highest Degree	Oncology	175	43.97%
Obtained	Others	223	56.03%

4.3.2 Reliability analysis

(1) Knowledge and skills

Table 4.5 below shows that the overall Cronbach's alpha coefficient for the "knowledge and skills" dimension scale is 0.9225. According to Nunnally and Bernstein (1994), a Cronbach's alpha exceeding 0.90 indicates outstanding internal consistency, reflecting a very high level of reliability with measurements that are both stable and dependable. A detailed examination of the contribution of individual items is as follows:

First, the corrected item-total correlation (CITC) assesses the degree of association between each item and the total scale score, excluding the item itself. It is generally accepted that this coefficient should exceed 0.30 or 0.40 to indicate good item discrimination and alignment with the overall construct of the scale. In this dimension, all items exhibit coefficients ranging from 0.7399 to 0.8405, well above the recommended threshold, demonstrating a strong correlation with the latent construct of "knowledge and skills" and confirming their effectiveness in measuring this construct.

Second, the alpha if item deleted statistic is used to assess whether any individual item undermines the overall reliability of the scale. In this dimension, the Cronbach's alpha values if an item is deleted are all lower than the overall Cronbach's alpha of 0.9225, ranging from 0.8995 to 0.9138. This strongly indicates that all items in this dimension contribute positively to the internal consistency of the scale, with no evidence of redundancy or conceptual misalignment with the core construct.

Taken together, the "knowledge and skills" dimension scale exhibits outstanding internal consistency reliability in this study. All psychometric indices meet or surpass established benchmarks, underscoring the strong structural integrity of the scale. The six items consistently and reliably capture oncologists' competencies in the domain of knowledge and skills. This high level of reliability provides a robust empirical foundation for subsequent validity analyses and model construction, reinforcing the trustworthiness of the study's findings.

Table 4.5 Reliability analysis results of the knowledge and skills dimension

Item	Item-total correlation	Corrected item-total correlation	Alpha if item deleted	Total Cronbach's alpha
1. knowledge and skills 1	0.8185	0.7431	0.9131	0.9225
2. knowledge and skills 2	0.8131	0.7399	0.9138	
3. knowledge and skills 3	0.8965	0.8405	0.8995	
4. knowledge and skills 4	0.8657	0.8000	0.9053	
5. knowledge and skills 5	0.8326	0.7493	0.9125	
6. knowledge and skills 6	0.8701	0.8020	0.9051	

(2) Physician-patient communication

Reliability analysis of Table 4.6 indicates that the "physician-patient communication" dimension exhibits an exceptionally high Cronbach's alpha of 0.9288, well above the established threshold of 0.90 for excellent internal consistency (Nunnally & Bernstein, 1994). This indicates that the scale yields highly stable and consistent measurements, underscoring its robustness as an instrument for assessing communication-related competencies.

A detailed analysis of individual items is presented as follows:

First, the corrected item–total correlation (CITC) reflects the extent to which each item correlates with the total score of the remaining items in the scale. All four items in this dimension show strong correlations, ranging from 0.8173 to 0.8589. These values substantially exceed the commonly recommended thresholds of 0.30 and 0.40, confirming that each item reliably measures the core construct of physician-patient "communication" and maintains strong consistency with the overall scale.

Second, the alpha if item deleted statistic is used to examine how the overall reliability of the scale is affected when a specific item is removed. The results show that removing any item from this dimension leads to a reduction in the overall Cronbach's alpha, with values ranging from 0.9036 to 0.9116—all below the current overall alpha of 0.9288. This finding clearly indicates that each item within this dimension makes a substantial and positive contribution to the overall internal consistency of the scale, with no evidence of redundant items that are misaligned with the underlying construct or that detract from the scale's reliability.

Taken together, the "physician-patient communication" dimension scale demonstrates outstanding internal consistency reliability in the context of this study. All relevant reliability indicators exhibit strong performance, affirming the scale's ability to consistently and accurately assess oncologists' communication competence. This high degree of reliability provides a robust psychometric foundation for subsequent analyses based on this dimension, such as validity assessments and model development, thereby ensuring the overall quality and credibility of the study's measurement outcomes.

Table 4.6 Reliability analysis results of physician-patient communication dimension

Item	Item-total correlation	Corrected item-total correlation	Alpha if item deleted	Total Cronbach's alpha
1. Physician-patient communication 1	0.8855	0.8173	0.9116	0.9288
2. Physician-patient communication 2	0.8966	0.8321	0.9087	
3. Physician-patient communication 3	0.9064	0.8472	0.9057	
4. Physician-patient communication 4	0.9121	0.8589	0.9036	

(3) Scientific innovation

Reliability analysis in Table 4.7 indicates that the overall Cronbach's alpha for the "scientific innovation" dimension scale is 0.9111. According to widely accepted psychometric standards (Nunnally & Bernstein, 1994), this value indicates excellent internal consistency, suggesting that the scale provides stable and highly reliable measurements.

The item-level contributions are analyzed as follows:

First, the corrected item-total correlation (CITC) is used to assess the degree of association between each item and the total score of the scale (excluding the item itself). In this dimension, all four items show high correlation coefficients, ranging from 0.7863 to 0.8462. These values are well above the commonly accepted threshold of 0.40, indicating that each item is closely aligned with the underlying construct of "scientific innovation" and effectively captures its essential meaning.

Second, the "alpha if item deleted" statistic is used to assess whether any item weakens the overall reliability of the scale. The results show that removing any of the items in this dimension reduces the overall Cronbach's alpha, with values ranging from 0.8763 to 0.8888, all of which are below the overall alpha of 0.9111. This indicates that all items in this dimension contribute positively to the scale's internal consistency, with no redundancy or misalignment with the core construct.

In sum, the "scientific innovation" dimension scale demonstrates outstanding internal consistency in this study. All reliability indicators meet or exceed recommended psychometric criteria, supporting the conclusion that the scale reliably and consistently measures oncologists' competence in research. This solid reliability foundation provides a sound basis for subsequent analyses (e.g., validity testing and model development), thereby ensuring the quality of the research data and the credibility of the study's conclusions.

Table 4.7 Reliability analysis results of scientific innovation dimension

Item	Item-total correlation	Corrected item-total correlation	Alpha if item deleted	Total Cronbach's alpha
1. Scientific innovation 1	0.9049	0.8462	0.8763	0.9111
2. Scientific innovation 2	0.8975	0.8329	0.8788	
3. Scientific innovation 3	0.8673	0.7960	0.8879	
4. Scientific innovation 4	0.8653	0.7863	0.8888	

(4) Ethics and law

Reliability analysis in Table 4.8 indicates that the overall Cronbach's alpha for the "ethics and law" dimension is 0.9051. This value exceeds the 0.90 threshold and, according to Nunnally and Bernstein (1994), reflects excellent internal consistency, indicating that the scale produces stable and reliable measurements.

First, the corrected item-total correlation (CITC) measures the degree of association between each item (excluding the item itself). All five items in this dimension show strong correlations, ranging from 0.6906 to 0.8254. Although the CITC for Ethics 1 (0.6906) is slightly lower than the others, it remains well above the commonly recognized threshold of 0.30 or 0.40. This indicates that all items are strongly linked to the core construct of ethics and law and effectively differentiate levels of ethical competence.

Second, examining the alpha if item deleted statistic is used to assess how removing any specific item affects the scale's overall reliability. Results show that removing any item reduces the overall Cronbach's alpha, which falls between 0.8702 and 0.8997, all of which are below the overall alpha of 0.9051. This indicates that each item contributes positively and essentially to the scale's internal consistency, with no redundant or inconsistent items requiring removal.

In summary, the "ethics and law" dimension scale demonstrates excellent internal consistency in this study. All reliability metrics meet or exceed recognized psychometric standards, supporting the conclusion that the scale reliably assesses oncologists' competence in ethical decision-making and legal awareness. This robust reliability foundation provides a sound basis for subsequent analyses (e.g., validity testing and model development).

Table 4.8 Reliability analysis results of ethics and law dimension

Item	Item-total correlation	Corrected item-total correlation	Alpha if item deleted	Total Cronbach's alpha
1. Ethics and law 1	0.8070	0.6906	0.8997	0.9051
2. Ethics and law 2	0.8588	0.7707	0.8821	
3. Ethics and law 3	0.8936	0.8254	0.8702	
4. Ethics and law 4	0.8677	0.7890	0.8784	
5. Ethics and law 5	0.8319	0.7377	0.8892	

(5) Team collaboration

Reliability analysis in Table 4.9 indicates that the overall Cronbach's alpha for the "team collaboration" dimension is 0.9123. According to Nunnally and Bernstein (1994), a Cronbach's alpha above 0.90 signifies excellent internal consistency. The alpha coefficient in this dimension exceeds this threshold, indicating that the five items are highly consistent and reliably measure oncologists' competence in team collaboration.

Further analysis of individual items supports this conclusion:

First, the corrected item-total correlation (CITC) evaluates the degree of association between each item and the total score (excluding the item itself). All items in this dimension show strong correlations, ranging from 0.7544 to 0.8149. These values substantially exceed the commonly accepted thresholds of 0.30 to 0.40, indicating that each item aligns closely with the latent construct of team collaboration and effectively discriminates among respondents' performance on this dimension.

Second, the alpha if item deleted statistic is used to assess whether removing any item would improve the scale's overall reliability. The results show that removing any item from the "team collaboration" dimension reduces the overall Cronbach's alpha, with values ranging from 0.8849 to 0.8981, all of which are below the overall alpha of 0.9123. This indicates that each item positively contributes to the scale's internal consistency and is important for measuring oncologists' competence in team collaboration.

In sum, the "team collaboration" dimension scale demonstrates outstanding internal consistency in this study. All reliability indicators perform well, supporting the scale's stability and dependability in assessing oncologists' collaborative abilities. This high level of reliability provides a sound basis for subsequent analyses (e.g., validity testing and model development).

Table 4.9 Reliability analysis results for the team collaboration dimension

Item	Item-total correlation	Corrected item-total correlation	Alpha if item deleted	Total Cronbach's alpha
1. Team collaboration 1	0.8489	0.7651	0.8952	
2. Team collaboration 2	0.8366	0.7544	0.8981	
3. Team collaboration 3	0.8711	0.7818	0.8928	0.9123
4. Team collaboration 4	0.8908	0.8149	0.8849	
5. Team collaboration 5	0.8619	0.7833	0.8915	

(6) Digital and intelligent healthcare

Reliability analysis in Table 4.10 indicates that the Cronbach's alpha for the "digital and intelligent healthcare" dimension is 0.9027. According to Nunnally and Bernstein (1994), a coefficient above 0.90 reflects excellent internal consistency. This result indicates that the scale reliably captures oncologists' competence in digital and intelligent healthcare, with

measurements that are stable and consistent.

The item-level contributions are analyzed as follows:

First, the corrected item-total correlation (CITC) assesses how strongly each item relates to the total score of the remaining items (excluding the item itself). Across all five items in this dimension, the correlation values range from 0.6841 to 0.7994, indicating consistently strong associations. Although the CITC for Item 3 (0.6841) is comparatively lower, it remains well above the commonly accepted thresholds of 0.30 to 0.40. This indicates that all items are strongly associated with the underlying construct of digital and intelligent healthcare and effectively differentiate levels of competence in digital and intelligent healthcare practice.

Second, the alpha if item deleted statistic is used to assess whether removing any item would enhance overall reliability. The results show that removing any item would reduce the overall alpha, with values ranging from 0.8721 to 0.8962, all of which are below the overall alpha of 0.9027. This indicates that each item contributes positively to the scale's internal consistency, with no evidence of redundancy or conceptual misalignment.

In summary, the "digital and intelligent healthcare" dimension demonstrates excellent internal consistency within the context of this study. All reliability indicators meet or exceed established psychometric benchmarks, supporting the scale's stability and accuracy in measuring oncologists' digital healthcare competencies. This robust reliability provides a sound basis for analyses (e.g., validity testing and model development).

Table 4.10 Reliability analysis results of the digital intelligent healthcare dimension

Item	Item-total correlation	Corrected item-total correlation	Alpha if item deleted	Total Cronbach's alpha
1. Digital and intelligent healthcare 1	0.8547	0.7661	0.8792	0.9027
2. Digital and intelligent healthcare 2	0.8485	0.7572	0.8811	
3. Digital and intelligent healthcare 3	0.7958	0.6841	0.8962	
4. Digital and intelligent healthcare 4	0.8673	0.7795	0.8764	
5. Digital and intelligent healthcare 5	0.8751	0.7994	0.8721	

4.2.3 Validity testing

As noted previously, this study assesses the validity of the oncologists' competency scale

through tests of content validity and construct validity, thereby ensuring the quality of the data employed in the analysis.

(1) Content validity testing

In this study, multiple strategies are employed to ensure strong content validity of the competency scale for oncologists. First, five domain experts are invited to systematically evaluate the content of the scale to examine whether the items adequately represent the intended construct and provide revision suggestions accordingly. Second, during the localization of the original English version of the scale, the research team strictly adheres to Brislin's "forward translation–back translation–revision" protocol (Brislin, 1980) . The team ensures semantic equivalence to enhance the cultural adaptability and linguistic equivalence of the Chinese version. Finally, this study conducts item-by-item reviews and iterative refinements to identify and amend potentially ambiguous or misleading formulations, thereby improving respondent comprehension and response accuracy. These coordinated procedures collectively strengthen the content validity of the scale.

(2) Construct validity testing

This section presents the construct validity results of oncologists' job competency, focusing on three aspects: overall model fit, convergent validity, and discriminant validity.

i. Overall model fit

To evaluate the construct validity of the proposed competency model for oncologists, this study conducts a confirmatory factor analysis (CFA) using the dataset in Stata 17.0. CFA serves to assess how well the hypothesized factor structure—that is, the theoretical model—fits the observed data. The overall model fit indices are summarized in Table 4.11.

As shown in Table 4.11, the chi-square statistic (χ^2) equals 11,261.915 with 362 degrees of freedom (df). Because the chi-square test is highly sensitive to sample size—especially in large samples such as the present one (n = 398)—its significance is expected. Consequently, relative fit indices are considered more informative (Bentler & Bonett, 1980). The chi-square to degrees of freedom ratio (χ^2/df) is 3.49. According to widely accepted criteria, a χ^2/df value below 3 indicates good model fit, while values below 5 are generally considered acceptable (Carmines et al., 1981; Wheaton et al., 1977). The χ^2/df value of 3.49, although slightly above the ideal threshold, remains within the acceptable range, indicating an adequate level of model-data fit.

The analysis then turns to absolute fit indices. The Root Mean Square Error of Approximation (RMSEA) is 0.079. According to Browne and Cudeck (1993), RMSEA values below 0.08 indicate acceptable model fit, while those below 0.05 reflect excellent fit. The value observed here suggests that the model achieves a satisfactory level of approximation to the data.

Incremental fit indices are also evaluated. The Comparative Fit Index (CFI) is 0.916, and the Tucker–Lewis Index (TLI, also known as the Non-Normed Fit Index) is 0.906. Both exceed the conventional threshold of 0.90, indicating that the model demonstrates a substantial improvement over the null model and satisfies the criterion for good fit (Hu & Bentler, 1999).

Finally, the model's parsimony-related fit is assessed using the Standardized Root Mean Square Residual (SRMR), which is 0.048. Following Hu and Bentler (Hu & Bentler, 1999), SRMR values below 0.05 denote excellent fit, and those under 0.08 indicate acceptable fit. The SRMR observed in this study meets the criterion for excellent fit, suggesting minimal average discrepancy between the predicted and observed covariance matrices.

Taken collectively, the fit indices provide robust empirical support for the adequacy of the proposed theoretical model. Although the χ^2/df ratio marginally exceeds the most stringent ideal threshold, all other major indicators—including the RMSEA, CFI, TLI, and notably the SRMR—meet or exceed widely accepted benchmarks for good model fit, with the SRMR falling well within the range indicative of excellent fit. These findings substantiate the structural validity of the oncologists' competency model, suggesting that the specified factor structure accounts well for the observed covariation among measured indicators in the sample.

Table 4.11 CFA fit indices of the model proposed in this study

χ2	df	χ2/df	RMSEA	CFI	TLI	SRMR
11261.915	362	3.49	0.079	0.916	0.906	0.048

After confirming that the overall model fit of the oncologist competency scale meets acceptable thresholds, this study further examines the internal parameter estimates, focusing on the standardized factor loadings of each observed variable on its corresponding latent construct and their statistical significance. Table 4.12 presents the detailed results. As shown in the table:

First, all observed indicators exhibit substantial standardized loadings on their respective latent constructs. Specifically, the loadings range from 0.746 for item SZ3 (digital and intelligent healthcare) to 0.911 for item GT3 (physician–patient communication). According to established criteria (Nunnally & Bernstein, 1994), factor loadings above 0.50 indicate adequate representation of the latent construct, while values above 0.70 suggest strong item–construct relationships. All items in this study exceed the 0.70 benchmark, indicating that each item serves as a strong and reliable indicator of its underlying construct. These findings provide strong empirical support for the convergent validity of the scale.

Second, the z-values of all path coefficients (i.e., the ratio of the parameter estimates to their standard errors) substantially exceed 2.58, which is the critical threshold for a two-tailed test at the 0.01 significance level (α). Specifically, all z-values in this study exceed 30,

indicating that the factor loadings of all observed indicators on their respective latent variables are statistically significant at $p < 0.001$. This confirms that the relationships between observed indicators and latent variables are statistically reliable.

Overall, the parameter estimates within the oncologist competency measurement model demonstrate strong validity. Each observed indicator effectively and significantly reflects its corresponding latent construct, with standardized factor loadings consistently at a high level. These results further support that the competency scale developed in this study possesses sound convergent validity, providing a solid foundation for subsequent analyses and applications based on this model.

Table 4.12 Fit Results of the oncologists' competency model

Path	Standardized path coefficient	standard Error	Z-value
KN1 ←-- Knowledge and Skills	0.770	0.022	34.35
KN2 ←-- Knowledge and Skills	0.775	0.022	35.17
KN3 ←-- Knowledge and Skills	0.867	0.015	58.91
KN4 ←-- Knowledge and Skills	0.849	0.016	52.50
KN5 ←-- Knowledge and Skills	0.786	0.021	37.16
KN6 ←-- Knowledge and Skills	0.853	0.016	53.88
GT1 ←-- Physician-patient. Communication	0.839	0.017	50.35
GT2 ←-- Physician-patient. Communication	0.859	0.015	57.01
GT3 ←-- Physician-patient. Communication	0.911	0.011	83.87
GT4 ←-- Physician-patient. Communication	0.909	0.011	83.02
KY1 ←-- Scientific Innovation	0.871	0.015	59.87
KY2 ←-- Scientific Innovation	0.900	0.012	73.13
KY3 ←-- Scientific Innovation	0.886	0.013	66.04
KY4 ←-- Scientific Innovation	0.818	0.019	43.59
LL1←-- Ethics and Law	0.785	0.022	35.91
LL2←-- Ethics and Law	0.805	0.020	40.69
LL3←-- Ethics and Law	0.860	0.016	55.10
LL4←-- Ethics and Law	0.830	0.018	45.73
LL5←-- Ethics and Law	0.787	0.021	36.82
XZ1←-- Team Collaboration	0.838	0.017	49.38
XZ2←-- Team Collaboration	0.823	0.018	45.24
XZ3←-- Team Collaboration	0.799	0.020	39.39
XZ4 ←-- Team Collaboration	0.834	0.018	47.46
XZ5 ←-- Team Collaboration	0.825	0.018	45.84
SZ1 ←-- Digital and Intelligent Healthcare	0.846	0.017	50.32
SZ2 ←-- Digital and Intelligent Healthcare	0.778	0.022	34.99
SZ3 ←-- Digital and Intelligent Healthcare	0.746	0.024	30.56
SZ4 ←-- Digital and Intelligent Healthcare	0.829	0.018	45.60
SZ5 ←-- Digital and Intelligent	0.831	0.018	45.71

Healthcare

The Average Variance Extracted (AVE) and Composite Reliability (CR) values for each dimension are calculated based on the standardized factor loadings of the corresponding measurement indicators. The results are presented in Table 4.13. As shown in Table 4.13, the AVE values for each dimension of oncologists' job competency range from 0.651 to 0.775, all exceeding 0.50; and CR ranges from 0.903 to 0.932, well above 0.70. Both findings indicate satisfactory convergent validity of the measurement model. For all six dimensions, namely, knowledge and skills, patient–physician communication, scientific innovation, ethics and law, team collaboration, and digital and intelligent healthcare, the AVE values are greater than the squared correlations between each dimension and the others. Therefore, this study concludes that oncologists' competency is composed of six distinct dimensions and demonstrates good discriminant validity.

Table 4.13 AVE and CR of all job competency dimensions of oncologists

	Knowledge and skill	Physician-patient communication	Scientific innovation	Ethics and law	Team collaboration	Digital and intelligent healthcare
Knowledge and skill	(0.669)					
Physician-patient communication	0.500	(0.775)				
Scientific innovation	0.464	0.362	(0.756)			
Ethics and law	0.486	0.616	0.501	(0.672)		
Team collaboration	0.473	0.501	0.456	0.666	(0.679)	
Digital and intelligent healthcare	0.497	0.438	0.500	0.537	0.666	(0.671)
CR	0.924	0.932	0.925	0.907	0.914	0.903

Note: Values in parentheses denote the average variance extracted (AVE); values without parentheses indicate the squared inter-dimension correlations.

Table 4.11 shows that the model fit indices meet the recommended thresholds, with $\chi^2/df = 3.49$, RMSEA = 0.079 (<0.08), CFI = 0.916, and TLI = 0.906. Table 4.12 shows that all standardized factor loadings in the six-dimensional model of oncologists' job competency exceed 0.70, which indicates that each item validly measures its corresponding latent construct, demonstrating sound convergent validity to some extent. Table 4.13 further shows that the six-dimensional structure exhibits satisfactory convergent and discriminant validity. Taken together, these results support the statistical adequacy and discriminant validity of the six-dimensional model.

4.3 Relationship between competency and performance

4.3.1 Performance framework and indicators

(1) Definition of performance

Performance is typically defined as the observable work behaviors and measurable outcomes demonstrated by an organization or individual within a specific period, reflecting their level of achievement and the extent to which goals are attained. Performance reflects not only a composite expression of efficiency and output but may also be influenced by variables such as years of service, age, professional title, and job position. However, as performance is inherently multidimensional, its measurement and interpretation often depend on the observer's perspective, which may vary across organizational, team, and individual levels, thereby contributing to the ongoing debate over its definition in academic discourse. Current mainstream perspectives can be broadly categorized into three orientations: results-oriented, behavior-oriented, and an integrative approach combining both behavior and results.

The first perspective emphasizes the outcome dimension of performance, equating it with the results or output achieved by employees in specific positions. This view has historical roots in Frederick W. Taylor's concept of piece-rate pay, which advocates for evaluating employee performance based on quantifiable output. As one of the pioneers of industrial psychology, Hugo Munsterberg defined performance in the early 20th century as a reflection of work outcomes (Hollingworth, 1913). Later, Bernardin et al. (1995) describe performance as "the record of outcomes produced by specific activities", thus defining it as the results derived from job functions within a defined temporal and spatial context.

The second perspective centers on the behavioral process of performance, suggesting that it is not merely reflected in outcomes but also in the series of observable actions undertaken by employees during task execution. Campbell et al. (1973) argue that performance should be defined in terms of employees' behavioral manifestations, rather than relying solely on end results. Campbell (1990) further emphasizes that performance should be conceptualized as a set of employee behaviors that fall within their control and align with organizational objectives. Rotundo (2002) reinforces the notion of performance as an agentic process, stressing that the significance of performance behavior lies in its direct contribution to organizational goal attainment. This perspective highlights the processual, malleable, and developmental aspects of behavior, making it particularly applicable to jobs where performance outcomes are difficult to quantify but the behavioral processes are of high intrinsic value, such as in management,

research and development, and healthcare settings.

As research evolves, scholars increasingly recognize the limitations of approaches that focus exclusively on either behavior or results. An excessive emphasis on outcomes may overlook contextual constraints and the effort exerted during the process, while an exclusive focus on behavior may lead to distorted performance evaluations. Consequently, a growing body of research advocates an integrated approach that combines behavior and outcomes in performance evaluation. Barry and Stewart (1997) propose that performance encompasses both the behaviors directed toward achieving work goals and the tangible results produced by those behaviors. Behavior serves not only as a means to performance but also as an integral component of performance assessment. Chen (2011), in his literature review, asserts that performance represents a unified manifestation of behavior, competence, and outcomes. Empirical findings by Mathew et al. (2012) also demonstrate that performance is composed of both behavioral and outcome-based dimensions.

There is a growing consensus in the academic community that performance should be defined through an integrative lens, giving weight to both the specific behaviors employees exhibit in organizational tasks and the results those behaviors generate. This study follows this approach by defining individual job performance as a series of observable behaviors closely aligned with job responsibilities, along with the organizational outcomes resulting from these behaviors. The study specifically focuses on oncologists' job competency and examines its relationship with their job performance. Given the high complexity of cancer care and its inherently multidisciplinary nature, the job performance of oncologists extends beyond individual clinical competence to encompass their central roles in collaborative decision-making, research translation, technological innovation, and comprehensive patient management across the full continuum of care.

(2) Structure of performance

As a core variable in organizational behavior research, job performance consistently draws significant attention from both academic and practical domains regarding its structural composition. Daniel Katz and Robert L. Kahn (1978) are the first to propose a structural framework for individual performance, categorizing organizational behavior into three types: willingness to join and remain in the organization, execution of core task behaviors essential for fulfilling job responsibilities, and spontaneous behaviors that go beyond formal role expectations. This categorization establishes a foundational framework for subsequent studies on performance structure. Building upon a systematic review of prior literature, John P.Campbell (1990) proposes an eight-dimensional model of job performance, encompassing

task-specific proficiency, non-task-specific proficiency, written and oral communication, personal discipline, effort, peer support, supervision and leadership, as well as managerial and administrative capabilities. This model marks a transition in performance research from a focus on task-based behavior to a multidimensional conceptualization.

However, some scholars criticize this model for overemphasizing behaviors while overlooking their external outcomes for organizational performance. In response to such reflections, Borman and Motowidlo (1993) introduce a seminal two-dimensional framework that distinguishes between task performance and contextual performance. Task performance refers to an employee's ability to complete explicitly defined duties outlined in the job description, emphasizing goal-directedness and outcome orientation, and is typically closely linked to knowledge, skills, and experience. In contrast, contextual performance focuses on organizational citizenship behaviors—such as voluntarily assisting colleagues, adhering to organizational rules, and demonstrating professionalism—which, although not directly tied to output, play a crucial role in maintaining operational efficiency and shaping organizational culture. This dimension is particularly salient in the Chinese context, where interpersonal relationships and collectivist values are deeply embedded; consequently, contextual performance often carries greater weight in performance evaluations. In further research, Van Scotter and Motowidlo (1996) refine contextual performance into two subdimensions: job dedication and interpersonal facilitation. The former reflects an employee’s proactive commitment to organizational responsibilities, such as adherence to rules and perseverance in the face of difficulties; the latter pertains to behaviors that foster positive interpersonal interactions and enhance organizational cohesion.

As organizational environments become increasingly dynamic, the traditional two-dimensional framework proves insufficient for capturing employees’ capacity to adapt to rapid changes. In response, Allworth and Hesketh (1997) propose adaptive performance as the third dimension of job performance and substantiate it through empirical analysis. Johnson (2001) emphasizes that adaptive performance reflects an employee’s behavioral flexibility in response to environmental, task-related, and occupational changes.

Although this dimension has gained broad acceptance, some scholars question its conceptual overlap with task and contextual performance. To enhance its structural clarity and practical applicability, Pulakos et al. (2000) develop an eight-dimension model of adaptive performance, encompassing emergency handling, problem-solving, stress management, learning new tasks, cross-cultural interaction, and more. Follow-up studies further refine these dimensions using supervisor-based evaluations (Pulakos et al., 2002). In the Chinese context,

Sun and Jiao (2002), drawing on semi-structured interviews and the Delphi method, propose a three-dimensional model comprising task performance, individual trait performance, and interpersonal performance. Wen (2005) constructs a four-dimensional framework of task, adaptive, effort, and interpersonal performance based on survey data, and validates its structural integrity. Han et al. (2007) apply the critical incident technique and structural equation modeling to develop a four-dimensional model including relational performance, task performance, innovation performance, and learning performance, which further expands the depth of performance research.

More recently, Tao and Wang (2006), building on Pulakos' eight-factor framework, conduct empirical analysis on 334 samples and distill four critical dimensions: stress and crisis management, innovative problem-solving, continuous learning, and interpersonal-cultural adaptability. These dimensions offer a theoretical foundation for training assessment. Charbonnier-Voirin and Roussel (2012) incorporate adaptive performance into performance structure models. They propose a three-dimensional framework of task–relational–adaptive performance, thereby enhancing the explanatory power of performance across diverse organizational contexts.

Some scholars also advocate for the inclusion of dimensions such as learning performance and innovation performance to better reflect the demands of highly complex roles. Nevertheless, the task–relational–adaptive three-dimensional structure has become the prevailing consensus, particularly in highly dynamic sectors such as healthcare, the military, and aviation. In highly specialized and rapidly evolving fields such as oncology, adaptive performance is especially vital. Physicians must continually respond to emerging technologies, interdisciplinary collaboration, and unforeseen public health crises. Adaptive performance thus reflects not only clinical competence but also long-term professional growth potential. Accordingly, integrating adaptive performance into the performance framework for oncologists holds both theoretical significance and practical relevance.

4.3.2 Hypothesis on relationship between competency and performance

In early human resource assessment research, intelligence was widely regarded as an important predictor of individual job performance. However, as empirical research in this area has progressed, this assumption has increasingly been challenged within the academic community. Barrett and Depinet (1991) demonstrate that the correlation between intelligence test scores and job performance is weak. This weak correlation suggests the limited explanatory power of intelligence measures. Neisser et al. (1996) further note that although intelligence correlates

with certain cognitive tasks, its predictive power for job performance in real-world work contexts remains relatively limited. Since McClelland first introduced the concept of competence in his seminal 1973 article Testing for Competence Rather Than Intelligence (McClelland, 1973), there has been no universally accepted definition of the term; however, it is widely acknowledged that competence is closely associated with job performance and demonstrates strong predictive validity. Boyatzis (1991) further argues in his competency model that high-level individual performance results from the dynamic alignment of personal competence, organizational environment, and job demands. Therefore, the development of a performance-oriented talent assessment system should be grounded in competency research, with the aim of identifying core potentials and behavioral attributes that exhibit a causal relationship with high performance. Spencer and Spencer (1993) share a similar view, suggesting that competence refers to the deep-seated characteristics that enable individuals to perform effectively in specific contexts, and that these characteristics are linked to performance through observable causal pathways.

In healthcare, Xu (2023) contends that competency-based evaluations yield more accurate predictions of individual performance by focusing on clinicians' capabilities, behaviors, and outcomes during care delivery. Wu (2004) observes that core competencies exert a direct influence on job performance, while other competency elements affect performance indirectly through their interaction with these core attributes. Jin et al. (2004) find that different categories of competency attributes exert varying influences on performance. For example, relational competencies such as organizational coordination and team collaboration primarily affect interpersonal facilitation and dedication to work. Problem-solving competencies, including problem identification and integrative analysis, contribute significantly to the enhancement of task performance, whereas competencies related to integrity and responsibility serve as effective predictors of accountability and work commitment.

Lv (2006) argues that integrating competency profiles with job analysis enhances both the scientific rigor and practical applicability of performance appraisals. Wu et al. (2006) contend that employee performance arises from the interaction of individual attributes, organizational context, and job demands, such that no single factor alone can determine performance outcomes. Lin and Zhang (2010) demonstrate that competency-based evaluations in hospital settings assess both historical achievements and future potential, thereby mitigating one-sided judgments and reducing employee dissatisfaction.

Bonesso et al. (2020) show that behavioral competencies—encompassing emotional, social, and cognitive intelligence—positively influence individual performance, career progression,

and well-being, and can be developed through targeted training interventions. Park (2020) finds that the three dimensions of vocational competence—"knowing why", "knowing how", and "knowing who"—each exert a significant positive effect on perceived job performance, with "knowing why" and "knowing who" demonstrating particularly strong impacts. Lin (2021) reports in the e-commerce sector that project management competence enhances job performance, with intrinsic and extrinsic motivation acting as moderating factors. Huy and Phuc (2020) observe in Vietnamese public research institutions that a competency framework boosts research performance, with task frequency serving as a moderator.

Overall, competencies show a robust positive correlation with performance, influencing job performance directly and indirectly through interactions with other factors.

(1) Knowledge and skills and job performance

Oncologists' knowledge and skills form the cornerstone of their clinical performance. In the era of precision medicine, they need to master the fundamentals of tumor biology and molecular biology, apply established diagnostic and treatment principles for common malignancies, interpret genomic assays to tailor therapy, actively participate in multidisciplinary team (MDT) decision-making, stay current with cutting-edge modalities such as CAR-T and mRNA vaccines, and ground their treatment plans in the latest guidelines and evidence. Proficiency in these domains directly shapes clinical decision-making and patient outcomes. Evidence indicates that physicians with a solid grounding in tumor biology and molecular biology gain deeper insight into tumorigenesis and progression, thereby enabling them to devise more effective treatment strategies. Moreover, the ability to interpret genomic findings accurately and translate them into precision treatment strategies has become pivotal for improving treatment efficacy and patient survival. A thorough understanding of and active participation in multidisciplinary team (MDT) processes allows clinicians to integrate multidisciplinary expertise and deliver individualized care plans that optimize overall treatment outcomes. Familiarity with innovative therapies such as CAR-T and mRNA vaccines expands treatment options for patients, particularly when conventional approaches prove insufficient. Formulating treatment decisions in line with current guidelines and cutting-edge research ensures that regimens remain both scientifically rigorous and state-of-the-art, thereby enhancing clinical outcomes. Thus, there is a pronounced positive association between knowledge and skills of oncologist and their clinical performance. Enhancing their knowledge and skills not only elevates individual performance but also bolsters team-based treatment outcomes and patient satisfaction.

Accordingly, the following hypothesis is proposed:

H1: Knowledge and skills have a positive effect on oncologists' job performance.

(2) Physician-patient communication and job performance

In oncology practice, physician–patient communication serves as a foundational professional skill and exerts a strong influence on physicians' clinical performance. Effective communication enhances patient understanding, adherence, and satisfaction, which in turn improves treatment outcomes and overall quality of care. To start with, cancer patients often experience anxiety and depression. When clinicians offer meaningful emotional support, they alleviate distress and strengthen patients' confidence in treatment. Studies show that emotional well-being significantly affects adherence and quality of life, and that clinician-provided support improves both psychological health and treatment engagement (Epstein & Street Jr, 2007). Second, oncology treatment regimens are often complex and high-risk. Clear and patient-centered explanations provided to patients and their families foster informed decision-making and trust. Research links the clarity of clinician communication to patient satisfaction, showing that well-communicated information deepens understanding and involvement in treatment decisions and thereby enhances outcomes (Schmid Mast et al., 2005). In palliative care, oncologists undertake substantial emotional labor. Providing comprehensive information and empathy helps patients and families navigate the end-of-life journey and make care choices aligned with their wishes. Clinical evidence shows that the quality of end-of-life communication correlates with satisfaction in terminal care (Back et al., 2020). Moreover, as cancer populations become more diverse, adapting communication to patients' cultural backgrounds is essential for effective dialogue and conflict reduction. Evidence indicates that culturally sensitive strategies markedly improve cross-cultural care quality and patient satisfaction (Betancourt et al., 2003).

Accordingly, the following hypothesis is proposed:

H2: Physician–patient communication competence has a positive effect on oncologists' job performance.

(3) Team collaboration and job performance

In contemporary oncology care systems, team collaboration has emerged as a central determinant of care quality, treatment effectiveness, and clinical performance. Oncologists' team collaboration skills—encompassing interdisciplinary coordination, professional communication, resource management, clinical teaching, and quality oversight—are critical not only to the development of feasible and evidence-based individualized treatment plans but also serve as key indicators of professional competence and clinical effectiveness. To start with, multidisciplinary collaboration, typically operationalized through multidisciplinary team (MDT)

coordination involving medical oncology, surgical oncology, radiation oncology, diagnostic imaging, and pathology, is foundational to the diagnosis and treatment of malignancies. Evidence shows that MDT-based approaches significantly enhance the accuracy and consistency of clinical decisions, improve patient prognosis, and reduce treatment delays (Prades et al., 2015; Stokes et al., 2016). An oncologist's ability to actively and effectively engage in team discussions and synthesize multidisciplinary input is a core dimension of performance assessment. Second, effective collaboration also requires physicians to demonstrate strong communicative competence. Clearly articulating domain-specific insights while integrating perspectives from other specialties is essential to high-functioning team dynamics. Oandasan and Reeves (2005) emphasize that effective interprofessional communication reduces medical errors, enhances patient safety, and ultimately improves treatment outcomes. In addition, senior oncologists frequently take on additional responsibilities in teaching and training within the team. Studies indicate that active involvement in clinical education enhances the professional capacity of the team, fosters deeper knowledge integration and professional identity for the teaching physician, and contributes to higher levels of engagement and performance (Beckman & Lee, 2009). Mentorship of junior colleagues further supports team-wide improvements in care quality and operational efficiency. Moreover, oncologists' ability to coordinate referrals, secure medication access, and manage resource allocation directly influences both the accessibility and continuity of care. As Gorin et al. (2017) highlight, resource coordination is increasingly vital in oncology, particularly amid the rapid advancement of precision medicine and targeted therapies, where timely access and optimal distribution can substantially affect therapeutic outcomes. Finally, quality and safety management further exemplify an oncologist's capacity for effective team collaboration. The ability to continuously identify process vulnerabilities, streamline care pathways, and reduce preventable errors is a defining feature of performance excellence in oncology departments (Pronovost et al., 2008). Oncologists who demonstrate these capacities often exhibit a stronger sense of responsibility and systems thinking, both of which are essential for advancing clinical quality and organizational outcomes.

Accordingly, the following hypothesis is proposed:

H3: Team collaboration competence has a positive effect on oncologists' job performance.

(4) Digital and intelligent healthcare and job performance

Amid the rapid advancement of digital and intelligent healthcare, technologies are being integrated into all aspects of oncology practice at an unprecedented pace, profoundly transforming diagnostic and therapeutic workflows as well as the paradigms for evaluating

physician performance. Oncologists' competence in big data analytics, AI-assisted diagnostics, electronic medical record (EMR) management, telemedicine, and the application of emerging digital technologies have become central to assessing their overall clinical competence and performance (Clauser et al., 2011). First, the extensive use of medical big data in oncology has enhanced the precision of clinical decision-making. By integrating data on patient cohorts, genomic profiles, treatment responses, and outcomes, clinicians can predict risk, refine disease subtyping, and optimize personalized treatment strategies. As Ghassemi et al. (2021) note, data-driven clinical models improve consistency in therapeutic decision-making and enhance the scientific validity of prognostic assessments, thereby strengthening physician performance. Second, AI-powered systems such as automated image interpretation, digital pathology, and AI-assisted radiotherapy planning have achieved notable breakthroughs across various oncology subspecialties. Evidence suggests that AI-assisted image interpretation systems can reduce false negatives in breast cancer screening by approximately 5% while improving sensitivity (McKinney et al., 2020), and that AI-driven pathology image classification now approaches the accuracy of experienced pathologists (Litjens et al., 2017). The ability to effectively deploy such tools is essential not only for maintaining high-quality care under workload pressures but also for optimizing individual clinical output. Third, proficiency in managing EMRs is a vital component of routine clinical practice. Efficient use of EMRs reduces clinical documentation errors, streamlines medical recordkeeping, and facilitates both research and quality control. Campanella et al. (2016) finds that data completeness and system security are directly associated with the incidence of patient safety events, which making EMR management a significant determinant of work quality and physician performance. Thus, the extent to which physicians can systematically manage EMRs reflects their digital literacy and adherence to clinical standards. Telemedicine plays an increasingly prominent role in multidisciplinary oncology consultations, follow-up care, and regional healthcare collaboration. In the post-pandemic era, teleconsultation has become a key strategy for addressing disparities in access to high-quality care and improving diagnostic efficiency. Wootton (2012) emphasizes that oncologists skilled in remote communication and telemedicine technologies are better positioned to serve patients in underserved regions, thereby enhancing treatment accessibility and satisfaction, and in turn, achieving higher performance evaluations. Furthermore, oncologists' ability to adopt a forward-looking mindset, understand and critically evaluate innovations such as AI, machine learning, and mobile health (mHealth), and integrate those innovations into practice demonstrates their adaptability and innovative capacity. As Jiang et al. (2017) note, this capacity for technological integration is expected to become a core component

of future competency frameworks for physicians, with direct implications for research productivity, clinical output, and scholarly impact.

Accordingly, the following hypothesis is proposed:

H4: Competence in digital and intelligent healthcare has a positive effect on oncologists' job performance.

(5) Scientific innovation and job performance

In contemporary medical systems, scientific innovation is a key indicator of physicians' professional development. This is particularly salient in oncology, where rapid advances demand that oncologists not only possess solid clinical skills but also the ability to translate scientific discoveries into practical care (Heath et al., 2003). From the perspective of direct competence–performance linkage, however, scientific innovation is not typically the primary driver of clinical performance. Rather, it exerts its influence indirectly, by amplifying or modifying the effects of other core competencies. This stems from the fact that scientific innovation is fundamentally an academic competence. Its influence manifests in knowledge generation, problem identification, cross-disciplinary integration, and reflective learning. In contrast, clinical performance is more immediately shaped by technical execution, communication, and service efficiency. Accordingly, scientific innovation can be conceptualized as a moderating variable that shapes how effectively physicians translate their knowledge and skills or apply digital and intelligent healthcare tools in clinical settings.

Oncologists' knowledge and skills constitute the foundation of their clinical practice, encompassing tumor biology, diagnostic and therapeutic pathways, genomic testing, and multidisciplinary team (MDT) collaboration. However, their capacity for scientific innovation can significantly influence how effectively these competencies translate into clinical performance. To start with, physicians with research competence are better positioned to distill key insights from cutting-edge studies and facilitate the translation of knowledge into clinical action. For example, oncologists skilled in interpreting statistical data, reviewing literature, and formulating hypotheses tend to more readily identify clinical gaps and propose actionable solutions (Bland & Ruffin, 1992). This capacity enhances their ability to tailor standardized protocols into personalized treatment plans, thereby improving clinical outcomes and patient satisfaction. Second, scientific innovation reflects a physician's ability for continuous learning and reflection, factors critical to the progressive refinement of clinical skills and long-term performance (Eva & Regehr, 2005). Empirical studies show that clinicians with a research background have higher patient survival rates, greater adherence to clinical guidelines, and superior performance metrics compared with their non-research counterparts (Lloyd et al.,

2004). In addition, research competence enhances physicians' professional authority and influence. Activities such as publishing in high-impact journals or leading research projects help consolidate their leadership within multidisciplinary teams, improving coordination, advancing treatment strategies, and ultimately driving performance. Thus, oncologists' capacity for scientific innovation strengthens the applicability and evolution of their clinical knowledge.

Accordingly, the following hypothesis is proposed:

H5: Scientific innovation positively moderates the relationship between oncologists' knowledge and skills and their job performance.

Although digital and intelligent healthcare tools such as AI-based diagnostics, electronic medical records (EMRs), and telemedicine are increasingly integrated into oncology practice—with demonstrated efficacy (Topol, 2019)—their impact on performance may be attenuated among research-oriented physicians due to a "research-dominant cognition". On one hand, research-oriented physicians often apply a critical lens to technology, emphasizing evidence-based reasoning and mechanistic understanding. As a result, they may express skepticism toward the opaque, "black box" algorithms used in AI systems (Ghassemi et al., 2021). Such cognitive preferences may undermine their trust in and reliance on digital tools, leading to reduced usage and operational efficiency. On the other hand, the considerable cognitive and temporal investment required for research activities such as grant writing, data mining, or manuscript preparation may limit their bandwidth to engage with digital tools in routine care. For instance, Kroth et al. (2019) finds that physicians with heavy research loads demonstrated significantly lower efficiency and consistency in EMR use, thereby increasing the risk of documentation errors and patient dissatisfaction. Moreover, a preference for research-led clinical pathways, such as trial enrollment or emphasis on novel therapies, may clash with the standardized recommendations generated by intelligent systems and further dampen the tools' positive influence on performance.

Accordingly, the following hypothesis is proposed:

H6: Scientific innovation negatively moderates the relationship between digital and intelligent healthcare competence and oncologists' job performance.

(6) Ethics and law and job performance

In the context of oncology care, ethics and law constitute a critical dimension of physician competency. This includes respect for patient autonomy, the ability to navigate ethical dilemmas, adherence to clinical research standards, and compliance with healthcare regulations (Ten Have & Gordijn, 2014). However, unlike behavioral or technical domains such as clinical knowledge, communication, or team collaboration, ethics and law primarily function as normative

frameworks that guide and constrain medical practice. As a result, their influence on job performance tends to be indirect, operating through the modulation of how other competency dimensions contribute to performance outcomes.

Specifically, the indirect nature of ethics and law lies in its dual role: they provide a framework of compliance and behavioral boundaries for clinician–patient communication and team collaboration, thereby ensuring lawful conduct and legitimate decision-making; however, both excessive and insufficient levels of ethical sensitivity may produce counterproductive effects on these processes. Therefore, ethics and law should be conceptualized not as primary drivers of performance, but as pivotal moderators of other competency effects. The following discussion outlines two moderating pathways.

Ample empirical evidence supports the positive effect of clinician–patient communication on the performance of oncologists, with high communication competence shown to improve treatment adherence, patient satisfaction, and clinical outcomes (Epstein & Street Jr, 2007). However, when awareness of ethics and law becomes overly dominant physicians may, in striving to ensure legal and regulatory compliance, communicate in an overly cautious or rigid manner, avoid sensitive expressions, or suppress emotional engagement. This may result in communication that appears mechanical, detached, and lacking in empathy and support. Studies have shown that physicians with heightened ethical sensitivity tend to approach communication as a process of information delivery and risk avoidance, rather than as one grounded in empathy and emotional support (Mazor et al., 2004). In such cases, particularly in high-risk or sensitive communication scenarios or during initial consultations where physician–patient trust has not yet been established, patients may perceive interactions as impersonal, thereby undermining their trust and reducing compliance. Furthermore, physicians who experience a heightened burden of legal and ethical responsibility tend to adopt more conservative communication strategies, avoiding statements that may carry legal liability, which in turn may reduce openness and trust in the clinical encounters (Wynia et al., 1999). While ethics and law can help reduce medico-legal risk during communication, an excessively heightened state of this competency may restrict the beneficial impact of communication on performance, thus serving as a negative moderator.

Accordingly, the following hypothesis is proposed:

H7: Ethics and laws negatively moderate the positive effect of clinician–patient communication on oncologists' job performance.

In contrast to its moderating role in clinician–patient communication, ethics and law function primarily as a facilitative mechanism in team collaboration. As oncology care

increasingly depends on multidisciplinary team (MDT) coordination, cross-departmental resource integration, and management of the patient care continuum, ethics and law provide clear behavioral boundaries, role delineation, and accountability frameworks that support effective collaboration. As the Interprofessional Education Collaborative Expert Panel (Interprofessional Education Collaborative Expert Panel, 2011) argues, the presence of an ethical–legal framework within teams enhances collaboration quality and patient safety, particularly when addressing complex issues such as decision-making conflicts, risk management, and resource allocation. Physicians with higher ethical sensitivity tend to better comprehend interprofessional roles, actively facilitate consensus across disciplines, and support equitable and transparent decision-making processes, all of which contribute to improved organizational performance and patient outcomes (Singer et al., 2009). Moreover, physicians who exhibit strong ethics and law competency often serve as role models in areas such as clinical documentation, informed consent, and data protection, thereby enhancing the team's overall compliance culture and legal risk management (Hancock et al., 2020). In contexts such as medical disputes or ethics review of clinical trials, such physicians reinforce the positive contribution of team collaboration to performance by frequently assuming roles as mediators or legitimacy gatekeepers.

Accordingly, the following hypothesis is proposed:

H8: Ethics and law positively moderate the relationship between team collaboration and oncologists' job performance.

Based on the above hypotheses, a competency–performance relationship model is constructed, as illustrated in Figure 4.1.

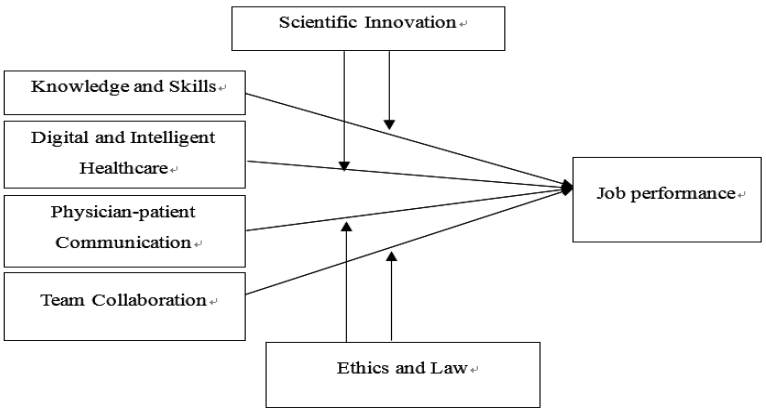

Figure 4.1 "Competency-performance" relational model

4.3.3 Descriptive statistics of key research variables

To examine the overall distribution of key variables within the sample, this study conducts

descriptive statistical analyses on six dimensions of oncologists' competencies—namely, knowledge and skills, physician-patient communication, scientific innovation, ethics and law, team collaboration, and digital and intelligent healthcare—as well as their job performance. The analysis includes the number of items per variable, minimum and maximum values, mean scores, and standard deviations. All competency dimensions and physician performance are measured using a 5-point Likert scale (1 = completely inconsistent/very low, 5 = completely consistent/very high). Detailed results are presented in Table 4.14.

As shown in the descriptive statistics in Table 4.14, the following patterns emerge:

(1) Regarding value range and data completeness, all variables report a minimum of 1.00 and a maximum of 5.00, fully consistent with the five-point Likert scale design. This indicates that respondents make full use of the score range across all variables, with no apparent outliers or values beyond the theoretical range.

(2) In terms of average scores, the ethics and law dimension ranks highest among the six competency domains (M = 3.92, SD = 0.86), followed by physician-patient communication (M = 3.86, SD = 0.95) and scientific innovation (M = 3.84, SD = 0.99). This suggests that surveyed oncologists perceive themselves as relatively competent in ethical and legal compliance, communication with patients, and engagement in scientific innovation, with mean scores approaching a moderately high level. Average scores for team collaboration (M = 3.73, SD = 0.95), digital and intelligent healthcare (M = 3.66, SD = 0.93), and knowledge and skills (M = 3.65, SD = 0.92) are slightly lower, yet remain above the midpoint, indicating a generally positive self-assessment of competency in these areas as well. The average score for physician performance is 3.52 (SD = 0.85), the lowest among all measured variables, yet still above the midpoint (3.00), reflecting a moderately favorable self-evaluation of job performance among oncologists.

(3) In terms of dispersion, the standard deviations of all variables range between 0.85 and 0.99. The scientific innovation dimension has the highest standard deviation (SD=0.99), indicating relatively large score differences among respondents and suggesting notable individual variation in perceived competency in this area. The ethics and law dimension and physician performance show relatively smaller standard deviations (SD=0.86 and SD=0.85, respectively), indicating more concentrated scores and slightly less variability in individual perceptions.

Overall, the standard deviations of all variables do not exhibit extreme dispersion or concentration, indicating a reasonable degree of variability in the sample data and providing a solid foundation for subsequent statistical analyses such as correlation and regression.

Therefore, based on the descriptive statistics, oncologists in the sample generally rate their competencies across dimensions and their own performance at a moderately high level. The scores of all variables span the full range of the scale and demonstrate a certain degree of dispersion, indicating good data quality suitable for further inferential statistical analysis. These results also provide a preliminary profile for understanding the current competency status of oncologists in Shanghai.

Table 4.14 Descriptive statistics of variables

Variable	Number of items	Minimum	Maximum	Mean	Standard deviation
Knowledge and skills	6	1.00	5.00	3.65	0.92
Physician-patient communication	4	1.00	5.00	3.86	0.95
Scientific innovation	4	1.00	5.00	3.84	0.99
Ethics and law	5	1.00	5.00	3.92	0.86
Team collaboration	5	1.00	5.00	3.73	0.95
Digital and intelligent healthcare	5	1.00	5.00	3.66	0.93
Job performance	14	1.00	5.00	3.52	0.85

4.3.4 Correlation analysis among key research variables

To assess the associations among competency dimensions and their links with physician performance, Pearson product–moment correlation coefficient is used to analyze the relationships among of the key variables. Detailed results are presented in Table 4.15.

(1) Correlations among competency dimensions

All six dimensions of competency demonstrate significant positive correlations ($p < 0.01$ for all coefficients). This suggests that these competencies do not function in isolation but are interrelated and mutually reinforcing. For example, physicians' proficiency in knowledge and skills correlates strongly with their competence in physician–patient communication ($r = 0.707$), scientific innovation ($r = 0.681$), ethics and law ($r = 0.697$), team collaboration ($r = 0.688$), and digital and intelligent healthcare ($r = 0.705$), all at $p < 0.01$.

(2) Correlations between competency dimensions and physician performance

Each of the six competency domains shows a significant positive association with physician performance, as shown in Table 4.15 ($p < 0.01$ for all coefficients). These findings provide initial support for the study's central hypothesis that competencies contribute positively to job performance. Team collaboration shows the strongest correlation with performance ($r = 0.666$), followed closely by digital and intelligent healthcare ($r = 0.665$), ethics and law ($r = 0.635$), and clinician–patient communication ($r = 0.633$), all at $p < 0.01$. These results indicate that physicians who demonstrate stronger team collaboration competence, greater proficiency in

digital tools, sound ethical awareness, and effective communication skills tend to perform better in their roles. Knowledge and skills ($r = 0.606$) and scientific innovation ($r = 0.546$) also show moderate correlations with performance ($p < 0.01$), further underscoring their relevance to clinical excellence.

Taken together, the results reveal broad and significant intercorrelations among competencies, indicating a coherent and integrated profile of professional capability. More importantly, the consistent positive correlations with performance provide a foundation for further analysis of predictive relationships, offering preliminary support for the proposed competency-performance framework. However, it should be noted that correlation does not imply causation; therefore, further analyses using advanced modeling approaches are required to clarify the underlying mechanisms. In addition, the Pearson correlation coefficients between the two dimensions of "scientific research and innovation" and "ethics and law" and the other four dimensions range from 0.602 to 0.816, indicating moderate to strong positive correlations and suggesting potential multicollinearity. To address this issue, multicollinearity diagnostics are conducted prior to regression analysis, and the results are reported in Section 4.3.5.

Table 4.15 Correlations among the key variables

Variable	Knowledge and skills	Physician-patient communication	Scientific innovation	Ethics and law	Team collaboration	Digital and intelligent healthcare	Physicians' performance
Knowledge and skills	1						
Physician-patient communication	0.707**	1					
Scientific innovation	0.681**	0.602**	1				
Ethics and law	0.697**	0.785**	0.708**	1			
Team collaboration	0.688**	0.708**	0.675**	0.816**	1		
Digital and intelligent healthcare	0.705**	0.662**	0.707**	0.733**	0.816**	1	
Physicians' performance	0.606**	0.633**	0.546**	0.635**	0.666**	0.665**	1

Note: Correlations are significant at $p < 0.05$ (*) and $p < 0.01$ (**); two-tailed tests.

4.3.5 Regression Analysis

(1) Multicollinearity Test

Prior to conducting regression analyses to test the research hypotheses, multicollinearity diagnostics are performed on the independent and moderating variables to assess whether high

intercorrelations among variables would affect the estimation of regression coefficients. Variance inflation factor (VIF) and tolerance are used as diagnostic indicators. VIF values exceeding 5 (or 10, depending on the threshold adopted) are generally considered indicative of problematic multicollinearity. As shown in Table 4.16, the VIF values for all variables range from 2.703 to 4.575, remaining below the conservative threshold of 5. Correspondingly, tolerance values range from 0.219 to 0.370, all exceeding the minimum acceptable level of 0.2. These results indicate that the data do not exhibit severe multicollinearity, thereby supporting the suitability of the data for subsequent regression analysis. It should be noted that, in models testing moderating effects, VIF values tend to be inflated due to the inherent correlation between interaction terms and their constituent variables. To address this issue, all variables are mean-centered prior to constructing interaction terms, thereby mitigating multicollinearity and improving the stability of regression coefficient estimates.

Table 4.16 Results of multicollinearity diagnosis

Variable	Tolerance	VIF
Knowledge and skill	0.340	2.941
Physician-patient communication	0.322	3.104
Scientific innovation	0.370	2.703
Ethics and law	0.219	4.563
Team collaboration	0.219	4.575
Digital and intelligent healthcare	0.257	3.896

(2) Results of Regression Analysis

As shown in Table 4.17, the regression model for job performance reports an R^2 of 0.557, indicating that the variables in the model explain 55.7% of the variance. The regression results show that knowledge and skills ($\beta = 0.123$, $p = 0.025$), physician–patient communication ($\beta = 0.139$, $p = 0.013$), team collaboration ($\beta = 0.166$, $p = 0.013$), and digital and intelligent healthcare competence ($\beta = 0.241$, $p < 0.001$) all exert significant positive effects on job performance. This indicates that oncologists who demonstrate solid professional knowledge, effective communication skills, strong collaboration, and proficient use of digital technologies are more likely to perform well in clinical practice, research, and patient management, thereby supporting H1–H4. In contrast, scientific innovation competence ($\beta = 0.011$, $p = 0.834$) and ethics and law literacy ($\beta = 0.110$, $p = 0.151$) do not significantly predict job performance directly, though both demonstrate significant moderating effects through interaction terms.

Specifically, research innovation positively moderates the impact of knowledge and skills on job performance ($\beta = 0.120$, $p = 0.017$), which supports H5; however, it negatively moderates the relationship between digital and intelligent healthcare competence and performance ($\beta = -0.122$, $p = 0.027$), supporting H6. This suggests that engagement in research may enhance the

practical value of professional knowledge, but under constraints of time and energy, it may reduce physicians' effectiveness in applying digital tools.

Ethics and law competency negatively moderates the relationship between physician–patient communication and performance (β = −0.118, p = 0.019), possibly because oncologists with higher ethical sensitivity exercise greater caution during communication, thereby reducing communication efficiency, supporting H7. At the same time, it positively moderates the association between team collaboration and performance (β=0.185, p=0.003), which indicates that physicians with strong ethical awareness can build effective collaboration grounded in compliance, thereby supporting H8.

In summary, scientific innovation and ethics and law do not directly determine performance but play a critical role by moderating how core competencies—such as knowledge and skills, digital and intelligent healthcare, physician-patient communication and team collaboration—affect performance. These findings deepen the understanding of the competency structure and performance mechanisms in oncologists.

Table 4.17 Regression analysis results with performance as the dependent variable

VARIABLES	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
gender	0.051	0,062	0.82	0.415	-0.071	0.172
age	0.007	0.012	0.55	0.579	-0.017	0.030
tenure	0.071	0.184	0.38	0.701	-0.291	0.433
Title1	-0.047	0.127	-0.37	0.711	-0.297	0.203
Title2	0.001	0.136	0.00	0.996	-0.267	0.269
Major	-0.066	0.063	-1.05	0.294	-0.189	0.057
Clinic	-0.088	0.065	-1.36	0.175	-0.215	0.039
Knowledge and Skill(kn)	**0.123**	0.055	2.25	**0.025**	0.016	0.230
Communication(gt)	**0.139**	0.056	2.49	**0.013**	0.029	0.248
Research(ky)	0.011	0.051	0.21	0.834	-0.089	0.110
Ethics(ll)	0.110	0.076	1.44	0.151	-0.040	0.260
Cooperation(xz)	**0.166**	0.066	2.51	**0.013**	0.036	0.297
Digital and Intelligent(sz)	**0.241**	0.062	3.89	**0.000**	0.119	0.364
cky*ckn	**0.120**	0.050	2.39	**0.017**	0.021	0.218
cky*csz	**-0.122**	0.055	-2.22	**0.027**	-0.229	-0.014
cll*cgt	**-0.118**	0.050	-2.36	**0.019**	-0.217	-0.020
cll*cxz	**0.185**	0.061	3.02	**0.003**	0.065	0.305

It is important to note that in the proposed model of this study, "scientific innovation" and "ethics and law" are theoretically conceptualized as potential moderators between job competency and job performance. Although these dimensions are structurally valid as independent constructs, their direct paths to performance do not reach statistical significance in the initial regression model, which may raise concerns regarding model overfitting or structural redundancy. To strengthen the explanatory rigor and ensure conceptual clarity, this study applies

hierarchical regression analysis to delineate the marginal contributions of main effects and interaction effects, and employs mean-centering to address potential multicollinearity. The analytical procedure consists of four steps:

Model 1: Control variables are entered (e.g., gender, age, years of service, educational background, and professional rank)

Model 2: Core dimensions of job competency are entered to test main effects;

Model 3: Moderating variables (scientific innovation and ethics and law) are entered to assess their independent explanatory power;

Model 4: Interaction terms between job competency and moderating variables are entered to test moderation effects.

As shown in Table 4.18, the inclusion of interaction terms significantly improves the model's explanatory power (Model 4, $\Delta R^2 = 0.023$, $p < 0.01$). The moderating effect of scientific innovation on the path from knowledge and skills to job performance (Model 4, $\beta = 0.188$, $p < 0.05$), as well as its moderating effect on the relationship between digital and intelligent healthcare and job performance, are statistically significant. Similarly, the moderating effect of ethics and law on the relationship between physician–patient communication and job performance, as well as its moderating effect on the relationship between team collaboration and job performance, are also significant. Moreover, drawing on established modelling practices in organizational behavior and psychometrics (Frazier et al., 2004; Hayes, 2013), it is methodologically appropriate to retain non-significant main effect paths, particularly when interaction effects are statistically significant and when theoretical assumptions define moderators as contextual rather than primary predictors. Accordingly, although some main effect paths of the moderating variables are non-significant in this study, retaining these paths remains theoretically meaningful and methodologically justified.

Table 4.18 Examination of the moderating role of scientific research innovation and ethics and law

Variables	Model 1	Model 2	Model 3	Model 4
Control Variables				
gender	-0.048	0.025	0.024	0.029
age	0.143*	0.013	0.014	0.023
tenure	0.040	0.012	0.011	0.014
Title1	-0.074	-0.038	-0.038	-0.028
Title2	-0.016	-0.013	-0.012	-0.000
Major	-0.088	-0.032	-0.033	-0.039
Clinic	-0.014	-0.047	-0.046	-0.049
Independent Variables				
Knowledge and Skill(kn)		0.107*	0.103*	0.134*
Digital and Intelligent(sz)		0.269**	0.266**	0.264**
Communication(gt)		0.224**	0.209**	0.156*
Cooperation(xz)		0.212*	0.193*	0.186*

Moderators				
Research(ky)			-0.001	.012
Ethics(ll)			0.043	0.112
Interaction Items				
cky*ckn				**0.188***
cky*csz				**-0.19***
cll*cgt				**-0.183***
cll*cxz				**0.283***
R^2	0.053	0.534	0.534	0.557
F	3.104**	40.18**	33.881**	28.129**
ΔR^2	0.053	0.481	0.000	0.023
ΔF	3.104**	99.572**	0.177	4.929**

Note: **Significantly correlated at the 0.01 level (bilateral); *Significantly correlated at the 0.05 level (bilateral).

Chapter 5: Discussion & Conclusion

5.1 Summary of key findings

This study primarily aims to develop a job competency model for oncologists in Shanghai that is both tailored to the Chinese healthcare context and specifically designed for the oncology profession. Centered on the core scientific question—"What critical competencies must oncologists possess to achieve high performance?"—the study systematically integrates literature review, expert interviews, KH Coder-based text analysis, and questionnaire surveys. It follows a structured methodological pathway of "theoretical extraction, textual induction, structural construction, and empirical validation", thereby completing the full process from competency identification to model development and empirical testing.

5.1.1 Core components of oncologists' job competency in Shanghai

This study develops a competency model comprising six core dimensions: knowledge and skills, physician–patient communication, scientific innovation, ethics and law, team collaboration, and digital and intelligent healthcare, encompassing a total of 19 specific competency attributes. The model not only incorporates the fundamental clinical capabilities emphasized in traditional medical education but also aligns with the evolving demands of contemporary oncology, including interdisciplinary integration, technological adaptability, and the provision of humanistic care. Specifically, the "knowledge and skills" dimension captures physicians' competencies in oncology diagnosis and treatment, including molecular targeting and immunotherapy, and serves as the foundational basis for clinical practice. The "physician–patient communication" reflects physicians' ability to communicate and interpret complex treatment plans, engage in palliative care discussions, and navigate family decision-making processes. The "scientific innovation" dimension encompasses clinical research literacy, evidence-based thinking, and data analysis competence. The "ethics and law" dimension involves awareness of and responsiveness to clinical ethical dilemmas, privacy protection, and medical dispute prevention. The "team collaboration" dimension captures the ability to collaborate effectively in multidisciplinary team (MDT) settings. Finally, the "digital and intelligent healthcare" dimension addresses the growing need for physicians to adapt to artificial

intelligence, clinical big data, and precision medicine in the digital era.

5.1.2 Internal logical relationships among competency dimensions

Structural equation modeling and interaction regression analyses reveal that the competency dimensions do not function independently but instead form a highly interrelated and dynamically structured system. The "knowledge and skills" dimension serves as the core foundational competency, demonstrating strong positive correlations with other dimensions and acting as a driving force in the overall system. The "scientific innovation" and "ethics and law" dimensions exert significant moderating effects in the path analyses, either enhancing or attenuating the relationships between "knowledge and skills" and other competency dimensions. Specifically, "scientific innovation" positively moderates the pathway between knowledge and performance, suggesting that physicians with strong research competence are more capable of translating knowledge into high-level performance. In contrast, "ethics and law" negatively moderates the relationship between physician-patient communication and job performance, indicating that heightened ethical sensitivity may lead to excessive caution and reduced communicative efficiency, while simultaneously enhancing the effect of "team collaboration" on performance. The "digital and intelligent healthcare" and "team collaboration" dimensions represent composite competencies with more complex mechanisms. The former influences not only physicians' capacity to adopt new technologies but also their ability to integrate and analyze multi-source information. The latter plays a critical role in multidisciplinary collaboration and significantly enhances physicians' capacity for respond systematically to complex clinical scenarios. Accordingly, the internal structure of oncologists' job competency may be conceptualized as a three-tiered system comprising foundational, supportive, and expanded capabilities. This structure exhibits sound hierarchical organization and functional integration, providing a robust theoretical basis for competency evaluation, job matching, and performance management.

5.1.3 Measurement of oncologists' job competency

Building upon the constructed model, the study develops a job competency scale for oncologists, employing a five-point Likert scale comprising 29 items across six dimensions. Reliability analysis (Cronbach's α values exceeding 0.85), confirmatory factor analysis (CFA results indicating good model fit), and discriminant validity tests all support the psychometric soundness of the instrument. A complementary job performance scale is also developed to

assess the relationship between competency and performance. The scale development process integrates text analysis with empirical investigation to ensure both local adaptation and broader applicability. To enhance the multidimensionality and reliability of assessment, future research may incorporate multiple sources of evaluation, including self-assessments, peer evaluations, supervisor appraisals, and patient feedback, to construct a 360-degree evaluation system for the comprehensive and dynamic assessment of oncologists' competencies.

5.1.4 Association between oncologists' competency and job performance

Regression and interaction effect analyses demonstrate that four competency dimensions—namely, knowledge and skills, physician–patient communication, team collaboration, and digital and intelligent healthcare—significantly and positively predict job performance among oncologists. This finding indicates that physicians with stronger integrative capabilities in medical service delivery, team coordination, and technological adaptation tend to exhibit higher clinical performance. Although "scientific innovation" and "ethics and law" do not directly predict performance scores, they show significant effects as moderators. Physicians with stronger research competencies are better equipped to integrate knowledge into systematic diagnostic and therapeutic pathways, while ethics and law competence contributes positively to team functioning and multidisciplinary collaboration. Therefore, high performance among oncologists does not result from the dominance of any single competency but rather from the interaction of multiple capabilities—particularly the integration of core professional skills with the ability to respond to complex situations. This conclusion not only enriches the empirical foundation of medical competency models but also offers scientific guidance for healthcare institutions in evaluating physician performance, designing promotion mechanisms, and developing capacity-building pathways.

5.1.5 Recommendations for improving oncologist training

5.1.5.1 Establishing a competency-based training objective framework

In response to the fragmented nature of job competency requirements, this study proposes restructuring training objectives at both the standardized residency training and specialty training stages based on the six-dimensional job competency model for oncologists. This approach aims to facilitate a paradigm shift in medical education from a knowledge-oriented model to a competency-driven one. Clear benchmarks for competency attainment at each stage should be specified in the training curricula, alongside well-defined indicators encompassing

clinical care, research capabilities, interdisciplinary communication, ethical literacy, and digital and intelligent healthcare. This would enable full alignment across learning objectives, training processes, and assessment systems. In addition, drawing on the international concept of a "competency map", differentiated competency development pathways should be designed for physicians at various career levels (e.g. junior physicians, attending physicians, core department members, academic leaders), so as to guide resource allocation, inform training plans, and outline individual career development.

5.1.5.2 Optimizing the structural design of residency and specialty training in oncology

The findings of this study suggest that oncology-related rotation structures and competency requirements during residency are insufficiently defined, while specialty training remains at an exploratory stage. It is therefore recommended to refine the oncologist training system under the "5+3+X" framework. During residency, greater integration across oncology-related departments should be pursued, with standardized rotation durations and assessment criteria for core modules such as medical oncology, radiation oncology, pathology, and imaging. At the specialty training stage, a tiered and differentiated model centered on subspecialty areas should be established to promote dedicated training tracks in breast cancer, gastrointestinal malignancies, neuro-oncology, and other organ-specific domains. This approach facilitates the transition from generalist practitioners to oncology experts. Multi-institutional joint training mechanisms should also be encouraged to facilitate cross-institutional and inter-regional rotations, thereby enhancing training quality and equity.

5.1.5.3 Developing a multidimensional competency assessment and feedback system

Effective evaluation is critical to improving physician training outcomes. A comprehensive, longitudinal evaluation system should be developed based on the six dimensions of job competency, incorporating diverse assessment tools such as Mini-CEX, DOPS, OSCE, 360-degree evaluations, and competency portfolios. These tools should assess physicians' performance in authentic clinical settings, with indicators covering domains such as knowledge acquisition, clinical reasoning, professional communication, team collaboration, ethical decision-making, and research engagement. A tripartite feedback mechanism involving trainers, supervisors, and trainees should be established to facilitate ongoing monitoring, individualized guidance, and adaptive learning pathways, thereby advancing a truly competency-driven model of education that promotes learning and teaching through evaluation.

5.1.5.4 Strengthening systematic training in non-technical competencies

This study highlights the significant role of non-technical competencies, such as communication, ethics, and interdisciplinary collaboration, in oncologists' job competency. However, these skills are often undervalued in current training practices. It is recommended to embed core courses such as "physician–patient communication skills", "clinical ethics in practice", and "interdisciplinary collaboration" into both residency and specialty training curricula. Training should incorporate standardized patient simulations, role-plays, case-based discussions, and scenario-based exercises to enhance physicians' capacity for humanistic care and clinical communication judgment in complex clinical environments. Particular attention should be given to high-stakes oncology scenarios, such as disclosing malignant diagnoses, discussing poor prognoses, or delivering palliative care, with targeted training to strengthen emotional regulation and empathetic expression. An ethical decision-making support framework should also be developed to reinforce education on informed consent, treatment autonomy, and end-of-life dignity.

5.1.5.5 Promoting the integrated development of research and educational competencies

Sustainable progress in oncology relies on a workforce equipped with strong research and teaching competencies. Therefore, structured research training modules should be incorporated into residency and specialty training, covering research design, data analysis, literature review, academic writing, and project management. Physicians should be encouraged to participate in mentor-led research or independently initiate research projects, to foster their ability to translate clinical challenges into scientific questions. Furthermore, the integration of research, clinical practice, and teaching should be promoted. Standardized teaching tasks, such as delivering mini-lectures, leading teaching-oriented ward rounds, and facilitating case discussions, should be included in evaluation metrics to systematically develop young faculty with teaching expertise. For senior trainees, research achievements or teaching practicum could be included as part of graduation criteria, thereby contributing to the institutionalization of academic capacity development.

5.1.5.6 Enhancing policy frameworks and institutional support mechanisms

Robust institutional support forms the foundation for high-quality oncologist training. Competency evaluation results should be formally integrated into human resource management systems, including promotion, appointment, and talent recruitment, to establish a closed-loop mechanism linking training, competency, and career development. A national-level competency

evaluation center for oncology and regional training alliances should be established to promote resource sharing, standard harmonization, and data exchange. To strengthen motivation, honors such as “Excellence in Teaching Award” and “Mentorship in Research Award” should be introduced to encourage active engagement from training institutions and faculty. In parallel, standardized requirements for specialty training bases, criteria for teaching competency, phased funding models, and oversight protocols should be developed to provide the necessary institutional and financial support for high-quality oncologist training, thereby promoting the systematic, standardized, and sustainable development of oncology education.

5.2 Comparative analysis between this study and other existing research

From a dimensional perspective, this study aligns closely with internationally recognized competency frameworks in medical education, such as ACGME and CanMEDS. For example, the ACGME’s core competencies emphasize that physician competence extends beyond clinical knowledge and procedural skills, highlighting the importance of clinical reasoning, communication, and ethical decision-making (Swing, 2007). Similarly, the CanMEDS framework defines “communicator” and “collaborator” as key physician roles, underscoring the critical importance of teamwork and patient-centered communication (Frank et al., 2015). These dimensions resonate with those proposed in this study, namely, knowledge and skills, physician–patient communication, and team collaboration. Moreover, our validation process demonstrates that competency meaningfully predicts physician performance. This finding is consistent with Epstein et al.’s (2002) conceptualization of medical competence as “the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice”, and their argument that high levels of integrated competence correlate with superior clinical outcomes.

Notably, traditional physician competency frameworks have rarely treated “research competence” as a standalone dimension. In both the ACGME and CanMEDS models, research-related capabilities are typically embedded within broader categories such as “practice-based learning” or “scholar”. By contrast, this study isolates research competence as a distinct domain and empirically demonstrates its significant predictive value for performance, which reflects the high emphasis placed on research productivity, particularly in top-tier oncology institutions in China such as those in Shanghai. This aligns with the argument that dual capability in clinical care and research has become essential for modern medical professionals (Yuan et al., 2025). Enhanced research ability enables physicians to refine treatment protocols and advance

evidence-based medicine, ultimately improving care quality.

Additionally, this study introduces a novel dimension: digital and intelligent healthcare. While traditional literature has touched upon capabilities in the digital era and technological adaptation, these elements are often scattered and lack integration into a dedicated competency domain. For instance, although the revised 2015 CanMEDS framework mentions digital health, it stops short of defining it as a primary domain (Frank et al., 2015). Given the rapid digital transformation in global healthcare marked by the rise of AI-driven diagnostics and precision oncology, the inclusion of digital intelligence reflects a forward-looking understanding of oncology's evolving landscape.

Recent institutional initiatives further illustrate this trend. In 2024, Fudan University launched over 100 "AI+" courses and introduced lectures under the "AI for Science" (AI4S) initiative, aimed at integrating artificial intelligence into scientific discovery. Academician Jin Li emphasizes at the 14th "Forum on Chinese Scholars and 21st-Century Shanghai Development" that AI4S will be a powerful catalyst for scientific innovation, with the potential to redefine research paradigms and ignite technological revolutions. Similarly, Shanghai Jiao Tong University School of Medicine released its *AI + Medical Education Action Plan* to promote the deep integration of AI with medical education. This plan includes AI-enhanced curricula, intelligent teaching platforms, and faculty development in the AI era. During the 2025 Two Sessions, Academician Fan Xianqun highlights that future physicians must be well-versed not only in conventional clinical techniques, but also in cutting-edge domains such as AI, endoscopic procedures, interventional therapies, and particle-based cancer treatments. As technologies like artificial intelligence, data analytics, and targeted therapy continue to evolve, digital competence is fast becoming a core component of oncologist capability. Wartman and Combs (2018) argue that physicians of the future must be equipped to make medical decisions in data- and AI-rich environments. Thus, the incorporation of digital healthcare into this study's model not only reflects oncology's position at the intersection of medicine and technology but also signals an urgent need to redefine medical education for the AI era.

The divergence between this study's model and traditional frameworks can be attributed to several factors. First, institutional and cultural differences play a role. Western models often emphasize professional autonomy and individual competence, relatively detached from institutional metrics of productivity. In contrast, the inclusion of dimensions such as "research innovation" and "digital and intelligent healthcare" in this model reflects China's unique dual-track evaluation system, which places equal weight on capability and output, particularly in elite hospitals where measurable performance indicators are heavily emphasized. Second,

oncology as a specialty has distinctive characteristics. Dimensions such as "scientific innovation", "digital and intelligent healthcare", and "ethics and law" in this model directly respond to specific features of oncology, including disease complexity, treatment uncertainty, ethical sensitivity (e.g., palliative care and end-of-life decision-making), and technological intensity (e.g., targeted therapy, immunotherapy, and AI-assisted diagnosis and treatment). These features may not be adequately addressed by generic models such as ACGME or CanMEDS which are designed for broad applicability across all clinical fields. Third, this study's sample primarily consists of physicians in the early stages of their careers (within five years of practice). In contrast, much of the existing literature involves multi-tiered samples and focuses on the evolution of competencies over time (Ten Cate & Scheele, 2007). Early-career physicians tend to emphasize foundational clinical practice, research potential, and technological adaptability, whereas managerial or leadership competencies, such as CanMEDS "Leader" role, may be less salient.

In this study, although the dimensions of "scientific innovation" and "ethics and law" do not directly predict oncologists' performance, they exhibit significant moderating effects in the interaction analysis. Specifically, when these dimensions vary in level, the positive impact of other competencies on performance is either attenuated or amplified. This finding aligns closely with real-world clinical settings and is supported by the literature. For instance, Epstein et al. (2002) emphasize that both scientific inquiry and ethical literacy constitute core components of clinical competence, serving as key drivers of physicians' comprehensive capabilities. In academic medical contexts, physicians function not only as clinicians but also as researchers and educators, with responsibilities to engage in research, solve complex problems, and uphold ethical standards in practice (Huecker & Shreffler, 2025). A systematic review by Moreira et al. (2021) finds that ethics education significantly enhances both ethical sensitivity and clinical performance among medical students and residents. In oncology, a field deeply reliant on interdisciplinary collaboration and ethical decision-making, scientific innovation facilitates the personalization of treatment plans and the integration of advanced technologies, while ethical and legal competence safeguards value-based judgment and risk governance during patient communication. Studies indicate that physicians with strong ethical sensitivity are better equipped to navigate clinical trials, informed consent, and palliative care, ultimately contributing to higher patient satisfaction and treatment adherence (Andersson et al., 2022). In such settings, ethics and scientific innovation function not as primary determinants of performance, but as amplifiers that enhance the efficacy of other competency domains. The moderating effects identified in this study are therefore consistent with the logic underpinning

international competency frameworks, suggesting that future efforts in physician training and evaluation should place greater emphasis on the systematic development of scientific and ethical competencies and their interactive roles.

5.3 Cross-Specialty Applicability

Admittedly, the six dimensions proposed in this study, namely, knowledge and skills, clinician–patient communication, scientific innovation, ethics and law, team collaboration, and digital and intelligent healthcare**,** are not unique to oncology. Physicians in other clinical specialties, such as internal medicine, surgery, and pediatrics, likewise require these competencies. For example, physicians must possess a solid foundation of medical knowledge and clinical skills (knowledge and skills); surgeons must communicate effectively with patients and their families (clinician–patient communication); and pediatricians frequently encounter ethical dilemmas in clinical decision-making (ethics and law). In this sense, the dimensional structure of the model demonstrates a degree of cross-specialty applicability. However, this applicability should be understood in light of two key considerations.

First, cross-specialty applicability does not imply that the model can be directly transferred across specialties. Substantial differences exist in the content, behavioral standards, and relative weighting of competencies within the same dimension across different specialties. Taking the dimension of digital and intelligent healthcare as an example, oncologists may prioritize competencies in AI-assisted imaging interpretation and genomic data analysis, whereas cardiologists may place greater emphasis on intelligent electrocardiogram (ECG) analysis systems, and neurologists may focus more on AI-assisted neuroimaging diagnostics. Accordingly, when adapting this model, other specialties should tailor the content of each dimension to their specific disease profiles, technological environments, and care delivery models, rather than applying it in a one-size-fits-all manner.

Second, this study develops an oncology-specific competency framework that has been empirically validated and demonstrates predictive validity for performance, without claiming exclusivity to oncology. Rather, it emphasizes that within the specific clinical context of oncology, the behavioral manifestations, competency requirements, and their mechanisms of influence on job performance exhibit distinct characteristics. For instance, the findings indicate that the ethics and law dimension exerts a negative moderating effect on the relationship between clinician–patient communication and job performance ($\beta = -0.118$, $p < 0.05$), which may partly reflect the unique challenges of high-stakes communication in oncology settings.

Whether similar moderating effects exist in other specialties remains to be examined in future research.

5.4 Research contributions

5.4.1 Academic contributions

This study makes three principal theoretical contributions, offering a systematic account of persistent gaps in the literature on physician competency, and achieving substantive advances in the domains of specialization, digital and intelligent healthcare, and the structural refinement of performance frameworks.

First, this study enriches the underexplored area of oncologists' job competency in the Chinese healthcare context. Most existing studies are grounded in general competency frameworks, such as CanMEDS and ACGME, and focus primarily on the capabilities required of residents and general practitioners. In contrast, empirical research targeting specialist physicians, particularly in the highly specialized domain of oncology, remains notably scarce. This study represents the first systematic investigation into the competency framework of oncologists. Drawing upon an in-depth understanding of the healthcare context in Shanghai and integrating both global and local perspectives on competency theory and medical education systems, it delineates the essential dimensions of job competency specific to oncologists. Methodologically, the study integrates KH Coder–based text mining, in-depth expert interviews, competency modelling frameworks (e.g., the iceberg model and the onion model), and quantitative survey instrument development. This multi-method approach establishes a coherent theoretical trajectory, from competency identification to structural modelling and scale construction, thereby offering a replicable methodological paradigm for the development of competency frameworks across other medical specialties.

Second, this study introduces a significant theoretical advancement in the conceptualization of competency dimensions. Traditional models of physician competency predominantly focus on foundational dimensions such as clinical care and communication, but inadequately reflect the evolving roles of physicians in the context of accelerating technological innovation. In response to the increasing integration of emerging technologies such as artificial intelligence, big data, and telemedicine into clinical settings, this study is the first to conceptualize digital and intelligent healthcare as a distinct competency dimension within the oncologist competency model. This dimension encompasses specific capabilities including data analytics, AI-supported

clinical decision-making, electronic health record management, and remote consultation. Such integration expands the theoretical boundaries of competency frameworks in digitalized healthcare contexts. More importantly, empirical analysis confirms that this dimension serves as a robust predictor of physician performance, thereby substantiating both its conceptual validity and practical relevance. Accordingly, this study provides a theoretical foundation for the digital and intelligent transformation of medical education and oncologist competency development systems.

Finally, this study expands the theoretical foundation and refines the structural design of physician performance assessment by conceptualizing a tripartite framework that integrates task performance, relational performance, and adaptive performance. Unlike conventional approaches that prioritize single indicators such as service volume or patient satisfaction, this study introduces the construct of adaptive performance, incorporating research productivity, engagement in clinical studies, and the translation of scientific findings into practice within the performance evaluation framework. This design aligns with the research-intensive and technologically dynamic nature of oncology, thereby enriching and extending the theoretical conception of physician performance. In addition, interaction-term regression analysis reveals that the dimensions of scientific innovation and ethics and law moderate the pathways through which other competency dimensions affect performance outcomes. The findings empirically validate the existence of interactive mechanisms across competency dimensions. This insight challenges the linearity assumption embedded in traditional competency models and offers a deeper understanding of the complex, systemic pathways through which physician competencies translate into performance.

Overall, the study not only contributes conceptual innovation in identifying competency dimensions, constructing modelling pathways, and redefining the structure of physician performance, but also further substantiates the intricate linkages between internal competency mechanisms and performance outcomes through empirical testing. It thereby provides a robust theoretical and methodological foundation for advancing physician competency theory, particularly in modelling and evaluating the capabilities of specialist practitioners.

5.4.2 Practical contributions

At the practical level, the oncologist job competency model and its corresponding measurement tool developed in this study provide structured, operationally feasible instruments and theoretical support for hospital management and clinical education, with significant applicability in healthcare settings.

First, the proposed competency model offers a precise and context-sensitive framework for assessing capabilities within hospital human resource management systems. At present, the lack of competency indicator systems aligned with the functional requirements of specialized clinical roles when defining job responsibilities, establishing recruitment criteria, and designing promotion pathways often leads to overly general and ambiguous evaluation standards. The assessment system developed in this study, which comprises six dimensions and nineteen specific competency attributes, enables hospital administrators to generate evidence-based profiles of job-specific competencies. Within the highly specialized field of oncology, the system supports greater precision and standardization in critical human resource functions, including candidate selection, role alignment, and promotion decisions. This competency-based framework establishes a foundational structure for the development of capability-oriented human resource management systems in specialized medical contexts.

Second, the competency model demonstrates strong applicability and practical value in clinical training and continuing medical education. Based on the competency structure identified in this study, hospitals and training institutions may design stratified and differentiated training strategies tailored to physicians' career stages and job responsibilities. For instance, residents entering clinical practice may benefit from enhanced training in core competencies such as foundational knowledge, clinical skills, and physician–patient communication. In contrast, for mid- to senior-level physicians with more years of practice, training efforts should focus on strengthening integrated competencies in scientific innovation, team collaboration, and digital and intelligent healthcare to align with the evolving clinical demands of oncology, including multidisciplinary team-based care, rapid technological advancements in treatment, and the increasing role of AI-assisted diagnosis and therapy. More importantly, moderation analysis in this study indicates that although ethics and law, along with scientific innovation, do not exert direct effects on performance, they play a critical supportive and integrative role within the overall competency structure. This finding suggests that training programs should avoid isolated reinforcement of individual competencies and instead focus on fostering synergistic interactions among competencies to promote a virtuous cycle within the competency ecosystem.

Finally, in the practice of performance evaluation, this study proposes a three-dimensional framework comprising task performance, adaptive performance, and relational performance, thereby broadening the perspective beyond traditional evaluation models. Unlike conventional approaches that narrowly focus on treatment volume or patient satisfaction, this model integrates a comprehensive assessment of clinical outcomes, research translation output, and

patient management and communication skills. It emphasizes evaluating physicians' overall value through three dimensions: the tasks they perform, the manner in which they perform them, and the recipients impacted by their work. This approach facilitates the transformation of performance evaluation systems from a result-oriented focus to one oriented around capabilities and behaviors. It also promotes the evolution of hospital performance management from a rudimentary, static process toward a more refined and dynamic system, thereby advancing a multi-stakeholder equilibrium that balances healthcare quality, physician professional development, and patient experience.

In summary, this study delivers a systematic oncologist competency modelling tool, stratified training strategies, and a multidimensional performance evaluation framework at the practical level. These contributions respond to the pressing needs of contemporary hospital management and medical education reform and establish a replicable and scalable paradigm for the training, assessment, and incentivization of specialist medical professionals.

5.5 Limitations and future research directions

Although this study conducts a relatively systematic theoretical exploration and empirical validation of the job competency model of oncologists and achieves preliminary findings, several noteworthy limitations persist in the study's design and implementation, warranting further refinement in future research.

First, the representativeness of the sample structure remains limited. On the one hand, the questionnaire data collected in this study primarily derive from oncology residents currently in training or who have completed training within the past three years at a specialized cancer hospital in Shanghai. This sample is relatively homogeneous in terms of career stage, knowledge structure, and professional responsibilities, which allows for a valid assessment of the structural validity and applicability of the job competency model among early-career oncologists, but it also limits the generalizability of the model to mid- and senior-level physicians, for whom its applicability, structural stability, and discriminative power remain insufficiently examined. This, in turn, constrains the model's utility across the full trajectory of professional development. Given that senior oncologists differ substantially from junior counterparts in terms of job responsibilities, competency priorities, and task complexity, future research should incorporate multi-level samples and apply techniques such as multi-group structural invariance testing or latent profile analysis to examine the structural stability and dimensional performance of the model across different career stages, and ultimately advance

the development of a competency evaluation framework that spans the entire career cycle of oncologists. On the other hand, the sample is geographically concentrated in first-tier cities, where medical resources are abundant and educational systems are well developed. This concentration may introduce bias in the applicability of findings to other contexts, such as second-tier cities, primary-level hospitals, or different institutional types, including general hospitals and private healthcare facilities. Future research should therefore broaden the scope of sample composition by including oncologists across diverse regions, institutional hierarchies, and stages of professional development.

Second, the measurement approach of performance is subject to certain biases arising from subjectivity. As this study primarily relies on self-evaluation by physicians to obtain performance data, and although multidimensional, itemized questions are incorporated into the design to enhance reliability and validity, the measurement remains influenced by self-perception, social desirability, and variability in evaluation contexts. Therefore, it remains difficult to eliminate the confounding effects of self-report bias entirely. In addition, for certain dimensions (such as disease control rate and improvement in quality of life), physicians' subjective assessments may not fully align with objective clinical data. Subsequent studies are therefore advised to incorporate multi-source assessment mechanisms, integrating patient satisfaction surveys, peer evaluations, supervisor ratings, institutional performance records, and electronic medical record data. This integrated approach would facilitate the construction of a multi-source and more objective performance measurement system and thereby enhance both the reliability and external validity of performance-related variables.

Third, the study is primarily based on cross-sectional data, which limits its ability to capture the dynamic evolution of the relationship between competency and performance. Competency is inherently a temporal and developmental construct, and its influence on performance may vary over time in response to changes in career stage, task roles, and clinical contexts. However, the cross-sectional design used in this study captures only the static association between oncologists' competency profiles and performance outcomes at a single time point. This approach limits the capacity to uncover how competency development influences performance over time. Future studies should consider employing longitudinal designs that capture both physicians' competency development during residency and corresponding changes in performance, to investigate developmental trajectories, critical inflection points, and underlying mechanisms across distinct competency dimensions. This would contribute to a more comprehensive understanding of the causal chain linking professional development and job performance in clinical practice.

Fourth, although this study integrates literature review, expert interviews, and text mining to derive a relatively systematic structure of competency dimensions, certain deeper psychological attributes such as empathy, professional responsibility, and resilience are not fully incorporated into the model framework. Future research may employ more in-depth exploratory methodologies, such as Behavioral Event Interviewing (BEI) and Situational Judgment Tests (SJT), to further identify and validate implicit competencies that are not readily measurable through self-evaluation and thereby enhance the structural completeness and predictive validity of the competency model.

Fifth, within the CanMEDS framework, “health advocacy” is identified as one of the seven core roles. This role emphasizes that physicians should leverage their professional position, as well as their knowledge and skills, to proactively identify and address social, environmental, and behavioral determinants of health at the individual patient level. At the population level, it entails active engagement in disease prevention, health promotion, the improvement of public health policy, and the protection of the health rights of vulnerable populations, thereby contributing to the advancement of health equity (Frank et al., 2015). Upon re-examining the interview transcripts and coding, health advocacy–related keywords (e.g., prevention, early screening, health education, and public health) are mentioned infrequently and do not emerge as an independent semantic cluster. The reasons are threefold.

(1) The interview participants are primarily oncologists from a tertiary Grade A hospital, whose clinical practice is mainly focused on the diagnosis and treatment of advanced-stage cancers, rather than on primary prevention or community-based health advocacy.

(2) In China, health advocacy has not yet been incorporated as a core competency for oncologists. This contrasts with international frameworks such as CanMEDS, reflecting differences in how the role of oncologists is defined within the local healthcare system.

(3) This dimension may have been insufficiently elicited due to the absence of specific prompts related to health advocacy in the interview guide.

Therefore, given the data-driven nature of this study, health advocacy is not included in the final competency model. Future research is encouraged to incorporate targeted prompts related to disease prevention, health promotion, and public health into interview design, or to include samples of community-based oncologists to further examine the relevance of this dimension within the competency model for oncologists.

Finally, although this study draws upon international competency frameworks such as ACGME and CanMEDS in constructing the job competency model for oncologists, and incorporates certain contextual features of the Chinese healthcare system into the questionnaire

design, it does not fully achieve the systematic integration of the cultural and institutional contexts unique to China in the model development and validation process, particularly within the culturally sensitive domains of "physician-patient communication" and "ethics and law". Key cultural variables, such as collectivist decision-making norms, high-context communication styles, and hierarchical organizational structures, have not been adequately incorporated. This limitation may compromise the model's theoretical adaptability and practical interpretability in cross-cultural settings. To enhance the model's local validity and translational value, future studies may consider developing culturally anchored subdimensions of competency such as "organizationally adaptive ethical reasoning" and apply multigroup structural equation modeling (SEM) to examine the structural stability of competency constructs across regions and healthcare cultures. These efforts will support the gradual establishment of a culturally embedded physician competency model, thereby reinforcing the practical utility of competency theory within the specific institutional and cultural landscape of medical education and training in China.

In summary, this study provides a valuable theoretical foundation and empirical basis for competency assessment among oncologists. However, further efforts are needed to expand the scope in terms of sample diversity, data objectivity, temporal design, dimensional coverage, and cultural embeddedness to facilitate the meaningful integration of physician competency research with clinical practice.

5.6 Conclusion

Grounded in competency theory, this study develops and validates a job competency model for oncologists comprising six dimensions and nineteen specific attributes. The model's predictive validity for job performance is empirically tested, and the analysis further identifies the moderating mechanisms of selected competency dimensions within the predictive pathway. These findings demonstrate strong theoretical significance and practical implications. The results not only enrich the conceptual scope and extend the application of physician competency frameworks but also offer empirical support and theoretical grounding for the selection, training, and evaluation of oncology specialists. This study has the potential to inform the development of scalable talent evaluation pathways within the broader agenda of high-quality development of China's healthcare system.

Bibliography

Aaronson, N. K., Ahmedzai, S., Bergman, B., Bullinger, M., Cull, A., Duez, N. J., Filiberti, A., Flechtner, H., Fleishman, S. B., Haes, J. C. J. M., Kaasa, S., Klee, M., Osoba, D., Razavi, D., Rofe, P. B., Schraub, S., Sneeuw, K., Sullivan, M., & Takeda, F. (1993). The European Organization for Research and Treatment of Cancer QLQ-C30: A quality-of-life instrument for use in international clinical trials in oncology. *Journal of the National Cancer Institute*, *85*(5), 365-376.

Abdelmoteleb, S. A. (2020). Work values and employee effort: A needs-supplies fit perspective. *Journal of Work and Organizational Psychology*, *36*(1), 15-25.

Abu-Helalah, M. A., Alshraideh, H. A., Da'Na, M., Al-Hanaqtah, M., Abuseif, A., Arqoob, K., & Ajaj, A. (2016). Delay in presentation, diagnosis and treatment for colorectal cancer patients in Jordan. *Journal of Gastrointestinal Cancer*, *47*(1), 36-46.

Allworth, E., & Hesketh, B. (1997, August 13-15). *Adaptive performance: Updating the criterion to cope with change*. 2nd Australian Industrial and Organizational Psychology Conference, Melbourne, Australia.

Andersson, H., Svensson, A., Frank, C., Rantala, A., Holmberg, M., & Bremer, A. (2022). Ethics education to support ethical competence learning in healthcare: An integrative systematic review. *Biomed Central Medical Ethics*, *23*(1), 29.

Back, A., Tulsky, J. A., & Arnold, R. M. (2020). Communication skills in the age of COVID-19. *Annals of Internal Medicine*, *172*(11), 759-760.

Barrett, G. V., & Depinet, R. L. (1991). A reconsideration of testing for competence rather than for intelligence. *American Psychologist*, *46*(10), 1012-1024.

Barry, B., & Stewart, G. L. (1997). Composition, process, and performance in self-managed groups: The role of personality. *Journal of Applied Psychology*, *82*(1), 62-78.

Batalden, P., Leach, D., Swing, S., Dreyfus, H., & Dreyfus, S. (2002). General competencies and accreditation in graduate medical education. *Health Affairs*, *21*(5), 103-111.

Beauchamp, T. L., & Childress, J. F. (2013). *Principles of biomedical ethics* (7th rev. ed.). Oxford University Press.

Beckman, T. J., & Lee, M. C. (2009). Proposal for a collaborative approach to clinical teaching. *Mayo Clinic Proceedings*, *84*(4), 339-344.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588-606.

Bernadin, H. K., Kane, J. S., Ross, S., Spina, J. D., & Johnson, D. L. (1995). Performance appraisal design, development and implementation. In R. Ferris, S. Rosen, & D. Barnum (Eds.), *Handbook of human resource management* (pp. 407-415). Blackwell.

Berwick, D. M., Nolan, T. W., & Whittington, J. (2008). The triple aim: Care, health, and cost. *Health Affairs*, *27*(3), 759-769.

Betancourt, J. R., Green, A. R., Carrillo, J. E., & Ananeh-Firempong, O. N. (2003). Defining cultural competence: A practical framework for addressing racial/ethnic disparities in health and health care. *Public Health Reports*, *118*(4), 293-302.

Bland, C. J., & Ruffin, M. T. T. (1992). Characteristics of a productive research environment: Literature review. *Academic Medicine*, *67*(6), 385-397.

Bonesso, S., Gerli, F., Zampieri, R., & Boyatzis, R. E. (2020). Updating the debate on behavioral competency development: State of the art and future challenges. *Frontiers in Psychology*, *11*, 1267.

Bonner, T. N. (2000). *Becoming a physician: Medical education in Britain, France, Germany, and the United States, 1750-1945*. JHU Press.

Borman, W. C., & Motowidlo, S. M. (1993). Expanding the criterion domain to include elements of contextual performance. In N. Schmitt & W. C. Borman (Eds.), *Personnel selection in organizations* (pp. 71-98). Jossey-Bass.

Boyatzis, R. E. (1991). *The competent manager: A model for effective performance*. John Wiley & Sons.

Brislin, R. W. (1980). Cross-cultural research methods: Strategies, problems, applications. In R. W. Brislin (Ed.), *Environment and culture* (pp. 47-82). Springer.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Sage.

Bui, H. T., Zeng, Y., & Higgs, M. (2017). The role of person-job fit in the relationship between transformational leadership and job engagement. *Journal of Managerial Psychology, 32*(5), 373-386.

Burmeister, J. W., Tracey, M. W., Kacin, S. E., Dominello, M. M., & Joiner, M. C. (2018). Improving research in radiation oncology through interdisciplinary collaboration. *Radiation Research, 190*(1), 1-4.

Byham, W. C., & Moyer, R. P. (1996). Using competencies to build a successful organization. *Training and Development, 54*(1), 61-80.

Campanella, P., Lovato, E., Marone, C., Fallacara, L., Mancuso, A., Ricciardi, W., & Specchia, M. L. (2016). The impact of electronic health records on healthcare quality: A systematic review and meta-analysis. *European Journal of Public Health, 26*(1), 60-64.

Campbell, J. P. (1990). *Modeling the performance prediction problem in industrial and organizational psychology*. Consulting Psychologists Press.

Campbell, J. P., Dunnette, M. D., Arvey, R. D., & Hellervik, L. V. (1973). The development and evaluation of behaviorally based rating scales. *Journal of Applied Psychology, 57*(1), 15-22.

Campion, M. A., Fink, A. A., Ruggeberg, B. J., Carr, L., Phillips, G. M., & Odman, R. B. (2011). Doing competencies well: Best practices in competency modeling. *Personnel Psychology, 64*(1), 225-262.

Caplan, R. D., & Van Harrison, R. (1993). Person‐environment fit theory: Some history, recent developments, and future directions. *Journal of Social Issues, 49*(4), 253-275.

Carmines, E. G., McIver, J. P., Bohrnstedt, G. W., & Borgatta, E. F. (1981). Social measurement: Current issues. *Analyzing Models with Unobserved Variables: Analysis of Covariance Structures, 80*, 65-115.

Chandio, M. T., Pandhiani, S. M., & Iqbal, R. (2016). Bloom's taxonomy: Improving assessment and teaching-learning process. *Journal of Education and Educational Development, 3*(2), 203-221.

Charbonnier Voirin, A., & Roussel, P. (2012). Adaptive performance: A new scale to measure individual performance in organizations. *Canadian Journal of Administrative Sciences, 29*(3), 280-293.

Chen, W. X., Dou, Z. C., Fun, Y. S., Gui, T., Han, X. P., Hu, B. T., Huang, M. L., Huang, X. J., Liu, K., Liu, T., Liu, Z. Y., Qin, B., Qiu, X. P., Wang, X. J., Wang, Y. X., Wen, J. R., Yan, R., Zhang, J. J., Zhang, M., Zhang, Q., Zhao, J., Zhao, X., & Zhao, Y. Y. (2023). 大模型时代的自然语言处理:挑战、机遇与发展 [Natural language processing in the era of large models: Challenges, opportunities and development]. *Scientia Sinica (Informationis), 53*(09), 1645-1687.

Chen, Y. S. (2011). *Research on competence-based performance evaluation of university counselors* [Doctoral dissertation]. Nanjing University of Aeronautics and Astronautics.

Chouhan, V. S., & Srivastava, S. (2014). Understanding competencies and competency

modeling-A literature survey. *International Organization of Scientific Research Journal of Business and Management*, *16*(1), 14-22.

Christianne, D., & Brian, H. K. (1994). New developments in employee training. *Work Study*, *43*(2), 13-16.

Clauser, S. B., Wagner, E. H., Aiello Bowles, E. J., Tuzzio, L., & Greene, S. M. (2011). Improving modern cancer care through information technology. *American Journal of Preventive Medicine*, *40*(5 Suppl 2), S198-S207.

Cockerill, T., Hunt, J., & Schroder, H. (1995). Managerial competencies: Fact or fiction? *Business Strategy Review*, *6*(3), 1-12.

Cohen, J. D., Li, L., Wang, Y., Thoburn, C., Afsari, B., Danilova, L., Douville, C., Javed, A. A., Wong, F., Mattox, A., Hruban, R. H., Wolfgang, C. L., Goggins, M. G., Dal Molin, M., Wang, T., Roden, R., Klein, A. P., Ptak, J., Dobbyn, L., Schaefer, J., Silliman, N., Popoli, M., Vogelstein, J. T., Browne, J. D., Schoen, R. E., Brand, R. E., Tie, J., Gibbs, P., Wong, H., Mansfield, A. S., Jen, J., Hanash, S. M., Falconi, M., Allen, P. J., Zhou, S., Bettegowda, C., Diaz, L. A. J., Tomasetti, C., Kinzler, K. W., Vogelstein, B., Lennon, A. M., & Papadopoulos, N. (2018). Detection and localization of surgically resectable cancers with a multi-analyte blood test. *Science*, *359*(6378), 926-930.

Cohen, T. R., & Morse, L. (2014). Moral character: What it is and what it does. *Research in Organizational Behavior*, *34*, 43-61.

Corbett, S. (2023). Developing contextualised literature-informed competency frameworks for middle managers in education. *Educational Management Administration & Leadership*, *51*(6), 1401-1421.

Crane, P. C., & Selanders, L. (2017). Surgical oncology nursing: Looking back, looking forward. *Seminars in Oncology Nursing*, *33*(1), 2-8.

Cruess, R. L., & Cruess, S. R. (2020). Professionalism, communities of practice, and medicine's social contract. *Journal of the American Board of Family Medicine*, *33*(Suppl), S50-S56.

Cufer, T., Kosty, M., Osterlund, P., Jezdic, S., Pyle, D., Awada, A., Close, J., El-Saghir, N., Lordick, F., Rutkowski, P., Tfayli, A., & Wildiers, H. (2021). Current landscape of ESMO/ASCO Global Curriculum adoption and medical oncology recognition: A global survey. *European Society for Medical Oncology Open*, *6*(6), 100219.

Cufer, T., & Kosty, M. P. (2023). ESMO/ASCO recommendations for a global curriculum in medical oncology edition 2023. *Journal of Clinical Oncology Global-Oncology*, *9*, e2300277.

Dean, M., & Street, R. L. J. (2014). A 3-stage model of patient-centered communication for addressing cancer patients' emotional distress. *Patient Education and Counseling*, *94*(2), 143-148.

DeVita, V. T. J., & Chu, E. (2008). A history of cancer chemotherapy. *Cancer Research*, *68*(21), 8643-8653.

Dobson, C. M., Russell, A. J., & Rubin, G. P. (2014). Patient delay in cancer diagnosis: What do we really mean and can we be more specific? *Biomed Central Health Services Research*, *14*, 387.

Edgerton, J. D., Roberts, L. W., & von Below, S. (2012). Education and quality of life. In K. Land, A. Michalos, & M. Sirgy (Eds.), *Handbook of social indicators and quality of life research* (pp. 265-296). Springer.

Emerson, N. D., Tabuenca, K., & Bursch, B. (2022). End-of-life care in patients with cancer 16-24 years of age. *Current Oncology Reports*, *24*(2), 195-202.

Epstein, R. M., Hundert, E. M., Rogers, B., & Schill, A. L. (2002). Defining and assessing professional competence Ethics and Total Worker Health (®): Constructs for Ethical Decision-Making and Competencies for Professional Practice. *Journal of the American Medical Association*, *287*(2), 226-235.

Epstein, R. M., & Street Jr, R. L. (2007). Patient-centered communication in cancer care: promoting healing and reducing suffering. *National Cancer Institute*.

Eva, K. W., & Regehr, G. (2005). Self-assessment in the health professions: A reformulation and research agenda. *Academic Medicine*, *80*(10 Suppl), S46-S54.

Fan, C. Z., & An, G. Y. (2016). 综合性医院的肿瘤科中住院医师规范化培训的思考 [Reflection on resident standardization training in the oncology department of comprehensive hospitals]. *Chinese Medical Records*, *17*(08), 75-77.

Flexner, A. (1910). Medical education in the United States and Canada. *Science*, *32*(810), 41-50.

Frank, J. R., & Danoff, D. (2007). The CanMEDS initiative: implementing an outcomes-based framework of physician competencies. *Medical Teacher*, *29*(7), 642-647.

Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology research. *Journal of Counseling Psychology*, *51*(1), 115-134.

Friedman, B. D., & Allen, K. N. (2011). Systems theory. *Theory & Practice in Clinical Social Work*, *2*(3), 3-20.

Ghassemi, M., Oakden-Rayner, L., & Beam, A. L. (2021). The false hope of current approaches to explainable artificial intelligence in health care. *Lancet Digital Health*, *3*(11), e745-e750.

Gorin, S. S., Haggstrom, D., Han, P. K. J., Fairfield, K. M., Krebs, P., & Clauser, S. B. (2017). Cancer care coordination: A systematic review and meta-analysis of over 30 years of empirical studies. *Annals of Behavioral Medicine*, *51*(4), 532-546.

Grant, R. M., & Baden-Fuller, C. (2018). How to develop strategic management competency: Reconsidering the learning goals and knowledge requirements of the core strategy course. *Academy of Management Learning & Education*, *17*(3), 322-338.

Green, P. (1999). *Building robust competencies: Linking human resource systems to organizational strategies*. Jossey-Bass.

Greguras, G. J., & Diefendorff, J. M. (2009). Different fits satisfy different needs: Linking person-environment fit to employee commitment and performance using self-determination theory. *Journal of Applied Psychology*, *94*(2), 465-477.

Groenvold, M., Petersen, M. A., Aaronson, N. K., Arraras, J. I., Blazeby, J. M., Bottomley, A., Fayers, P. M., de Graeff, A., Hammerlid, E., Kaasa, S., Sprangers, M. A., & Bjorner, J. B. (2006). The development of the EORTC QLQ-C15-PAL: A shortened questionnaire for cancer patients in palliative care. *European Journal of Cancer*, *42*(1), 55-64.

Hackney, L., O'Neill, S., O'Donnell, M., & Spence, R. (2023). A scoping review of assessment methods of competence of general surgical trainees. *The Surgeon*, *21*(1), 60-69.

Hadjimichael, D., & Tsoukas, H. (2019). Toward a better understanding of tacit knowledge in organizations: Taking stock and moving forward. *Academy of Management Annals*, *13*(2), 672-703.

Hajdu, S. I. (2004). A note from history: The first tumor pathologist. *Annals of Clinical and Laboratory Science*, *34*(3), 355-356.

Hajdu, S. I. (2011a). A note from history: Landmarks in history of cancer, part 1. *Cancer*, *117*(5), 1097-1102.

Hajdu, S. I. (2011b). A note from history: Landmarks in history of cancer, part 2. *Cancer*, *117*(12), 2811-2820.

Hajdu, S. I. (2016). Pathfinders in oncology from ancient times to the end of the Middle Ages. *Cancer*, *122*(11), 1638-1646.

Hajdu, S. I. (2017). Pathfinders in oncology from the end of the Middle Ages to the beginning of the 19th century. *Cancer*, *123*(11), 1888-1897.

Hall, J., Atkinson, A., Chan, M. K., Tourian, L., Thoma, B., & Pattani, R. (2023). The clinical learning environment in CanMEDS 2025. *Canadian Medical Education Journal*, *14*(1), 41-45.

Han, Y., Liao, J. Q., & Long, L. R. (2007). 雇员工作绩效结构模型构建与实证研究 [Model construction and empirical research of employee work performance structure]. *Journal of Management Sciences in China*, (05), 62-77.

Hancock, J., Witter, T., Comber, S., Daley, P., Thompson, K., Candow, S., Follett, G., Somers, W., Collins, C., White, J., & Kits, O. (2020). Understanding burnout and moral distress to build resilience: A qualitative study of an interprofessional intensive care unit team. *Canadian Journal of Anesthesia*, *67*(11), 1541-1548.

Hansen, H. H., Bajorin, D. F., Muss, H. B., Purkalne, G., Schrijvers, D., & Stahel, R. (2004). Recommendations for a global core curriculum in medical oncology. *Annals of Oncology*, *15*(11), 1603-1612.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* Guilford Press.

Heath, C., Luff, P., & Svensson, M. S. (2003). Technology and medical practice. *Sociology of Health & Illness*, *25*(3), 75-96.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences*, *102*(46), 16569-16572.

Hlubocky, F. J., Back, A. L., & Shanafelt, T. D. (2016). Addressing burnout in oncology: Why cancer care clinicians are at risk, what individuals can do, and how organizations can respond. *American Society of Clinical Oncology Education Book*, *35*, 271-279.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and organizations: Software of the mind* (3rd ed.). McGraw-Hill.

Hollingworth, H. L. (1913). Scientific books: Psychology and industrial efficiency. *Science*, *38*(967), 56-57.

Hsu, S. (2023). *Knowledge sharing and word-of-mouth development of financial services: Moderation of risk preference and customer education* [Master's thesis]. National Yang Ming Chiao Tung University.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1-55.

Huecker, M. R., & Shreffler, J. (2025). *Ethical issues in academic medicine*. StatPearls.

Hui, D., Hoge, G., & Bruera, E. (2021). Models of supportive care in oncology. *Current Opinion in Oncology*, *33*(4), 259-266.

Huy, P. Q., & Phuc, V. K. (2020). The impact of public sector scorecard adoption on the effectiveness of accounting information systems towards the sustainable performance in public sector. *Cogent Business & Management*, *7*(1), 1717-1718.

Jacobs, P. A. (2016). *The potential of the comet competence diagnostic model for the assessment and development of occupational competence and commitment in technical vocational education and training* [Doctoral dissertation]. Universität Bremen.

Jenkins, V., Fallowfield, L., & Saul, J. (2001). Information needs of patients with cancer: Results from a large study in UK cancer centres. *British Journal of Cancer*, *84*(1), 48-51.

Jensen, A. R. (2011). The theory of intelligence and its measurement. *Intelligence*, *39*(4), 171-177.

Jiang, F., Jiang, Y., Zhi, H., Dong, Y., Li, H., Ma, S., Wang, Y., Dong, Q., Shen, H., & Wang, Y. (2017). Artificial intelligence in healthcare: Past, present and future. *Stroke and Vascular Neurology*, *2*(4), 230-243.

Jiang, T. (2022). 因果推断经验研究中的中介效应与调节效应 [Mediating effects and moderating effects in causal inference empirical research]. *China Industrial Economics*, (05), 100-120.

Jin, Y. H., Chen, W. Q., & Wang, C. M. (2004). 管理胜任特征与工作绩效关系研究 [Research on the relationship between management competency and job performance].

Journal of Psychological Science, *27*(6), 1349-1351.

Johnson, D. H. (2014). Obligations of an academic and clinical oncologist: Historical reflections. *American Society of Clinical Oncology Educational Book*, *34*, 78-81.

Johnson, J. W. (2001). The relative importance of task and contextual performance dimensions to supervisor judgments of overall performance. *Journal of Applied Psychology*, *86*(5), 984-996.

Jöreskog, K. G. (1969). A General Approach to Confirmatory Maximum Likelihood Factor Analysis. *Psychometrika*, *34*(2), 183-202.

Katz, D., & Kahn, R. L. (1978). *The social psychology of organizations*. John Wiley Publishers.

Köckerling, F., Köckerling, D., & Lomas, C. (2013). Cornelius Celsus--ancient encyclopedist, surgeon-scientist, or master of surgery? *Langenbecks Archives of Surgery*, *398*(4), 609-616.

Kroth, P. J., Morioka-Douglas, N., Veres, S., Babbott, S., Poplau, S., Qeadan, F., Parshall, C., Corrigan, K., & Linzer, M. (2019). Association of electronic health record design and use factors with clinician stress and burnout. *Jama Network Open*, *2*(8), e199609.

Kumar, P., Wright, A. A., Hatfield, L. A., Temel, J. S., & Keating, N. L. (2017). Family perspectives on hospice care experiences of patients with cancer. *Journal of Clinical Oncology*, *35*(4), 432-439.

Kurtz, S., Silverman, J., Benson, J., & Draper, J. (2003). Marrying content and process in clinical method teaching: Enhancing the calgary – cambridge guides. *Academic Medicine*, *78*(8), 802-809.

Leach, D. C. (2002). Competence is a habit. *Jama-Journal of the American Medical Association*, *287*(2), 243-244.

Ledford Jr, G. E. (1995). Paying for the skills, knowledge, and competencies of knowledge workers. *Compensation & Benefits Review*, *27*(4), 55-62.

Li, H. Z. (2004). *管理研究方法论* [Methodology of management research] (Vol. 1ed.). Xi'an Jiaotong University Press.

Lin, L., Savoia, E., Agboola, F., & Viswanath, K. (2014). What have we learned about communication inequalities during the H1N1 pandemic: A systematic review of the literature. *Biomed Central Public Health*, *14*, 484.

Lin, L., & Zhang, M. (2010). 基于胜任力的医院岗位绩效评价 [Competency-based performance evaluation of hospital positions]. *Chinese Hospital Management*, *30*(5), 35-36.

Lin, Y. (2021). A study on the relationship between project management competency, job performance and job motivation in e-commerce industry. *Measuring Business Excellence*, *25*(1), 24-57.

Lin, Z. Y. (2001). *3P模式: 中国企业人力资源管理操作方案* [3P model: Human resource management operation plan for Chinese enterprises]. CITIC Publishing.

Litjens, G., Kooi, T., Bejnordi, B. E., Setio, A. A. A., Ciompi, F., Ghafoorian, M., van der Laak, J., van Ginneken, B., & Sánchez, C. I. (2017). A survey on deep learning in medical image analysis. *Medical Image Analysis*, *42*, 60-88.

Liu, G. C., & Cao, C. M. (2022). 中国体医融合人才培养的专业、职业、就业体系构建——临床运动生理学的域外经验 [The construction of professional, vocational, and employment system for the integration of Chinese sports medicine - The experience of clinical exercise physiology]. *China Sport Science*, *42*(12), 29-42.

Lloyd, T., Phillips, B. R., & Aber, R. C. (2004). Factors that influence doctors' participation in clinical research. *Medical Education*, *38*(8), 848-851.

Loud, J. T., & Murphy, J. (2017). Cancer screening and early detection in the 21(st) century. *Seminars in Oncology Nursing*, *33*(2), 121-128.

Ludmerer, K. M. (1999). *Time to heal: American medical education from the turn of the century*

to the era of managed care. Oxford University Press.

Lv, Z. B. (2006). 建立基于胜任特征的绩效评价体系 [Establish a performance evaluation system based on competency characteristics]. *China Science and Technology Information*, (02B), 56.

Ma, Q. G. (2005). *应用统计学* [Applied statistics]. China Science Publishing & Media Ltd.

Makoul, G., Krupat, E., & Chang, C. (2007). Measuring patient views of physician communication skills: Development and testing of the communication assessment tool. *Patient Education and Counseling*, *67*(3), 333-342.

Marrelli, A. F. (1998). An introduction to competency analysis and modeling. *Performance Improvement*, *37*(5), 8-17.

Matalon, S. A., Howard, S. A., & Abrams, M. J. (2019). Assessment of radiology training during radiation oncology residency. *Journal of Cancer Education*, *34*(4), 691-695.

Mathew, J., Ogbonna, E., & Harris, L. C. (2012). Culture, employee work outcomes and performance: An empirical analysis of Indian software firms. *Journal of World Business*, *47*(2), 194-203.

Mattiuzzi, C., & Lippi, G. (2019). Current cancer epidemiology. *Journal of Epidemiology and Global Health*, *9*(4), 217-222.

Mazor, K. M., Simon, S. R., Yood, R. A., Martinson, B. C., Gunter, M. J., Reed, G. W., & Gurwitz, J. H. (2004). Health plan members' views about disclosure of medical errors. *Annals of Internal Medicine*, *140*(6), 409-418.

McClelland, D. C. (1973). Testing for competence rather than for "intelligence". *American Psychologist*, *28*(1), 1-14.

McFarland, D. C., & Hlubocky, F. J. (2019). The oncologist as therapist. *Journal of Oncology Practice*, *15*(10), 539-546.

McKinney, S. M., Sieniek, M., Godbole, V., Godwin, J., Antropova, N., Ashrafian, H., Back, T., Chesus, M., Corrado, G. S., Darzi, A., Etemadi, M., Garcia-Vicente, F., Gilbert, F. J., Halling-Brown, M., Hassabis, D., Jansen, S., Karthikesalingam, A., Kelly, C. J., King, D., Ledsam, J. R., Melnick, D., Mostofi, H., Peng, L., Reicher, J. J., Romera-Paredes, B., Sidebottom, R., Suleyman, M., Tse, D., Young, K. C., De Fauw, J., & Shetty, S. (2020). International evaluation of an AI system for breast cancer screening. *Nature*, *577*(7788), 89-94.

McLagan, P. A. (1980). Competency models. *Training and Development Journal*, *34*(12), 22-26.

McPhail, S., Johnson, S., Greenberg, D., Peake, M., & Rous, B. (2015). Stage at diagnosis and early mortality from cancer in England. *British Journal of Cancer*, *112*(Suppl 1), S108-S115.

Memon, M. A., Salleh, R., & Baharom, M. N. R. (2015). Linking person-job fit, person-organization fit, employee engagement and turnover intention: A three-step conceptual model. *Asian Social Science*, *11*(2), 313-323.

Mensah, J. K., & Bawole, J. N. (2020). Person‐job fit matters in parastatal institutions: Testing the mediating effect of person‐job fit in the relationship between talent management and employee outcomes. *International Review of Administrative Sciences*, *86*(3), 479-495.

Mirabile, R. J. (1997). Everything you wanted to know about competency modeling. *Training and Development*, *51*(8), 73-77.

Moreira, F., Teixeira, P., & Leão, C. (2021). Effectiveness of medical ethics education: A systematic review. *Medical Education Publish*, *10*, 175.

Nasca, T. J., Philibert, I., Brigham, T., & Flynn, T. C. (2012). The next GME accreditation system--rationale and benefits. *New England Journal of Medicine*, *366*(11), 1051-1056.

Neisser, U., Boodoo, G., Bouchard Jr, T. J., Boykin, A. W., Brody, N., Ceci, S. J., Halpern, D. F., Loehlin, J. C., Perloff, R., & Sternberg, R. J. (1996). Intelligence: Knowns and

unknowns. *American Psychologist*, *51*(2), 77-101.
Nikendei, C., Weyrich, P., Jünger, J., & Schrauth, M. (2009). Medical education in Germany. *Medical Teacher*, *31*(7), 591-600.
Nunnally, J., & Bernstein, I. (1994). *Psychometric theory* (3rd ed.). NY: MacGraw-Hill.
Oandasan, I., & Reeves, S. (2005). Key elements for interprofessional education. Part 1: the learner, the educator and the learning context. *Journal of Interprofessional Care*, *19*(Suppl 1), 21-38.
Oehley, A. (2007). *The development and evaluation of a partial talent management competency model* [Doctoral dissertation]. University of Stellenbosch.
Oyetunde, M. O., & Oluwafunke, K. I. (2015). Professional development and career pathway in nursing. *International Journal of Sciences*, *4*(6), 92-104.
Park, Y. H. (2020). Career competencies and perceived work performance. *The Journal of Asian Finance, Economics and Business*, *7*(6), 317-326.
Parry, S. B. (1996). Just what is a competency? (And why should you care?). *Training*, *35*(6), 58.
Pavlidis, N., Peccatori, F. A., Aapro, M., Eniu, A., Kay, S., Rolfo, C., Cavalli, F., & Costa, A. (2020). The impact of the European School of Oncology masterclass in clinical oncology on self-professional development. *Critical Reviews in Oncology Hematology*, *151*, 102976.
Pinsky, P. F. (2015). Principles of cancer screening. *Surgical Clinics of North America*, *95*(5), 953-966.
Prades, J., Remue, E., van Hoof, E., & Borras, J. M. (2015). Is it worth reorganising cancer services on the basis of multidisciplinary teams (MDTs)? A systematic review of the objectives and organisation of MDTs and their impact on patient outcomes. *Health Policy*, *119*(4), 464-474.
Pronovost, P. J., Berenholtz, S. M., & Needham, D. M. (2008). Translating evidence into practice: A model for large scale knowledge translation. *British Medical Journal*, *337*, a1714.
Pulakos, E. D., Arad, S., Donovan, M. A., & Plamondon, K. E. (2000). Adaptability in the workplace: Development of a taxonomy of adaptive performance. *Journal of Applied Psychology*, *85*(4), 612-624.
Pulakos, E. D., Schmitt, N., Dorsey, D. W., Arad, S., Borman, W. C., & Hedge, J. W. (2002). Predicting adaptive performance: Further tests of a model of adaptability. *Human Performance*, *15*(4), 299-323.
Ren, L., & Zhao, X. F. (2021). 基于洋葱模型的妇幼专科医院新护士岗位胜任力模型及指标体系构建 [Based on the onion model, construction of the new nurse position competence model and indicator system of maternity and child health hospital]. *Journal of Nursing (China)*, *28*(7), 21-25.
Rogers, B., & Schill, A. L. (2021). Ethics and total worker health (®): constructs for ethical decision-making and competencies for professional practice. *International Journal of Environmental Research and Public Health*, *18*(19), 10030.
Rotundo, M. (2002). The relative importance of task, citizenship, and counterproductive performance to global ratings of job performance: A policy-capturing approach. *Journal of Applied Psychology*, *87*(1), 66-80.
Sandberg, J. (2000). Understanding human competence at work: An interpretative approach. *Academy of Management Journal*, *43*(1), 9-25.
Sanghi, S. (2003). *The handbook of competency mapping: Understanding, designing and implementing competency models in organizations*. Sage.
Schmid Mast, M., Kindlimann, A., & Langewitz, W. (2005). Recipients' perspective on breaking bad news: How you put it really makes a difference. *Patient Education and Counseling*, *58*(3), 244-251.

Shet, S. V., Patil, S. V., & Chandawarkar, M. R. (2019). Competency based superior performance and organizational effectiveness. *International Journal of Productivity and Performance Management*, *68*(4), 753-773.

Shi, K. (2006). 基于胜任特征模型的人力资源开发 [Human resource development based on competency model]. *Advances in Psychological Science*, (4), 586-595.

Shi, K., Wang, J. C., & Li, C. P. (2002). 企业高层管理者胜任特征模型评价的研究 [Research on the evaluation of the competency model for senior corporate managers]. *Acta Psychologica Sinica*, (03), 306-311.

Shippmann, J. S., Ash, R. A., Batjtsta, M., Carr, L., Eyde, L. D., Hesketh, B., Kehoe, J., Pearlman, K., Prien, E. P., & Sanchez, J. I. (2000). The practice of competency modeling. *Personnel Psychology*, *53*(3), 703-740.

Singer, S., Lin, S., Falwell, A., Gaba, D., & Baker, L. (2009). Relationship of safety climate and safety performance in hospitals. *Health Services Research*, *44*(2 Pt 1), 399-421.

Singh, S. D., Henley, S. J., & Ryerson, A. B. (2016). Surveillance for cancer incidence and mortality — United States, 2012. *Morbidity and Mortality Weekly Report*, *63*(55), 17-58.

Škrinjarić, B. (2022). Competence-based approaches in organizational and individual context. *Humanities and Social Sciences Communications*, *9*(1), 1-12.

Smith, R. A., Andrews, K. S., Brooks, D., Fedewa, S. A., Manassaram-Baptiste, D., Saslow, D., Brawley, O. W., & Wender, R. C. (2018). Cancer screening in the United States, 2018: A review of current American Cancer Society guidelines and current issues in cancer screening. *A Cancer Journal for Clinicians*, *68*(4), 297-316.

Song, P. L. (2010). 基于企业成长不同阶段的企业家胜任力结构辨析 [Analyzing the structure of entrepreneurial competence based on different stages of enterprise growth]. *China Management Magazine*, (02), 51-61.

Spencer, L. M., & Spencer, S. M. (1993). *Competence at work: models for superior performance*. Wiley.

Stevens, G. W. (2013). A critical review of the science and practice of competency modeling. *Human Resource Development Review*, *12*(1), 86-107.

Stokes, J., Checkland, K., & Kristensen, S. R. (2016). Integrated care: Theory to practice. *Journal of Health Services Research & Policy*, *21*(4), 282-285.

Sun, J. M., & Jiao, C. Q. (2002). 对管理者工作绩效结构的探索性研究 [Exploratory study on the structure of managerial work performance]. *Chinese Journal of Ergonomics*, (03), 1-10.

Swami, M., & Case, A. A. (2018). Effective palliative care: What is involved? *Oncology-New York*, *32*(4), 180-184.

Swing, S. R. (2007). The ACGME outcome project: Retrospective and prospective. *Medical Teacher*, *29*(7), 648-654.

Tao, Q., & Wang, C. M. (2006). 管理培训背景下适应性绩效的结构分析 [Structural analysis of adaptive performance in the context of management training]. *Journal of Psychological Science*, *29*(3), 614-617.

Ten Cate, O. (2013). Nuts and bolts of entrustable professional activities. *Journal of Graduate Medical Education*, *5*(1), 157-158.

Ten Cate, O., Balmer, D. F., Caretta-Weyer, H., Hatala, R., Hennus, M. P., & West, D. C. (2021). Entrustable professional activities and entrustment decision making: A development and research agenda for the next decade. *Academic Medicine*, *96*(7S), S96-S104.

Ten Cate, O., & Scheele, F. (2007). Competency-based postgraduate training: can we bridge the gap between theory and clinical practice? *Academic Medicine*, *82*(6), 542-547.

Ten Have, H., & Gordijn, B. (2014). *Handbook of global bioethics*. Springer Netherlands.

Thoma, B., Karwowska, A., Samson, L., Labine, N., Waters, H., Giuliani, M., Chan, T. M., Atkinson, A., Constantin, E., Hall, A. K., Gomez-Garibello, C., Fowler, N., Tourian, L., Frank, J., Anderson, R., Snell, L., & Van Melle, E. (2023). Emerging concepts in the CanMEDS physician competency framework. *Canadian Medical Education Journal*, *14*(1), 4-12.

Thornton III, G. C., & Byham, W. C. (2013). *Assessment centers and managerial performance*. Elsevier.

Topol, E. (2019). *Deep medicine: How artificial intelligence can make healthcare human again*. Hachette UK.

Trautmann, M., Voelcker-Rehage, C., & Godde, B. (2011). Fit between workers' competencies and job demands as predictor for job performance over the work career. *Journal for Labor Market Research*, *44*(4), 339-347.

Truant, T. L., Fitch, M. I., O'Leary, C., & Stewart, J. (2017). Global perspectives on cancer survivorship: From lost in transition to leading into the future. *Canadian Oncology Nursing Journal*, *27*(3), 287-294.

Van Scotter, J. R., & Motowidlo, S. J. (1996). Interpersonal facilitation and job dedication as separate facets of contextual performance. *Journal of Applied Psychology*, *81*(5), 525.

Wang, C. M., & Chen, M. K. (2002). 管理胜任力特征分析:结构方程模型检验 [Management competency analysis: Structural equation model testing]. *Journal of Psychological Science*, *25*(5), 513-516.

Wang, Q., & Xu, J. H. (2019). 国内图书馆职业研究述评与未来趋向 [Review and future trends of domestic library science research]. *Journal of Academic Libraries*, *37*(04), 14-24.

Wartman, S. A., & Combs, C. D. (2018). Medical education must move from the information age to the age of artificial intelligence. *Academic Medicine*, *93*(8), 1107-1109.

Wei, Z. H., Huang, X. F., Wen, J. J., & Lu, G. M. (2022). *临床实践教育教学改革探索* [Exploration of clinical practice education teaching reform]. Chongqing University Electronic Audio-Visual Publishing Co., Ltd.

Wen, J. D. (2005). 经济学研究的复杂性科学思路 [The scientific approach to the complexity of economic research]. *Economic Perspectives*, (06), 66-72.

Wen, Z. Y. (2005). 工作绩效的四因素结构模型 [A four-factor structural model of job performance]. *Journal of Capital Normal University (Social Sciences Edition)*, (05), 105-111.

Wheaton, B., Muthen, B., Alwin, D. F., & Summers, G. F. (1977). Assessing reliability and stability in panel models. *Sociological Methodology*, *8*, 84-136.

Wong, W. Y., & Moni, K. (2014). Teachers' perceptions of and responses to student evaluation of teaching: Purposes and uses in clinical education. *Assessment and Evaluation in Higher Education*, *39*(4), 397-411.

Wootton, R. (2012). Twenty years of telemedicine in chronic disease management--an evidence synthesis. *Journal of Telemedicine and Telecare*, *18*(4), 211-220.

Wu, M. J. (2004). 职业营销经理胜任特征模型研究 [Research on competency model of professional marketing manage]. *Journal of Chongqing University (Social Science Edition)*, *10*(1), 126-129.

Wu, M. L. (2009). *结构方程模型: AMOS的操作与应用* [Structural equation modeling: Operation and application of AMOS]. Chongqing University Press.

Wu, X. P., Xu, F. Y., & Zhou, Y. (2006). 高校教师工作绩效的影响因素分析 [Analysis of factors influencing the work performance of university teachers]. *Journal of East China Normal University (Educational Sciences)*, *24*(1), 30-37.

Wynia, M. K., Latham, S. R., Kao, A. C., Berg, J. W., & Emanuel, L. L. (1999). Medical professionalism in society. *New England Journal of Medicine*, *341*(21), 1612-1616.

Xu, J. (2021). *医疗意见领袖与患者就医行为研究* [Research on medical opinion leaders and patient medical-seeking behaviors]. Huazhong University of Science and Technology Press.

Xu, L., Fu, P., Xi, Y., Zhang, L., Zhao, X., Cao, C., Liao, Y., Li, G., Xue, X., & Ge, J. (2014). Adding dynamics to a static theory: How leader traits evolve and how they are expressed. *The Leadership Quarterly, 25*(6), 1095-1119.

Xu, Y. D. (2023). *The impact of public hospitals' leadership competency on scientific research performance* [Master's degree]. Southeast University.

Ye, J. Y. (2010). 人文社会科学评价体系探讨 [Exploration of the evaluation system of humanities and social sciences]. *Journal of Nanjing University (Philosophy, Humanities and Social Sciences), 47*(1), 97-110.

Yuan, F., Song, S. T., Fu, J., Zhang, Y., Jia, X. M., & Liu, R. (2022). 浅析大型综合性医院规培医师科研能力的培养与建设 [Research on the cultivation and construction of scientific research ability of doctors in large general hospitals]. *Shanghai Management Science, 44*(4), 113-115.

Zhang, L., & Zhang, J. Q. (2023). 论素养观念的传统与变革——一项素养本质再认识的学术史研究 [On the tradition and change of the concept of literacy: An intellectual history study of the re-recognition of the nature of literacy]. *Journal of Educational Studies, 19*(4), 40-50.

Zhong, L. F., & Shi, K. (2003). 胜任特征研究的新进展 [New advances in the study of competency characteristics]. *Nankai Business Review*, (02), 4-8.

Zhu, Y. X., & Yang, F. (2023). ChatGPT/生成式人工智能与教育创新：机遇、挑战以及未来 [ChatGPT/Generative AI and educational innovation: Opportunities, challenges and the future]. *Journal of East China Normal University (Educational Sciences), 41*(07), 1-14.

Zou, M., Sun, H. W., Qiu, Z. Y., & Li, A. Q. (2022). 基于世界卫生组织康复胜任力架构的康复心理学专业人才胜任力研究 [Competency research on rehabilitation psychology professionals based on the WHO rehabilitation competency framework]. *Chinese Journal of Rehabilitation Theory and Practice, 28*(3), 327-334.

Zuo, M. Y. (2000). 国内外企业知识管理研究综述 [Review of domestic and foreign enterprise knowledge management research]. *Scientific Decision Making*, (03), 31-37.

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Webliography

Accreditation Council for Graduate Medical Education. (2025, July 1). *The ACGME common program requirements*. ACGME. Retrieved July 21, 2025, from https://www.acgme.org/programs-and-institutions/programs/common-program-requirements

American Cancer Society. (2004, July 30). *Targeted therapy.* AMC. Retrieved July 21, 2025, from https://www.cancer.org/cancer/managing-cancer/treatment-types/targeted-therapy.html

American Cancer Society. (2024a, March 05). *Cancer facts & figures 2024.* ACS. Retrieved July 21, 2025, from https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/2024-cancer-facts-figures.html

American Cancer Society. (2024b, June 25). *Types of cancer treatment.* AMC. Retrieved July 21, 2025, from https://www.cancer.org/cancer/managing-cancer/treatment-types.html

Chinese Medical Doctor Association. (2022, August 5). *The content and standards of standardized training for residents (2022 edition)*. CMDA. Retrieved July 21, 2025, from https://www.ccgme-cmda.cn/pole-portal/#/detail?id=1716790175751796748&columnId=1751623757524193281

Frank, J. R., Snell, L., Sherbino, J., & Boucher, A. (2015, October 30). *CanMEDS 2015.* Physician Competency Framework. Retrieved July 21, 2025, from https://royalcollege.ca/en/standards-and-accreditation/canmeds

General Medical Council. (2015, May 1). *Outcomes for graduates.* GMC. Retrieved July 21, 2025, from https://www.gmc-uk.org/education/standards-guidance-and-curricula/standards-and-outcomes/outcomes-for-graduates

Interprofessional Education Collaborative Expert Panel. (2011, June 30). *Core competencies for interprofessional collaborative practice: Report of an expert panel*. Interprofessional Education Collabora-tive, Washington DC. Retrieved July 21, 2025, from http://www.aacn.nche.edu/education-resources/ipecreport.pdf

Interprofessional Education Collaborative. (2023, November 20). *IPEC core competencies for interprofessional collaborative practice: Version 3*. IPEC. Retrieved July 21, 2025, from https://www.ipecollaborative.org/ipec-core-competencies?utm_source

Juan, S. (2025, April 29). *The impact of tacit knowledge acquisition and absorptive capability on individual performance: From the knowledge seeker's perspective*. Journal of Knowledge Management. Retrieved July 21, 2025, from https://www.emerald.com/jkm/article-abstract/doi/10.1108/JKM-08-2024-0986/1253711/The-impact-of-tacit-knowledge-acquisition-and?redirectedFrom=fulltext

Medical Device Innovation Consortium. (2025, May 29). *Maturity model assessment: Development of digital health technologies*. MDIC. Retrieved July 21, 2025, from https://mdic.org/resources/maturity-model-assessment-development-of-digital-health-technologies

National Health and Family Planning Commission of the People's Republic of China, Office of the Central Organizational Establishment Commission of the Communist Party of China, National Development and Reform Commission of the People's Republic of China, Ministry Education of the People's Republic of China, Ministry of Finance of the People's Republic of China, National Administration of Traditional Chinese Medicine of the People's Republic of China, & Ministry of Human Resources and Social Security of the

People's Republic of China. (2013, December 31). *Guiding opinions on the establishment of a system of standardized training for resident doctors*. National Health and Family Planning Commission of the People's Republic of China. Retrieved July 21, 2025, from https://www.nhc.gov.cn/wjw/c100175/201401/f30492c1678b41fe961dba55e5909364.shtml

National Health and Family Planning Commission of the People's Republic of China, The State Council's Leading Group on Deepening the Reform of the Medical and Health System of the People's Republic of China, National Development and Reform Commission of the People's Republic of China, Ministry Education of the People's Republic of China, Ministry of Finance of the People's Republic of China, Ministry of Human Resources and Social Security of the People's Republic of China, State Administration of Traditional Chinese Medicine of the People's Republic of China, & General Logistics Department, Ministry of Health, People's Liberation Army. (2015, December 14). *Guidance on pilot implementation of standardized training for subspecialty physicians*. National Health and Family Planning Commission of the People's Republic of China. Retrieved July 21, 2025, from https://www.nhc.gov.cn/wjw/c100175/201601/8e37adcd888847f8925fd22d41abbeca.shtml

San Francisco Health Improvement Partnership. (2024, May 1). *Cancer*. SFHIP. Retrieved July 21, 2025, from https://sfhip.org/chna/community-health-data/cancer/

Shanghai Municipal Health Commission, Shanghai Municipal Finance Bureau, & Shanghai Municipal Education Commission. (2024, July 1). *Notice on printing and distributing the "Implementation measures for the training of specialty physicians in shanghai"*. Shanghai Municipal Health Commission. Retrieved July 21, 2025, from https://www.shanghai.gov.cn/gwk/search/content/81b4d7e8b06a4a75a75d73873fbeee46

World Health Organization. (2018, July 30). *Cancer is the second leading cause of death globally, accounting for an estimated 9.6 million deaths, or 1 in 6 deaths.* WHO. Retrieved July 21, 2025, from https://www.who.int/health-topics/cancer?utm_source=chatgpt.com#tab=tab_1

World Health Organization. (2022, January 16). *Open call for experts to serve as members of the Digital Health Competency Framework Committee*. WHO. Retrieved July 21, 2025, from https://www.who.int/news-room/articles-detail/open-call-for-experts-to-serve-as-members-of-the-digital-health-competency-framework-committee

Annex A: Expert Profile

Category	ID	Gender	Age	Academic Degree	Professional Title	Specialty	Years of Work Experience
oncologist in a specialized cancer hospital	M1	male	48	doctorate	senior-level	medical oncology	22
	M2	male	52	doctorate	senior-level	medical oncology	30
	M3	male	43	doctorate	mid- to senior-level	medical oncology	19
	M4	female	37	doctorate	mid- to senior-level	medical oncology	12
	M5	male	39	doctorate	mid- to senior-level	medical oncology	15
oncologist in a specialized cancer hospital	M6	male	46	doctorate	senior-level	surgical oncology	18
	M7	male	43	doctorate	senior-level	surgical oncology	20
	M8	male	34	doctorate	mid- to senior-level	surgical oncology	12
	M9	male	33	doctorate	mid- to senior-level	surgical oncology	5
oncologist in a specialized cancer hospital	M10	male	62	doctorate	senior-level	radiation oncology	40
	M11	female	55	doctorate	senior-level	radiation oncology	31
	M12	female	42	doctorate	mid- to senior-level	radiation oncology	18
	M13	female	38	doctorate	mid- to senior-level	radiation oncology	12
oncologist in a specialized cancer hospital	M14	male	53	doctorate	senior-level	pathology	25
	M15	female	45	doctorate	mid- to senior-level	pathology	23
	M16	female	44	doctorate	mid- to senior-level	pathology	14
	M17	female	38	doctorate	mid- to senior-level	pathology	9

medical technical personnel in a specialized cancer hospital	M18	male	48	doctorate	senior-level	diagnostics and Medical Technology	26
	M19	female	40	doctorate	mid- to senior-level	diagnostics and Medical Technology	16
	M20	male	44	doctorate	mid- to senior-level	diagnostics and Medical Technology	20
senior researcher in a specialized cancer hospital (basic and clinical researcher)	M21	male	42	doctorate	senior-level	basic and clinical research	13
	M22	male	34	doctorate	mid- to senior-level	basic and clinical research	6
administrative staff in a specialized cancer hospital (clinical specialty development)	M23	male	38	doctorate	mid- to senior-level	hospital administration	11
administrative staff in a specialized cancer hospital (education and training)	M24	female	45	master	other	hospital administration	14
administrative staff in a specialized cancer hospital (education and training)	M28	female	55	master	senior-level	hospital administration	31
HR expert in the medical industry	M27	female	49	master	other	human resources	26
psychologist in the medical industry	M29	female	43	doctorate	senior-level	psychology	15
oncologist in a general hospital	M25	male	37	doctorate	mid- to senior-level	medical oncology	9
oncologist in a maternity hospital	M26	male	50	doctorate	senior-level	gynecologic oncology	26
oncologist in a general hospital	M30	male	38	doctorate	mid- to senior-level	surgical oncology	11

Annex B: Interview Outline

Core competencies and their underlying meanings for oncologists

Q1: From your personal perspective, what competencies do you believe an oncologist should possess? What specific elements or meanings do these competencies entail?
Q2: From your professional standpoint, what core competencies should oncologists develop throughout their career? What key components or skill sets do these competencies include?
Objective: To gain a comprehensive understanding of the breadth and specificity of competencies required for oncologists, which encompass knowledge, clinical skills, and patient management capabilities.

Key competency attributes of oncologists

Q1: What key competency attributes do you believe oncologists should possess?
Q2: Based on your observation, which competency attribute is most critical for oncologists? How do these attributes influence physicians' clinical practice and patient care? You may elaborate from the perspectives of medical expertise, procedural skills, communication and collaboration, or psychological adaptability.
Objective: To identify the personal attributes and professional capacities that oncologists need to cultivate during their career progression, which include communication, empathy, and decision-making abilities.

Current capacity of oncologists to meet specialized medical service needs

Q1: In your view, are oncologists currently able to meet the healthcare service demands of oncology-specialized hospitals? If not, in what areas do the gaps most significantly manifest?
Q2: Do you believe the overall competency level of current oncologists can meet the rapidly expanding healthcare service needs of oncology hospitals? If not, where are the primary shortfalls? You may provide a comparative analysis from the perspectives of knowledge depth and breadth, clinical decision-making capacity, and interdisciplinary collaboration.
Objective: To assess the discrepancy between the current competency profile of oncologists and evolving service demands, in order to inform future training and professional development strategies.

The distinctive nature of oncologist competencies

Q1: Compared to traditional physicians in internal medicine or surgery, what unique competencies should oncologists possess?

Q2: In what ways do the professional competencies of oncologists differ from those of conventional internal medicine or surgical specialists? How do these unique capabilities help them address the challenges of cancer care? Additionally, in the context of value-based healthcare, how can oncologists balance treatment efficacy and cost to ensure high-value care for patients?

Objective: To highlight the distinctive features of oncologist competencies, particularly in interdisciplinary knowledge, treatment planning, and psychosocial support, and to explore their relevance within value-based care frameworks.

The development of a job competency indicator framework for oncologists

Q1: What are your views and suggestions regarding the development of a job competency indicator framework for oncologists?

Q2: As we construct a job competency indicator framework for oncologists, what specific suggestions would you offer? Which factors do you believe should be taken into account?

Objective: To collect expert insights on constructing a scientifically robust and practically applicable competency indicator framework, including indicator selection, weighting schemes, and assessment method.

Annex C: Survey Questionnaire

Questionnaire on Job Competency of Oncologists in Shanghai

Dear Sir or Madam:

Thank you for your time despite your busy schedules. Your participation is sincerely appreciated.

Given the fact that this questionnaire is a section of an academic research to study and analyze the job competency of oncologists in Shanghai, there are no right or wrong answers as long as your perspectives are appropriately reflected. This questionnaire is used solely and purely for academic research. We promise that all your information and answers will be strictly confidential in accordance with academic morality. Your feedback is of vital importance and highly valued.

- **Personal Information**

1. Your gender: a. Male b. Female
2. Your age: _____ (please fill the blank)
3. Your years of working: a. 0~5 years b. 6~10 years c. 11~15 years d. 16~20 years e. over 20 years
4. Your professional title:

a. Senior professional title

b. Associate senior professional title

c. Intermediate professional title

d. Primary professional title

e. No professional title

5. Your highest academic degree before entering the resident standardization training base:

a. Bachelor b. Master c. Ph.D.

6. Have you participated in a standardized residency training program integrated with a clinical master's degree?

a. Yes b. No

7. Have you participated in a standardized residency training program integrated with a clinical postdoctoral fellowship?

a. Yes b. No

8. The field of study for your highest degree: a. oncology b. others
9. Department of your resident standardization training base:

a. Internal medicine department

b. Surgery department

c. Radiation oncology department

d. Clinical pathology department

f. Radiology department

g. Nuclear medicine department

h. Ultrasound medicine department

i. Anesthesiology department

j. Others

10. Your resident standardization training phase:

a. First grade

b. Second grade

c. Third grade

d. One year after completing resident standardization training

e. Two years after completing resident standardization training

f. Three years after completing resident standardization training

g. Others

11. The type of hospital of your resident standardization training:

a. Tumor hospital b. General hospital c. Other specialized hospital

12. The level of the hospital where you take resident standardization training:

a. Grade III level A hospital

b. Grade III level B hospital

c. Grade II, level A hospital

d. Grade II, level B hospital

e. Grade I hospital

13. The hospital you are working in or plan to work in after completing resident standardization training:

a. Tumor hospital b. General hospital c. Other specialized hospital d. Others

14. The level of the hospital where you work or are going to work after the resident standardization training:

a. Grade III level A hospital

b. Grade III level B hospital

c. Grade II, level A hospital

d. Grade II, level B hospital

e. Grade I hospital

f. Non-medical institution

15. Your patient population:

a. Early-stage patients b. Terminal-stage patients c. Patients who need end-of-life care

- **Please choose the answer that best reflects your point of view after reading all the items based on your oncological knowledge, clinical skills and communication with your patients.**

(1 stands for “strongly disagree”; 2 stands for “disagree”; 3 stands for “neutral”; 4 stands for “agree”; 5 stands for “strongly agree”)					
1. I have a full grasp of tumor biology and molecular biology.	1	2	3	4	5
2. I can comprehend and apply principles of diagnosis and treatment of common malignant tumors.	1	2	3	4	5
3. I can make tailored therapeutic regimen based on genetic test results.	1	2	3	4	5
4. I have a deep understanding of Multidisciplinary Therapy (MDT) and can effectively engage in decision-making process.	1	2	3	4	5
5. I am familiar with newly developed treatment technology such as CAR-T and mRNA vaccine.	1	2	3	4	5
6. I can perform or participate in treatment decisions making based on the latest guidance and research.	1	2	3	4	5
7. I can offer patients with mental support to ease their anxiety and depression.	1	2	3	4	5
8. I can articulate a patient’s condition and therapeutic regimen to his or her family.	1	2	3	4	5
9. I can give a patient sufficient informational and emotional support in the face of palliative care.	1	2	3	4	5
10. I can adopt different ways of communicating with patients from different cultural backgrounds.	1	2	3	4	5
11. I am adept at statistical analysis of data and interpreting research results.	1	2	3	4	5
12. I can compose theses and have them published in SCI journals to apply clinical research results to practices.	1	2	3	4	5
13. I can track and comprehend the latest progress made in oncology.	1	2	3	4	5
14. I can strike a collaborative tone with artificial intelligence and bioinformatics to conduct interdisciplinary research.	1	2	3	4	5
15. I can solve the ethical dilemma of extending life and improving life quality when engaging with terminal-stage patients.	1	2	3	4	5
16. I respect the decision-making right of patients and avoid excessive care when making plans for palliative care.	1	2	3	4	5
17. I guarantee full protection of the legitimate rights of subjects in clinical research.	1	2	3	4	5
18. I know well and act on medical laws and regulations, and my therapeutic regimen is under the legal framework.	1	2	3	4	5
19. I stand for the legitimate rights and interests of doctors and patients when dealing with medical disputes.	1	2	3	4	5

20. I can effectively cooperate with other departments such as surgery, pathology, radiation oncology to make the optimal therapeutic regimen.	1	2	3	4	5
21. I can articulate my opinion from professional perspectives while respecting the views of other departments in a group discussion.	1	2	3	4	5
22. I can shoulder the responsibility of teaching and training young doctors in my department.	1	2	3	4	5
23. I can channel such medical resources as referral and access to medicine, making medical care more available.	1	2	3	4	5
24. I can continuously improve healthcare security and quality management and reduce malpractice.	1	2	3	4	5
25. I can optimize decisions on tumor treatment by using medical big data analysis.	1	2	3	4	5
26. I am adept at AI-assisted diagnosis systems such as AI image interpretation and intelligent pathological analysis.	1	2	3	4	5
27. I can effectively manage patients' electronic medical records (EMR) and ensure that there is no missed information or unsafety.	1	2	3	4	5
28. I can provide targeted treatment advice in an online group consultation through telemedicine.	1	2	3	4	5
29. I can understand and assess the latest progress made by AI in oncology and apply these achievements to practices.	1	2	3	4	5

- **Please choose the answer that best reflects your point of view after reading all the items based on your work achievements.**

(1 stands for "strongly disagree"; 2 stands for "disagree"; 3 stands for "neutral"; 4 stands for "agree"; 5 stands for "strongly agree")

1. My patients have a high disease control rate after receiving treatment (such as stable or reduced tumor sizes)	1	2	3	4	5
2. Patients', especially terminal-stage patients', survival rate is improved with my therapeutic regimen.	1	2	3	4	5
3. My treatment approach boosts patients' life quality.	1	2	3	4	5
4. Side effects are under my control.	1	2	3	4	5
5. Clinical trials in which I take the lead or participate make significant contributions to the refinement of treatment approaches.	1	2	3	4	5
6. My research results are frequently quoted by my colleagues and wildly acknowledged in academic conferences on oncology.	1	2	3	4	5
7. Results of clinical trials in which I participate significantly contribute to the innovation of tumor treatment.	1	2	3	4	5

8. Outcomes of scientific research which I conduct are applied clinically, improving treatment regimen or patients' life quality.	1	2	3	4	5
9. Scientific research in which I take the lead is of vital importance to the long-term development of tumor treatment.	1	2	3	4	5
10. I can explain the therapeutic regimen and its expected effect clearly to patients.	1	2	3	4	5
11. Patients find the treatment information that I offer easy to understand.	1	2	3	4	5
12. I can help patients make well-informed decisions and make sure that they fully understand the therapeutic regimen.	1	2	3	4	5
13. My patients have a high level of satisfaction with the treatment results.	1	2	3	4	5
14. I can help patients manage and treat side effects and give them timely psychological support during the process.	1	2	3	4	5