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The Correlation of Patient Safety Culture and Patient-Centeredness Self-Efficacy of Physicians' Patient Safety Behavior

REN Xuqi

Doctor of Management

Supervisors:
PhD Luís Manuel Dias Martins, Associate Researcher,
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BUSINESS
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Abstract

This study aims to explore the factors influencing safety behavior in medical practice, from the perspectives of patient safety culture and patient-centeredness self-efficacy. Based on social cognitive theory and person-situation interaction theory, a research model is developed to investigate the impact of patient safety culture and patient-centeredness self-efficacy on patient safety behaviors, as well as the relationship among the three. The study collected 635 valid samples from 13 large tertiary hospitals in eastern, central, and western China through a questionnaire survey and empirically tested the research model and hypotheses.

Our research results indicated that physicians in large tertiary hospitals in China achieved good scores in terms of patient safety culture, patient-centeredness self-efficacy, and the overall assessment of patient safety behavior. However, there were differences across various dimensions. The three variables related to patient safety were influenced by demographic characteristics, occupational characteristics, and geographical characteristics. Moreover, our research found a significant positive relationship between the overall scores of the three variables: patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. Furthermore, we identified two paths in the impact of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behavior: 1) the direct causal relationship of "patient safety culture → patient safety behavior"; and 2) the indirect relationship through the mediator patient-centeredness self-efficacy, that is, "patient safety culture → patient-centeredness self-efficacy → patient safety behavior".

This study not only broadens the theoretical perspective of research on patient safety but also provides empirical evidence for healthcare managers on how to improve organizational patient safety culture, patient-centeredness self-efficacy, and clinical effectiveness. It offers strategic recommendations and a theoretical foundation for the continued development of research related to patient safety and the reduction of adverse medical events.

Keywords: Patient Safety Culture, Patient-Centeredness Self-Efficacy, Patient Safety Behavior, Physician

JEL: I18; J28

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Resumo

O objetivo deste estudo é explorar os fatores que influenciam o comportamento de segurança na prática médica, a partir das perspetivas da cultura de segurança do doente e da autoeficácia "centrada no doente". Com base na teoria da cognição social e a teoria da interação social, foi estabelecido um modelo de investigação para explorar o impacto da cultura de segurança do doente e da autoeficácia "centrada no doente" no comportamento de segurança do doente, bem como a relação entre os três. O estudo recolheu 635 questionários válidos de 13 grandes hospitais terciários do Leste, Centro e Oeste da China e testou empiricamente o modelo e as hipóteses de investigação.

Os resultados da nossa investigação indicam que os médicos dos grandes hospitais terciários na China alcançaram boas pontuações no que respeita à cultura de segurança do doente, na autoeficácia "centrada no doente" e na avaliação global do comportamento de segurança do doente. No entanto, existem diferenças em várias dimensões. As características demográficas, as características ocupacionais e as características geográficas, têm um impacto nas três variáveis relacionadas com a segurança do doente. Além disso, a nossa investigação revelou uma correlação positiva significativa entre as pontuações globais das três variáveis: cultura de segurança do doente, autoeficácia "centrada no doente" e comportamento de segurança do doente. Adicionalmente, identificámos dois percursos no impacto da cultura de segurança do doente e da autoeficácia "centrada no doente" no comportamento médico de segurança do doente: 1) a relação causal direta "cultura de segurança do doente → comportamento de segurança do doente" e 2) a relação indireta mediada pela autoeficácia "centrada no doente", nomeadamente, "cultura de segurança do doente → autoeficácia centrada no doente → comportamento de segurança do doente".

Este estudo não só amplia a perspetiva teórica da investigação sobre a segurança do doente entre, como também fornece evidências empíricas para os gestores de saúde sobre como melhorar a cultura organizacional de segurança do doente, a autoeficácia "centrada no doente" e a eficácia clínica. Fornece recomendações estratégicas e uma base teórica para o desenvolvimento contínuo de investigação relacionada com a segurança do doente, bem como a redução de eventos médicos adversos.

Palavras-chave: Cultura de segurança do doente, Autoeficácia centrada no doente, Comportamento de segurança do doente, Médico
JEL: I18; J28

摘　要

本研究旨在通过从患者安全文化、以患者为中心自我效能的方向探索医生患者安全行为的影响因素。本研究采用了社会认知理论及人—情境交互作用理论作为本研究的理论基础，并建立研究模型，探索患者安全文化、“以患者为中心”自我效能对医生患者安全行为的影响及三者之间的关系。本研究收集了来自中国东部、中部和西部地区 13 家大型三级甲等医院的 635 份有效数据，以实证的方式检验了研究模型和假设。

我们的研究结果表明来自中国 13 家大型三甲医院的临床医生在组织患者安全文化，“以患者为中心”的自我效能和医生患者安全行为的整体测评中都取得较好的评分。但是在不同维度的测量中存在一定差异，其中人口学特征、职业特征及地域特征对于患者安全相关三个变量的测评分别具有一定的影响。其次我们的研究还发现患者安全文化、“以患者为中心”自我效能、患者安全行为三个变量的整体得分之间均呈现正相关关系，同时患者安全文化和以患者为中心自我效能对医生患者安全行为的影响中既存在“患者安全文化→患者安全行为”的直接路径，也存在通过以“患者为中心”自我效能中介的“患者安全文化→以患者为中心自我效能→患者安全行为”这一路径。

本研究在理论上拓宽了患者安全相关的研究视野，而且也在实践上提供了关于如何提高组织患者安全文化、“以患者为中心”自我效能及医生患者安全行为的实证依据。为患者安全相关的研究持续发展和降低不良医疗事件的发生提供了策略建议和理论基础。

关键词：患者安全文化，“以患者为中心”自我效能，患者安全行为，临床医生

JEL: I18; J28

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List of Abbreviations

AE	Adverse Event
AEMT	Adverse effects of medical treatment
AGFI	Goodness of Fit Index
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
CAST	Causal Analysis based on Systems Theory
CFA	Confirmatory Factor Analysis
CFI	Comparing Fit Index
CI	Confidence Interval
CMB	Common Method Bias
CMV	Common Method Variance
CR	Combination Reliability
CRM	Crew Resource Management
CUSP	Comprehensive Unit-based Safety Program
DALYs	Disability Adjusted Life Years
EFA	Exploratory Factor Analysis
GFI	Fit Index
HFACS	Human Factors Analysis and Classification System
HSOPSC	Hospital Survey on Patient Safety Culture
IAEA	International Atomic Energy Agency
INSAG	International Nuclear Safety Advisory Group
MaPSaF	Manchester Patient Safety Framework
MI	Modified Index
NFI	Normative Fit Index
NHC	National Health Commission
NRLS	National Reporting and Learning System
PCSE	Patient Centeredness Self-Efficacy
PSB	Patient safety behavior
PSC	Patient Safety Culture

PSE	Physicians' Self-Efficacy
PSIT	Person-Situation Interaction Theory
PSRA	Patient Safety Regulatory Agency
RCA	Root Cause Analysis
RMSEA	Root Mean Square Error
SAQ	Safety Attitudes Questionnaire
SAQAP	Safety Attitudes Questionnaire Action Plan
SBAR	Situation, Background, Assessment, Recommendations
SCM	Swiss Cheese Model
SCT	Social Cognitive Theory
SE	Self-Efficacy
SEM	Structural Equation Modeling
SEPCQ	Self-Efficacy in Patient Centeredness Questionnaire
SIDR	Structured Interdisciplinary Rounds
SRMR	Normalized Residual Root Mean Square Error
Team STEPPS	Team Strategies and Tools to Enhance Performance and Patient Safety
TLI	Non Normative Fit Index
USSR	Union of Soviet Socialist Republics
WAPS	World Alliance for Patient Safety
WHO	World Health Organization

Chapter 1: Introduction

1.1 Research Background

1.1.1 Severe challenges to patient safety

The World Health Organization (WHO, 2023) states that providing safe and effective medical services to patients is the mission of healthcare professionals, and no one should be harmed in the process of healthcare. The most fundamental principle of healthcare services should be "do no harm". Adverse effects of medical treatment (AEMT) are generally defined as unforeseen injuries occurring during the course of medical interventions. Such injuries can compromise the precision of patient diagnoses, exacerbate patient discomfort and financial strain, and potentially result in serious long-term, irreversible outcomes or mortality. AEMT arises from conditions prevalent in healthcare settings, including potential safety hazards, adverse conditions, or incidents that are not attributable to patients' natural course of disease or underlying disease (Kong et al., 2024).

However, extensive statistical data and research evidence have revealed a significant burden of patient harm in healthcare systems worldwide, affecting both developed and developing countries. The burden of patient harm that arises in these medical practices has significant impacts on humanity, morality, ethics, and finances.

In the 1990s, the U.S. Institute of Medicine (IOM) released a set of data showing that approximately 440,000 to 980,000 deaths occur each year due to medical errors (Homsted, 2000), making these errors the third leading cause of death in the country (Weeks, 2016). A survey in Italy showed that about 4% of hospitalized patients suffer from medical errors, resulting in an estimated 50,000 to 140,000 deaths annually (Gorini et al., 2012). In Australia, approximately 1.65 million people experience hospital-acquired infections each year (B.G.Mitchell et al., 2017). In New Zealand, adverse medical events account for 32% of all hospital expenditures (Brown et al., 2002). Relevant research in the Netherlands suggests that the cumulative direct medical cost of all adverse medical events in Dutch hospitals in 2004 reached 355 million euros, including preventable adverse medical events with 30,000 hospitalizations and over 300,000 bed stays, which cost 161 million euros (Hoonhout et al., 2009) .

Research data from South Korea, representing the Asian region, estimated the Disability-Adjusted Life Years (DALYs) and economic costs associated with adverse medical events based on the 2019 Korean Patient Safety Incident Survey (Choi et al., 2023). The results indicate that DALYs caused by preventable adverse events ranged from 1,114.4 to 1,658.5 per 100,000 person-years. In 2016, the estimated annual medical expenses resulting from adverse events in South Korea totaled approximately 870 billion Korean won (700 million USD), with preventable adverse events costing between 150 billion (120 million USD) and 300 billion Korean won (240 million USD).

With the rapid development of medical technology, the complexity of healthcare services has also increased, and patient safety issues in countries around the world are facing increasingly severe challenges. According to WHO (2023), approximately one in ten patients worldwide suffer harm during healthcare, and over 3 million people die annually due to unsafe medical care. Mortality rates are particularly high in low- and middle-income countries, where about four in every 100 people die due to unsafe care. Common preventable adverse events, including medication errors, surgical risks, healthcare-associated infections, diagnostic errors, patient falls, pressure ulcers, patient identification mistakes, transfusion safety issues, and venous thromboembolism, can all lead to patient harm. These events not only impact individuals but also impose substantial economic burdens, potentially reducing global economic growth by 0.7% annually. Indirect costs related to patient harm are estimated to reach trillions of dollars worldwide. Notably, over 50% of patient harm events are preventable through proactive measures, with approximately half of these injuries linked to drug-related adverse events (WHO, 2023). A meta-analysis of 7,780 studies published globally over the past 20 years (between 2000 and 2020) on preventable drug hazards in healthcare settings found that approximately one-third of patients experienced preventable drug-related injuries, with over 25% of these injuries classified as severe or life-threatening (Hodkinson et al., 2020). The results of a meta-analysis on the systematic quantification of the incidence, severity, and nature of preventable patient injuries across various global healthcare settings suggest that approximately one in every 20 patients suffers preventable harm during healthcare (Panagioti et al., 2019). In summary, investing in and researching ways to reduce patient harm not only saves significant medical costs but, more importantly, enhances patients' health outcomes. These critical challenges in patient safety underscore the urgent need to prioritize efforts to address these issues.

1.1.2 Patient Safety Culture as a primary measure to enhance patient safety

Patient safety culture (PSC), as a key component of organizational culture in medical institutions, refers to the value system, behavioral habits, and work atmosphere built around patient safety. Its core goal is to minimize the risk of patient injury that may occur during the medical service process through continuous improvement (Carpenter et al., 2010). WHO (2023) points out that patient safety culture is crucial for achieving patient safety, encompassing the development and implementation of strategies, policies, plans, initiatives, and interventions aimed at enhancing safety. Specifically, PSC includes the values, beliefs, guidelines, and processes related to patient safety that are commonly recognized by members of the organization.

Patient safety culture not only means the prioritization of patient safety in organizational goals but also contrasts with other goals, such as patient numbers or efficiency. Establishing a patient safety culture is a key measure to ensure patient safety, and thus, healthcare institutions are recommended to evaluate their own patient safety culture (Azyabi et al., 2022).

National Health Commission (2018) emphasized the importance of patient safety in its *Notice on Further Strengthening Patient Safety Management*, highlighting that improving the patient safety management level of medical institutions and fostering a positive patient safety culture are key measures to safeguarding people's lives and health. Mardon et al. (2010) suggest that a positive PSC can significantly reduce the incidence of medical errors and accidents.

1.1.3 The relationship between self-efficacy and organizational patient safety culture

Self-efficacy (SE) refers to an individual's belief in their confidence and ability to succeed in a specific field or task. This belief can also be understood as an individual's expectation and assessment of their ability to successfully perform a task. It influences an individual's behavioral choices, level of effort, and persistence when faced with challenges. In the medical field, the self-efficacy of healthcare professionals affects their clinical decision-making, patient communication, and medical error-reporting behavior. Loeb et al. (2018) demonstrated that higher self-efficacy enhances the motivation of healthcare professionals to engage in patient safety activities. Rahmani et al. (2023) also indicated that organizational patient safety culture has a positive predictive effect on physicians' self-efficacy (PSE). In a culture that emphasizes patient safety, physicians are more likely to report medical errors, participate in quality improvement activities, and communicate effectively with team members.

Furthermore, the six dimensions of patient safety culture—system culture, informed culture, reporting culture, fairness and justice culture, resilience culture, and learning culture—create a supportive environment for enhancing physicians' self-efficacy. Physicians' self-efficiency is not only influenced by patient safety culture but also contributes to its development. Physicians with high self-efficacy are more likely to adopt positive patient safety behaviors, such as proactively reporting medical errors, participating in team discussions, and contributing to quality improvement activities. All these behaviors foster the establishment and maintenance of a positive patient safety culture. In an organizational culture centered on patient safety, healthcare professionals feel more supported by their organizations, which can increase their self-efficacy. The conservation of resource theory suggests that providing timely psychological support when individuals face negative situations can delay the depletion of psychological resources. This theory also suggests that psychological resources can either be consumed or replenished (Baluszek et al., 2023). Thus, the development of a patient safety culture helps supplement the psychological resources of healthcare professionals and improve their self-efficacy. Moreover, some studies suggest that self-efficacy may influence patient safety behavior through mediators. For instance, physicians' self-efficacy may shape their perceptions of patient safety culture, thereby affecting their patient safety behavior (X.Wang & Zhao, 2023).

In summary, there is a strong positive relationship between patient safety culture and the self-efficacy of healthcare professionals. Building a robust patient safety culture enhances physicians' self-efficacy, which will further promote the development of patient safety culture. Therefore, medical institutions should attach importance to the establishment of patient safety culture and improve the quality of medical services and patient safety by enhancing the self-efficacy of healthcare professionals.

1.1.4 Patient- centered healthcare service model and patient-centeredness self-efficacy of healthcare professionals

With the continuous development of the economy and the advancement of social informatization, patients have access to increasingly abundant information and available medical resources. In the medical field, patients are no longer passive recipients of services. Their awareness and ability to actively participate in the entire healthcare process are increasing (O'Hara et al., 2018). This change has impacted the traditional "disease-centered" healthcare service model.

A patient-centered healthcare service model has emerged, advocating respecting and responding to patients' personal preferences, needs, and values, while ensuring that patients'

values guide all clinical decisions (Ortiz, 2018). This patient-centered healthcare service model is regarded by the medical community as one of the key elements in achieving high-quality healthcare services. In addition to improving patient satisfaction, enhancing the quality of medical care, and promoting better health outcomes (John et al., 2020), it can also help bridge differences in health beliefs and cultural perspectives between physicians and patients, enhance physician-patient relationships, and reduce the occurrence of adverse medical events (Epstein et al., 2010; Park et al., 2018).

The patient-centered healthcare service model underscores the importance of patient participation and effective physician-patient communication (Bousquet et al., 2024; M.Chen et al., 2024). In this framework, the physicians' diagnostic and treatment behaviors directly determine the effectiveness of medical services. Mistri et al. (2023) demonstrated that patient-centered healthcare service models are associated with better medical outcomes, faster recovery rates, fewer complications, and shorter hospital stays. Patient-centeredness self-efficacy (PCSE) refers to the confidence physicians have in their ability to perform specific tasks within a patient-centered healthcare model (John et al., 2020). Based on Bandura's social cognitive theory, patient-centeredness self-efficacy highlights self-efficacy as a powerful determinant of human behavior (Loeb et al., 2018). It influences individuals' activity choices, the effort they put into the activity, and the amount of time they persist in those activities.

In medical practice, healthcare professionals' self-efficacy is closely tied to their ability to adhere to clinical guidelines and provide high-quality care (Harsul et al., 2020). This self-efficacy is also intertwined with patient safety culture, which refers to how individual and group cognition, behavior, and abilities determine an organization's commitment, style, and practice towards patient safety (Alabdullah & Karwowski, 2024). Patient safety culture is the foundation of medical quality, and physicians' patient-centeredness self-efficacy is critical in fostering this culture. X. Wang and Zhao (2023) indicated that patient-centeredness self-efficacy significantly impacts physicians' safety behavior, and thus, its enhancement is essential for improving healthcare service quality and patient safety.

1.1.5 Physicians' unsafe behavior as a key factor contributing to adverse medical events

Safety behavior refers to the body's safety response to external stimuli, a process in which goals are achieved through specific actions. In other words, when humans are faced with environmental stimuli that affect safety, they can make rational judgments and adopt behavior responses that comply with safety operation standards (B. Weaver et al., 2023). Cook et al. (2004) suggested that evaluating physicians' safety behavior is a necessary step in changing

unsafe behaviors. So far, there has been limited research on the safety behavior of nursing staff (Din, 2020; A. M. Wang, 2021; F. Zhang & Wang, 2018) and physicians (Ron, 2009; Tang et al., 2016) in China. However, physicians' safety behavior has particular relevance in the medical context, as their unsafe behavior is a key factor leading to adverse medical events. Research indicates that the human factor of physicians is an important factor in adverse medical events. In today's "patient-centered" healthcare system, physicians, as the primary providers of high-quality medical services, are regarded as essential human resources. Physicians' diagnosis and treatment behaviors directly determine the effectiveness of medical services. Negative behaviors include communication errors, failure to adhere to standard operating procedures, inadequate leadership, and breakdowns in teamwork and communication. Such behaviors not only increase the risk of harm to patients but also affect the overall medical safety in hospitals. Specifically, medical errors and adverse events can cause harm to patients, prolong hospital stays, increase medical costs, and even impact patients' survival and quality of life (S.Z.Li et al., 2024).

According to social cognitive theory (Bandura, 2001) and person-situation interaction theory (Mosteo et al., 2023), physicians' patient safety behavior can be influenced by "self-efficacy", as the internal factor, and "patient safety culture", as the external factor. Therefore, exploring the impact of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behavior can shed light on how external environmental factors, internal individual factors, and their interaction influence physicians' patient safety behavior. This can help reduce the occurrence of adverse medical events, improve the overall medical safety in hospitals, and provide a theoretical reference and strategic recommendations.

1.2 Research problem

Global research data suggest that the burden of injury and disease caused by adverse medical events varies to some extent across different countries and populations (Khan et al., 2020; Nauman et al., 2020). However, this issue warrants global attention, particularly in the context of the rapidly aging global population. We need to place more focus on the injury and disease burden imposed by adverse medical events on elderly and unhealthy populations (Lin et al., 2024; Shin et al., 2024). Besides the elderly, studies in the field of pediatric healthcare also indicate an increasing incidence of adverse medical events in young children (Fujiwara et al., 2024). These adverse events not only cause immense physical and psychological suffering to

patients but also lead to additional medical costs, placing a heavy economic burden on governments and patients (Sunshine et al., 2019).

The burden of injury and disease caused by adverse effects of medical treatment (AEMT) is more prominent in low- and middle-income countries. The report from WHO (2019) states that unsafe medical practices in hospitals within low- and middle-income countries lead to approximately 134 million patient injury incidents each year, causing around 2.6 million fatalities. Among Organization for Economic Co-operation and Development (OECD) nations, patient safety incidents account for roughly 15% of total hospitalization costs. Additionally, adverse medical events in primary care and outpatient settings inflict injuries on 40% of patients, with up to 80% of these incidents being preventable.

WHO (2021) also points out that weak and inadequate medical infrastructure, as well as resource shortages and heavy workloads for physicians, nurses, and other healthcare professionals, increase the risk of medical errors due to insufficient and uneven distribution of medical resources. Additionally, the lack of training and education on healthcare professionals may make it difficult for them to master the latest medical knowledge and skills. This leads to limited personal technical proficiency of healthcare professionals, affecting the quality of patient care. Moreover, inadequate supervision and regulations related to health management, incomplete information systems, and lack of effective systems to monitor, report, and analyze adverse medical events have hindered the timely detection and prevention of patient safety issues. Natural disasters, wars, epidemics, and other public health crises can deplete medical resources and increase the risk of adverse medical events. Furthermore, the lack of funding has restricted investments and updates to medical technology, as well as the implementation of measures to improve medical quality. These factors have jointly imposed increasingly severe challenges for developing countries in terms of patient safety.

China also faces numerous challenges in the management of patient safety and adverse medical event events (X. Gao et al., 2019; Kong et al., 2024). The safety behavior of physicians is a key factor in medical safety incidents. However, in China, limited research has been conducted on physicians' patient safety behavior, particularly lacking in-depth analysis from multiple perspectives and dimensions.

1.3 Research questions

In recent years, with the continuous improvement of hospital management concepts and the growing awareness of patient autonomy, patient safety issues have garnered significant

attention from WHO and hospital management communities across the globe, becoming one of the most important topics in the field of hospital management. The occurrence of adverse medical events not only causes physical and psychological harm to patients but also places a substantial economic burden on both patients and the state. A key factor in the occurrence of adverse medical events is the behavior of healthcare professionals. Drawing on social cognitive theory, we posit that by observing the surroundings and others, individuals can reflect on these observations based on their own circumstances and adjust their self-regulation ability accordingly. Patient safety culture, as one of the hospital's healthcare cultures, encompasses important individual cognitive and environmental factors that influence the safety behaviors of healthcare professionals. Self-efficacy is an individual's or a group's self-assessment and subjective judgment of their ability to perform certain tasks, and it can also be influenced by cognitive and environmental factors. Social cognitive theory considers self-efficacy as a cognitive variable strongly linked to individual behavior. The triadic reciprocal determinism (TRD) model of this theory assumes an interaction between individual cognition, environmental factors, and behavior, meaning that behavior is not only governed by the individual but also constrained by the environment. Among these factors, individual cognition plays a central role in shaping behavior, guiding and controlling actions through subjective initiative, while the outcomes of these actions, in turn, influence cognition and emotions. Similarly, the behavior an individual adopts is closely related to the environment in which they find themselves, and the environment changes in response to the individual's behavior as well.

Based on this background, our research primarily focuses on the following research questions (RQs):

RQ1: How do environmental factors of patient safety culture impact physicians' patient safety behavior in hospitals?

RQ2: What factors influence physicians' patient-centeredness self-efficacy, and how does self-efficacy impact physicians' patient safety behavior?

RQ3: What is the relationship between patient safety culture, physicians' patient-centeredness self-efficacy, and physicians' patient safety behavior?

Through in-depth exploration and research on the above questions, we hope to provide empirical evidence and theoretical guidance for hospitals' patient safety management strategies, especially on how to improve physicians' patient safety behavior and reduce the occurrence of adverse medical events.

1.4 Research purpose

The purpose of this study is to explore the impact of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behaviors. By investigating the factors influencing the safety behaviors of physicians — the actors involved in adverse medical events—this study aims to reveal how external environmental factors, individual internal factors, and their interactions play a role therein. The findings will contribute to reducing the occurrence of adverse medical events, improving medical safety in hospitals, and providing theoretical references and strategic recommendations. The specific research objectives of this study are as follows:

(1) To investigate the current state of patient safety culture and its influencing factors, and to understand how this perception influences physicians' patient-centeredness self-efficacy, as well as how these two factors affect physicians' patient safety behavior.

(2) To explore and analyze the relationship between patient safety culture, physicians' patient-centeredness self-efficacy, and physicians' patient safety behavior, and to identify the significantly related risk and protective factors therein.

(3) To understand the relevant influencing factors of physicians' patient safety behaviors at the individual level and the hospital management level; to explore the mechanisms behind the occurrence of physicians' patient safety behaviors in the specific medical context of China and propose feasible preventive measures; to promote the development of policies related to medical safety in China and identify effective pathways to foster physicians' patient safety behaviors; to provide suggestions from the perspective of health policy and management to promote physicians' patient safety behaviors, reduce the occurrence of adverse medical events, and minimize the disease burden on patients and the country caused by medical risk events.

1.5 Thesis structure

The research subjects of this study are specifically defined as clinical frontline physicians from tertiary general hospitals in China. In addition, the core research problem, research content, methods, and overall framework of this study are clearly outlined. On this basis, an in-depth literature review was conducted, focusing on relevant theories, research methods, and the current status of patient safety culture, patient-centeredness self-efficacy, physicians' patient safety behavior, and other key research topics. The findings and methods of previous studies were systematically reviewed and analyzed to establish the main research questions of this study.

Based on the literature review, the theoretical foundation and framework of this study were established, and targeted research hypotheses and theoretical model were proposed in alignment with the realities of medical safety in public hospitals. To ensure scientific validity and accuracy, a pilot test was conducted using well-established scales that have been empirically validated both globally and in China. Based on the analysis of the data from the pilot test, the questionnaire for the formal survey was developed. Three provinces from each of China's regions—eastern, central, and western—were randomly selected, with one to two tertiary hospitals from each province. Ultimately, the survey included a total of 13 general hospitals. Relevant data were collected from the research subjects through online questionnaires. An in-depth analysis of the collected data was conducted to validate the proposed research hypotheses. The content of each chapter of this thesis is as follows:

Chapter 1: Introduction. The chapter begins by highlighting the importance of studying physicians' patient safety behavior, particularly in the context of frequent adverse medical events. It emphasizes the significance and practical relevance of researching patient safety and the patient safety behaviors of clinical physicians. Subsequently, it presents the research background, research problem, research questions, objectives, and the overall structure of this thesis.

Chapter 2: Literature Review. This chapter reviews the key research topics of this study, including patient safety culture, patient-centeredness self-efficacy, adverse medical events, and safety behavior, as well as the related theories, measurement methods, structural dimensions, and research status of the key variables. In addition, it systematically reviews the relationships between patient safety culture, patient-centeredness self-efficacy, and physicians' patient safety behavior, providing a theoretical foundation for subsequent research. The hypotheses, research model, and structural diagram of the relationships among the variables are also proposed.

Chapter 3: Research Methods. This chapter clearly defines the research subjects and provides detailed description of the methods for questionnaire design, data collection, and statistical analysis. It also describes the specific methods and processes of the design, distribution, and collection of questionnaires. Finally, validity testing is performed on the collected empirical data to ensure their reliability and accuracy.

Chapter 4: Results. A descriptive analysis of the collected data is first conducted, followed by correlation analysis and analysis of variance (ANOVA). Finally, the theoretical model is validated and compared with alternative models using structural equation modeling (SEM), and the results of hypothesis testing are summarized.

Chapter 5: Discussion. This chapter compares, analyzes, and discusses the findings of the empirical research with those of previous studies. The patient safety culture of the investigated large tertiary hospitals in China, the current state of physicians' patient-centeredness self-efficacy and patient safety behavior, and the differences across various dimensions and characteristics are discussed and analyzed. Subsequently, the relationship between patient safety culture, patient-centeredness self-efficacy, and physicians' patient safety behavior, as well as the hypothesis testing results of this study, are discussed and analyzed.

Chapter 6: Conclusions. Based on an in-depth discussion of the study's data analysis results, the findings are summarized. Then, the theoretical contributions of the study are presented, and its potential significance and implications for patient safety management practices are pointed out. Finally, the limitations of this study are identified, and directions for future research are proposed.

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Chapter 2: Literature Review

This chapter comprehensively and systematically reviews the existing literature on global patient safety challenges and responses, social cognitive theory, person-situation interaction theory, patient safety culture, patient-centeredness self-efficacy, patient safety behavior, and adverse effects of medical treatment (AEMT). The origin, connotation, and measurement of these concepts are discussed in depth, and the concepts, significance, and measurement methods of each variable are presented in detail. In addition, the relationships between the variables are discussed, and the research hypotheses of this study are proposed.

2.1 Global patient safety challenges and responses

The first work plan developed by the World Patient Safety Alliance introduced the concept of "global patient safety challenges" (WHO, 2009). In this work plan, the first step is to determine the patient safety burden that poses significant risks to the health of populations worldwide. Based on these burdens, first-line interventions were formulated, and alliances were established with countries to disseminate and implement these measures. Each challenge focuses on a specific theme representing a major risk to patient health and safety. In 2005, the World Patient Safety Alliance selected the theme "*Healthcare Related Infections*", also known as "*Clean and Safer*", as the theme for its first global patient safety challenge. This theme became a key component of the World Health Organization (WHO)'s early efforts. In 2008, the World Patient Safety Alliance introduced the theme of the second global patient safety challenge: "*Safe Surgery Saves Lives*". The primary goals of these challenges were to reduce healthcare-related infections and minimize surgery-related risks. They aimed to secure commitments from countries worldwide and inspire global action to enhance patient safety. The scale and pace of these challenges' implementation were unprecedented. Both themes garnered swift and robust commitments and practices from health ministers, professional organizations, regulatory agencies, health system leaders, civil society organizations, and healthcare practitioners across various nations (WHO, 2021).

Since 2019, WHO has designated September 17th as World Patient Safety Day (WHO, 2019). On this day, events are held globally to promote solidarity and coordinated action among countries and international partners to enhance patient safety. This global campaign features an

annual theme dedicated to raising public awareness, improving global understanding of patient safety issues, and mobilizing stakeholders to take action in eliminating preventable harm in healthcare, thereby advancing patient safety. At the same time, WHO has launched its flagship initiative, "*Patient Safety Decade 2021-2030*", a transformative effort designed to guide and support strategic patient safety actions at global, regional, and national levels. A central component of this initiative is the development of the "*Global Patient Safety Action Plan 2021–2030*" (WHO, 2021).

With the rapid advancement of technology and the continuous innovation in medical practices, the large-scale fatalities caused by the COVID-19 pandemic in 2020 have further highlighted the risks to patient safety. Patient safety has now become a prominent issue on the political and healthcare agendas of many countries. In the "*Global Patient Safety Action Plan 2021–2030*", WHO outlined its vision: to ensure that every patient, regardless of region or time, has access to healthcare services that are both safe and respectful, with no harm occurring during the medical process. The mission of this plan is to promote the development of policies, strategies, and actions based on scientific evidence, patient experiences, system design, and partnerships to eliminate all preventable risks and sources of harm affecting patients and healthcare professionals. Its overarching goal is to significantly reduce avoidable harm caused by unsafe healthcare practices worldwide (WHO, 2021).

2.1.1 Comprehensive intervention methods and measures for safety culture

In order to minimize the occurrence of adverse medical events, countries around the world have successively implemented their solutions. Since 2003, in England and Wales, the National Health Service (NHS) has established The National Reporting and Learning System (NRLS), marking the birth of the world's first national-level patient safety incident reporting system. NRLS not only promotes a culture of openness and transparency but also improves the quality of patient care and enhances the alertness of healthcare professionals by learning from accidents (Alqenae et al., 2023; Cassidy et al., 2011).

Paine et al. (2010) designed a comprehensive unit-based safety program (CUSP) that covers multiple aspects such as safety science education, potential risk identification, collaboration with senior leadership, learning from mistakes, centralized communication and teamwork, safety incident reporting, patient safety rounds, patient safety journal clubs, and patient safety discussion forums. After the comprehensive implementation of CUSP in a large academic medical center, research has shown that the program effectively enhanced patient safety culture.

In China, the health authorities have also implemented numerous measures to enhance patient safety. Firstly, the Ministry of Health of China has introduced a series of policies to incorporate patient safety into the core guidelines for medical services, showing its commitment to improving the quality of medical care. The Ministry of Health and the State Administration of Traditional Chinese Medicine jointly issued a notice on the launch of the activity named "Hospital Management Year" with the theme of "*patient-centeredness and improving the quality of medical services*". This notice marks the official launch of the Hospital Management Year activity by the National Health Commission (NHC), which aims to improve the quality of medical services by placing patients at the center. This is one of the important measures taken by China to improve the quality of medical services and patient safety (Chinese government, 2006). NHC (2007) has also promoted projects such as the construction of safe hospitals and inspections of large hospitals nationwide and continued to advance the activities of the Hospital Management Year. Based on the experience of the Hospital Management Year, NHC has promoted multiple key measures with the aim of improving hospital quality and ensuring patient safety. Specific measures include:

(1) Build and optimize a medical quality management and control system to continuously improve the quality of medical services and ensure medical safety;

(2) Strengthen blood management to ensure the safety of blood;

(3) Strengthen the prevention and control of hospital infections;

(4) Develop a medical service regulatory information system and an information reporting platform for monitoring results;

(5) Establish a national-level specialized quality control and evaluation center by relying on disciplinary advantages and high-quality management of large medical institutions, gradually forming a three-level control and evaluation system for medical quality and safety at the national, provincial, and municipal levels;

(6) Systematically review and analyze the practical experience of handling medical disputes across regions and explore the establishment of a third-party coordination mechanism for doctor-patient disputes.

These measures aim to strengthen medical quality management from multiple aspects, enhance the safety and efficiency of medical services, and promote the continuous progress of China's medical system in terms of patient safety and service quality.

In 2023, the Chinese government issued a notice on carrying out a comprehensive action plan to improve medical quality (2023-2025). In the notice, the following action goals were clarified for Chinese medical institutions at secondary level or above: 1) The entire industry

needs to further strengthen quality and safety awareness and improve corresponding management systems and mechanisms. 2) It is necessary to further strengthen a diversified healthcare quality and safety co-governance system, including government regulations, institutional self-management, industry participation, and social supervision. 3) It is necessary to further consolidate the quality and safety management of basic medical care and improve the level of refinement, scientificity, and standardization of management. 4) It is necessary to improve the allocation of medical resources, balance services across medical institutions, enhance the ability of major disease diagnosis and treatment, improve medical quality and safety, and continuously improve public satisfaction with medical services (Chinese government, 2023). Based on this action plan, NHC (2023) further formulated the "*Patient Safety Special Action Plan (2023-2025)*" to protect the health rights and interests of patients, ensure patient safety, and improve the patient safety management level of medical institutions.

2.1.2 Specific safety interventions to improve patient safety

Haynes et al. (2011) conducted a study in which a surgical checklist was implemented in operating rooms and its effectiveness was evaluated. The results showed that the implementation of the checklist significantly enhanced the safety culture in operating rooms while reducing postoperative complications and mortality rates. O'Leary et al. (2015) conducted an interventional study in Chicago, in which Structured Interdisciplinary Rounds (SIDR) were implemented in medical institutions through collaboration between medical and nursing team leaders. In SIDR, each department arranged staggered rounds to ensure that physicians, nurses, pharmacists, social workers, and case managers could participate in their respective department rounds. The attending physician guided a physician to discuss the patient's condition in the conference room, while other professionals needed to be present to listen. The research showed that SIDR significantly enhanced the team collaboration awareness of healthcare professionals.

Patterson et al. (2013) conducted a study in a children's hospital that utilized the human resource management strategy "crew resource management" to enhance teamwork and safety culture. In the study, emotion models and communication skills were introduced, cases were reviewed, recovery videos in the healthcare and aviation fields were presented, the scope and types of medical errors were explored, and a systematic approach was adopted to address these errors. More specifically, videos were played to showcase CRM team collaboration and communication skills, and some medical shock cases were presented, followed by the stimulation of iatrogenic drug adverse events. Then, first aid, situational reproduction, and situation reporting were practiced, and learning content was reported and summarized. Finally,

knowledge testing was conducted. The research results indicated that this method could significantly enhance team collaboration and safety atmosphere.

Gupta et al. (2015) conducted an intervention study at the Imaging Interventional Ultrasound Department of Duke University Affiliated Hospital, using the Team Strategies and Tools to Enhance Performance and Patient Safety (Team STEPPS) approach. The study first introduced the situation, reports listening, and leadership learning. Subsequently, it promoted mutual understanding and environmental cognition among team members through patient situation learning, as well as learning situational supervision. That is followed by learning to provide feedback, offer suggestions, constantly ask questions, describe specific situations, declare results, and support each other. Finally, by learning situational cognition, evaluating and recommending intervention measures, and examining handover methods, it aimed to improve communication efficiency. The research showed that Team STEPPS could significantly enhance team collaboration and safety atmosphere. Shi et al. (2024) showed that the Children's Hospital affiliated with Fudan University in Shanghai, China, significantly improved its medical quality and safety management by introducing the TeamSTEPPS model for healthcare safety management. The study found that two years after the intervention, the hospital's quality management was significantly improved, particularly in surgical safety. Key outcomes included a reduction in perioperative mortality, elective reoperations, and severe transfusion reactions. Medication safety metrics also improved, with the defined daily dose decreasing to 24.85, inpatient antimicrobial use dropping to 40.59%, and outpatient antimicrobial prescriptions reduced to 13.26%. The patient identification execution rate increased to 94.5%, and the mortality rate among low-risk patients declined to 0.01%. Furthermore, physicians' scores on team collaboration perception and attitude significantly increased after participating in the guidance courses. This study from China demonstrates that TeamSTEPPS can effectively enhance team performance in medical organizations, significantly improving the quality, safety, and efficiency of medical care delivery.

Randmaa et al. (2014) conducted an intervention study in the anesthesia department of a medical institution, using the Situation, Background, Assessment, Recommendations (SBAR) communication method, mainly through the SBAR communication cards. The SBAR cards were adjusted according to the department's needs in cross-disciplinary work groups and were used in role-playing exercises and patient handover work. This study indicated that SBAR could significantly reduce accidents caused by communication errors.

Hinde et al. (2016) experimented with an interdisciplinary point of care (POC) simulation approach to improve safety culture in the operating room at a large teaching hospital, using the

Safety Attitude Questionnaire (SAQ) to evaluate differences in teamwork before and after the intervention. The teamwork pre-intervention score was 73.6, post-intervention score increased to 78.9, $p = 0.013$. The results of this study suggested that interdisciplinary medical simulation interventions could improve physicians‘ confidence and teamwork in dealing with critical incidents.

Therefore, in summary, implementing appropriate safety interventions in key aspects of the healthcare industry can improve medical quality and ensure patient safety.

2.2 Theories and models related to patient safety research

2.2.1 Concept, origin, and connotation of social cognitive theory

Social cognitive theory (SCT) was proposed by Bandura (1986). The roots of this theory can be traced back to the social learning and imitation theories of the 1940s. The main perspective of this theory is that individuals respond to social motivation primarily through external driving factors such as cues, responses, and rewards, thereby exhibiting corresponding learning behaviors (Borah et al., 2024). Social cognitive theory evolved from social learning theory (SLT) and was officially proposed in 1986. It emphasizes the dynamic and reciprocal relationship between individuals, the environment, and behavior. It suggests that individuals learn new behaviors through observing others, imitating actions, and interacting within the social environment, while also developing self-efficacy in the process.

Self-efficacy is a key element of individual cognition, referring to an individual's belief in their ability to perform specific tasks (Blom et al., 2021). This belief varies depending on specific task domains and contextual conditions, and only domain-specific self-efficacy can optimally predict corresponding behaviors (H.M.Chen et al., 2016). Self-efficacy can be strengthened through four methods: direct experience, vicarious experience, verbal persuasion, and emotional arousal (Bandura & Locke, 2003). Gaining direct experience is the most effective way to develop self-efficacy, as individuals can enhance it by overcoming obstacles and learning to manage failures. The second way to develop self-efficacy is through vicarious experience—when individuals observe similar others achieving success through effort, their confidence in their own abilities also increases. Verbal persuasion is the third way to influence self-efficacy. Encouragement and positive feedback from others can reinforce an individual's belief in their abilities, making them more persistent in the face of challenges. Lastly, individuals partially rely on their emotional state to assess their self-efficacy. By promoting

physical and mental well-being, enhancing physical strength, and regulating emotional states, individuals can further strengthen their self-efficacy.

Triadic reciprocal determinism (TRD) is a key conceptual framework within social cognitive theory, first introduced in 1971. This framework elaborates on the interaction mechanisms among three core elements: personal factors (e.g., cognition, emotions, and physiological events), environmental factors (e.g., the physical environment, family, friends, and social influences), and individual behavior. These three components interact dynamically and reciprocally, collectively shaping behavioral patterns and psychological states (Bandura, 1989).

Specifically, TRD reveals how individual behavior influences the surrounding environment and how individuals respond to environmental feedback. The theory emphasizes that although personal factors, environmental factors, and behavior interact in complex ways, they do not always hold equal importance within the TRD model. This is reflected in three key aspects:

(1) The causal interaction between individuals and behavior: A person's cognitive and emotional states can initiate and sustain specific behaviors, while behavior itself is also regulated by individual cognitive levels. Since cognitive and thought processes vary among individuals, different behavioral patterns emerge. Moreover, behavioral feedback further reshapes one's thinking and cognitive structures.

(2) The causal interaction between behavior and environment: Behavior and environment are mutually influential. The environment provides the context and conditions for behavior, facilitating its emergence and development, while individual behavior, in turn, can modify the environment.

(3) The causal interaction between environment and individuals: Environmental factors influence an individual's psychology and behavior, while individuals also adapt to and modify the environment through their actions. This interaction suggests that people are both products and creators of their environment. As illustrated in Figure 2.1, this dynamic relationship is represented by the TRD model (Bandura, 1989).

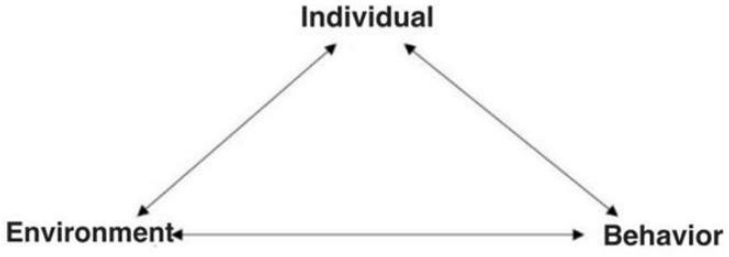

Figure 2.1 Triadic reciprocal determinism

Source: Bandura (1989)

Observational learning, the TRD model, and self-efficacy theory form the core ideas of social cognitive theory (Smoktunowicz et al., 2017). This theory strongly emphasizes human agency, suggesting that individuals can observe their surroundings and others during cognitive processes, reflect based on their own circumstances, and consequently adjust their self-regulation abilities (Bandura, 2018). The TRD model posits that individual behavior, personal factors (such as knowledge, beliefs, and attitudes), and environmental factors (such as organizational culture and social support) influence each other, collectively shaping specific behaviors. Due to its comprehensive depiction of the complexity of human behavior, this theory has been widely applied to explain the behavioral characteristics of individuals and groups.

2.2.2 Application of social cognitive theory in the healthcare industry and patient safety

Social cognitive theory posits that an individual's behavior, cognition, and emotional responses can be learned through observing the actions of others and the consequences of those actions. This theory integrates concepts and processes from cognitive, behavioral, and affective models. It also provides a comprehensive framework for understanding individual behavior within social environments and has been applied across various fields, including health behavior change, education, business, and health promotion. In the field of healthcare, social cognitive theory is primarily used to explain and predict individual health behaviors, such as dietary changes, participation in physical activity, and self-management of diseases (Silveira et al., 2024).

In a medical setting, the TRD model provides a theoretical framework for understanding and improving healthcare professionals' patient safety behaviors. For example, healthcare professionals' self-efficacy influences their decision-making ability and coping strategies in high-pressure medical environments. A positive organizational atmosphere (environmental factor) can enhance healthcare professionals' expertise by offering training and support systems. This improvement in professional competence not only enhances diagnostic and treatment outcomes and fosters harmonious doctor-patient relationships but also promotes the growth of self-efficacy among healthcare professionals (Belhomme et al., 2025). Moreover, medical behaviors (behavioral factors) can also impact individual experience accumulation and organizational culture, creating a positive cycle that reduces medical errors and enhances patient safety (Sax et al., 2007).

Recent studies have indicated that social cognitive theory and the TRD model have broad applications in medical safety management. For instance, improving hospital training systems and feedback mechanisms can enhance healthcare professionals' self-efficacy, leading to more

proactive implementation of patient safety measures (Hüner et al., 2023). Additionally, the importance of teamwork and interdisciplinary collaboration in medical practice can also be explained through this model, as interactions and experience-sharing among team members influence individual decision-making and execution, thereby improving overall safety levels (Lopez-Jeng & Eberth, 2020).

Social cognitive theory explains individual behavior from both personal and environmental perspectives, emphasizing the role of self-efficacy. It provides the theoretical foundation for exploring the mechanisms through which those factors influence physicians' patient safety behavior in this study.

2.2.3 Concept and connotation of person-situation interaction theory

As a classic theory in developmental psychology, person-situation interaction theory advocates a holistic interactionist approach, emphasizing that individual behavior results from the interaction between the person and the context. This theory provides a framework for understanding human development, suggesting that individuals and their contexts do not exist independently but rather form an integrated, complex, and dynamic system that functions as a whole (Tett & Burnett, 2003).

The individual subsystem consists of psychological, behavioral, and biological factors. It is characterized by activity and purposefulness, enabling individuals to perceive and regulate themselves while actively interacting with environmental subsystems, including social, cultural, and physical environments. The interaction between individual and contextual factors plays a critical role in shaping individual behavior, particularly in workplace settings (Chao et al., 2023). Therefore, exploring the emergence of behavior solely from either an individual or contextual perspective presents a certain degree of limitation.

2.2.4 Application of the person-situation interaction theory in healthcare and patient safety

The person-situation interaction theory posits that individual behavior is not determined by a single factor but results from the interaction between the person and the situation. Specifically, "person" includes an individual's abilities, personality, and attitudes, while "situation" encompasses environmental factors, social and cultural influences, and organizational structures. This theory highlights the dynamic relationship between the two, explaining

behavioral patterns in complex environments. In the healthcare industry, the theory finds application in several aspects:

(1) Medical decision-making and error reporting: Healthcare professionals' decisions are influenced not only by their expertise but also by contextual factors such as work environment, time constraints, and team communication. Studies indicate that excessive workload and inadequate handover procedures interact with individual factors to increase the risk of medical errors (Alrasheeday et al., 2024). Additionally, organizational culture—including attitudes toward punishment for medical errors, encouragement of error reporting, and leadership styles—affects healthcare professionals' willingness to report adverse medical events (Moraca et al., 2024).

(2) Team collaboration and communication: The quality of communication among healthcare professionals is influenced by individual traits (e.g., experience, communication style) and contextual factors (e.g., departmental atmosphere, time pressure). There is an interactive relationship between organizational culture and individual safety behaviors. Establishing a strong safety culture enhances healthcare professionals' awareness and implementation of safety practices (Sok May et al., 2024).

(3) Emergency response: In medical emergencies, healthcare professionals' responses depend on personal experience, stress tolerance, availability of on-site resources, and team coordination. Factors such as the accessibility of medical equipment, electronic health records, and decision-support systems influence healthcare professionals' work processes. Their effectiveness depends on individuals' adaptability to technology and the level of environmental support (Serralabós-Ferré et al., 2024).

According to the person-situation interaction theory, physicians' patient safety behaviors may be influenced by the interaction between the patient safety culture climate and their self-efficacy in patient-centered care. This theory serves as the theoretical foundation for examining the impact of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behavior in this study.

2.3 Patient safety culture

2.3.1 Organizational culture and safety culture

Organizational culture refers to a collection of shared values, beliefs, norms, behaviors, and practices within an organization or team, which shape the way the members interact, make

decisions, and approach work (Chesley, 2020). Organizational culture is a personalized characteristic of an organization that can influence members' behavior and the overall work environment of the organization. It includes a meaning system widely accepted and recognized by the organization's members, as well as the organization's identity, rituals, and beliefs (Aldhafeeri, 2024).

The concept of organizational culture was first introduced into the fields of management and organizational research in the late 1970s and began to receive widespread attention from the academic community in the early 1980s (Gerhart, 2009). This concept draws on insights from sociology and anthropology, which suggest that organizations can possess unique cultures, namely shared values, beliefs, and norms that guide the attitudes and behaviors of their members.

Organizational culture theory can be divided into two paradigms: functionalism and interpretivism. The perspective of functionalist theory emphasizes the power of normative operation and behavior, advocating for the promotion of cultural homogeneity and consistency, while the interpretive paradigm emphasizes the significance of individuals in organizations for social practice. Schein (1992) is an important figure in the study of organizational culture. He defined organizational culture as the fundamental assumptions and beliefs widely accepted by the organization's members, which define the natural views of the organization and its environment, emphasizing the role of the organization's leaders in the creation, transformation, and implementation of organizational culture.

Safety culture is a part of organizational culture. It refers to the collection of common values, beliefs, attitudes, and behavioral patterns of an organization, enterprise, or society towards safety (Churruca et al., 2021). It encompasses the attention, emphasis, and corresponding measures taken by organizations in their work practice regarding safety affairs, including requirements for the formulation of safety-related policies, safety operation regulations, safety education and training, safety facilities, psychological culture, and safety management. It is the sum of attitudes, values, norms, and behaviors towards safety within an organization, a manifestation of safety awareness and behavior throughout the organization or society, and a phenomenon of valuing safety and respecting the safety of life and property (Kim et al., 2016).

The concept of safety culture originated in the nuclear industry in the 1980s, and it first appeared following the Chernobyl nuclear accident in 1986, proposed by the International Nuclear Safety Advisory Group (INSAG) of the International Atomic Energy Agency (IAEA) in the IAEA's INSAG-1 report (Cooper, 2018). In the report, safety culture was described as a collection of characteristics and attitudes within organizations and individuals that prioritize the

safety of nuclear power plants. Subsequently, IAEA further expanded the concept of safety culture in its 1988 "*Safety Series No.75-INSAG-3*" on nuclear power plants. Therefore, it can be said that after the Chernobyl nuclear power plant accident, the international community began to pay attention to the importance of safety culture in the nuclear industry.

Since the concept of safety culture first emerged in the nuclear industry, it has been widely applied to other high-risk fields (Amirah et al., 2024). The application of safety culture has now expanded to various industries and fields, such as industrial manufacturing, transportation, modern agriculture, commercial circulation, technological innovation, emergency management, and healthcare (Moe et al., 2017; Nævestad et al., 2018).

Safety culture means different things to different organizations, so the definition of safety culture is also diverse. Safety culture can guide people to improve their work methods and provide clear safety operating procedures. The essence of safety culture structure is that it reflects a positive stance on improving occupational safety and reflects people's thinking and/or behavior related to safety (Panik et al., 2024). The existing evidence indicates that it is necessary to adopt proactive safety prevention measures for major safety issues identified in the common safety features (e.g., management/supervision, safety systems, risks, work pressure, capabilities, procedures, and rules). It is best to achieve this by focusing on the organization's safety management system and the safety-related behaviors of its members, rather than attempting to change people's values, beliefs, and attitudes (Pei & Zude, 2014).

The theoretical basis of safety culture is based on the study of organizational culture. The organizational culture model of Schein (1992) is one of the most influential models in the field of safety. As a part of organizational culture, safety culture includes the values, attitudes, perceptions, abilities, and behavioral patterns of individuals and groups. These factors collectively determine the organization's commitment to health and safety, as well as its management style and capabilities. The safety culture reciprocity model extracted from social cognitive theory provides a theoretical and practical framework for measuring and analyzing organizational safety culture in safety culture research.

The measurement methods of safety culture usually include quantitative and qualitative approaches. Quantitative measurement typically involves questionnaire surveys, such as the Safety Attitudes Questionnaire (SAQ), which evaluates an organization's safety culture through employees' responses to a series of safety related questions (Juhl et al., 2024). Qualitative methods include interviews, observations, and case studies to gain a deeper understand (Uwe, 2009).

The measurement of safety culture is a reliable predictor of safety behavior and results, and the most accurate measurement is through mixed methods. It should not be used for comparison between teams or as a tool for judgment/performance management, but rather as a source of information for improving comprehensive methods.

In summary, safety culture is a type of organizational culture, referring to the shared concern, respect, and management of safety by individuals and teams within an organization or society, as well as the common practice of recognizing risks and hazards and implementing preventive measures.

2.3.2 Definition and connotation of patient safety culture

WHO (2021) defines patient safety as "an organized framework of activities aimed at creating a culture, processes, procedures, behaviors, technologies, and environments in the field of healthcare that can consistently reduce risks, prevent injuries, minimize the possibility of errors, and mitigate the impact of injuries when they occur". Singer et al. (2003) introduced the concept of "hospital safety culture", defining it as the integration of the "do no harm" principle from the Hippocratic Oath into every level and technical operating procedure of an organization. This culture prioritizes "safety" in healthcare practices, ensuring it is given precedence in all departments and operations. Therefore, the patient safety culture is defined as a crucial organizational safety culture within hospitals and medical settings. Its core elements, such as preventing medical errors, avoiding injuries, reducing risks, and improving safety, are carried out around patient-centeredness. Its purpose is to ensure that patients' safety rights and interests are not infringed upon (Carpenter et al., 2010).

Sammer et al. (2010) conducted a comprehensive literature review and analysis of medical safety culture in American healthcare institutions, proposing that patient safety culture in healthcare institutions should cover seven aspects: leadership, evidence-based practices, teamwork, learning, communication, patient-centeredness, and fairness and justice. The patient safety culture model proposed by Morello et al. (2013) suggests that patient safety culture is an important component of organizational safety culture in hospitals and healthcare institutions. Employees in healthcare institutions ensure patient safety through shared beliefs, attitudes, values, and behaviors.

Patient safety culture is also considered the cornerstone of high-quality healthcare. Recent research has underscored its critical role in healthcare. In medical teams, the influencing factors of safety culture are multifaceted, including teamwork and communication, as well as leadership and accountability. A study examining the impact of empathy and leadership on

patient safety culture and healthcare quality within the healthcare system suggests that empathy and transformational leadership can foster a positive culture that prioritizes patient safety and quality among healthcare professionals. Leaders who demonstrate empathy are more likely to motivate their teams to provide patient-centered care and focus on error prevention. Furthermore, empathy and transformational leadership can improve organizational culture, patient experience, patient engagement, outcomes, and overall healthcare excellence in healthcare institutions. Therefore, it can be concluded that empathy serves as an antidote to healthcare professional burnout, and strengthening compassionate transformational leadership can significantly improve patient safety, patient engagement, and healthcare quality (Ahmed et al., 2024).

The research results on medical care for elderly patients suggest that effective communication is the foundation of high-quality healthcare. Good and effective communication not only helps establish a connection between healthcare professionals and patients, forming a treatment relationship conducive to patient-centered outcomes, but also allows the information exchange between healthcare professionals and patients to assist both parties in making better medical decisions and improving patients' self-management (Sharkiya, 2023). For patients requiring long-term care, patient safety culture is equally important. Garay et al. (2023) suggested that recognizing safety risks and promoting safe care is crucial for patients who depend on care and should be an integral part of overall prevention efforts in caregiving, including home care.

The professional and technical competence and the continuous learning status of healthcare professionals are also critical components of patient safety culture. Unsafe and incompetent medical practices are among the main causes of disability and even death in patients. Ensuring continuous learning and maintaining a high level of professional competence are essential for healthcare professionals to ensure patient safety and provide high-quality healthcare services, while also maintaining an error-free, healthy environment. Zaitoun et al.'s (2023) study on systematic evaluation, aimed at determining the relationship between nursing competence levels and nurses' safety culture scores and perceptions in the workplace, found evidence of a positive correlation between nursing competence and patient safety scores. The study suggested that research on patient safety culture should explore methods to reveal the positive impact of nursing competence on safety culture in medical institutions.

"Patient-centeredness" is the core content of patient safety culture, and most patient safety-related behavioral measures revolve around this theme. Patient-centered care, namely people-oriented care, has been shown to positively impact healthcare quality and the health of both

patients and healthcare providers. A meta-analysis comparing patient-centered interventions with "routine care" found that patient-centered care could reduce fall rates (in acute care and nursing home environments) while improving the benefits of reducing agitation in dementia patients and decreasing the use of antipsychotic drugs in elderly dementia patients (Rossiter et al., 2020).

In addition to ensuring patient safety, patient safety culture also emphasizes creating a safe and healthy environment for healthcare professionals while providing high-quality patient care. Research from healthcare teams has shown that effective communication and teamwork are crucial for enhancing patient safety culture awareness among healthcare professionals engaged in nursing work. Nurse managers should adopt leadership strategies in order to support nurses' psychological safety and foster a culture of fairness (Hassan et al., 2024). In a study exploring the association between cultural humility (including openness to cultural diversity among individuals and groups) and patient safety culture, the two variables were measured among 2011 employees from four different hospitals. The results showed that a higher perception of organizational cultural humility was associated with a higher overall perception of hospital safety, nonpunitive response to error (i.e., employees' mistakes did not have adverse effects on them), improved handoff and transition practices, and a more positive evaluation of organizational learning. Therefore, the study suggests that organizational cultural humility can be an important factor in improving hospitals' patient safety culture (Hook et al., 2016).

In summary, patient safety culture is a crucial organizational safety culture within hospitals and healthcare institutions, encompassing multiple aspects. The core purpose of cultivating a patient safety culture is to prevent medical errors, avoid harm, reduce medical risks, and enhance safety measures and behaviors to ensure patient medical safety.

2.3.3 Measurement of patient safety culture

Evaluating the patient safety culture of medical institutions is crucial for implementing patient safety interventions and creating a positive patient safety atmosphere, and patient safety culture assessment tools play an important role in this process. In addition, measuring patient safety culture is also a key method and means to foster the positive development of patient safety culture in healthcare institutions. Through these assessments, behaviors and environmental factors that promote patient safety can be identified and thus strengthened. At present, the main methods for measuring patient safety culture include both quantitative and qualitative approaches to provide a more comprehensive perspective.

The quantitative approach typically uses questionnaire surveys to collect data. Currently, widely used well-established questionnaires on patient safety culture in medical institutions include the Hospital Survey on Patient Safety Culture (HSOPSC) (Agency for Healthcare Research and Quality U.S. Department of Health and Human Services, 2019) and the Safety Attitudes Questionnaire (SAQ) (Tocco Tussardi et al., 2022), which can provide quantifiable data for analyzing various aspects of patient safety culture in healthcare institutions.

In addition, qualitative methods such as focus group discussions and interviews are also used to measure patient safety culture. They can help identify specific safety issues and enable a deeper understanding of patient safety culture. At present, a well-established and widely used qualitative measurement tool for patient safety culture in medical institutions is the Manchester Patient Safety Framework (MaPSaF) (Tocco Tussardi et al., 2022).

In the following, the measurement tools are introduced in more detail.

(1) Hospital Survey on Patient Safety Culture (HSOPSC)

HSOPSC is a measurement tool developed by the Agency for Healthcare Research and Quality (AHRQ) in the U.S. It was designed to assess the effectiveness of hospital work environments and organizational processes in preventing error types (Agency for Healthcare Research and Quality U.S. Department of Health and Human Services, 2019). HSOPSC is one of the most widely used and scientifically validated tools for evaluating patient safety culture in global healthcare. The HSOPSC questionnaire includes basic information about respondents, multi-dimensional questions, and additional questions such as patient safety grade and the number of adverse events reported in the past year (Alex Kim et al., 2019). Initially published in 2004, the original HSOPSC contained 42 items covering 12 dimensions of patient safety culture, such as communication openness, feedback and communication about error, and teamwork. Each item is rated on a 5-point scale (from "strongly disagree" to "strongly agree"), and analysis focuses on the positive response rate (the frequency of "agree" and "strongly agree"). Additionally, 18 negatively worded items require reverse scoring. Higher scores indicate a better patient safety culture within an organization.

In 2019, AHRQ revised the questionnaire to create HSOPSC 2.0, which retained the advantages of the original version while simplifying its dimensions and the number of items. The revised version optimized the structure and content of the questionnaire to better align with the evolving healthcare environment and needs (Agency for Healthcare Research and Quality U.S. Department of Health and Human Services, 2019). HSOPSC is widely used in healthcare institutions globally, having been translated into over 20 languages and applied in more than 40

countries (Palmieri et al., 2020). The HSOPSC 2.0 version enables comparisons both across different hospitals and across different departments or roles within the same institution.

The advantages of HSOPSC lie in its scientific rigor and standardization. It provides institutions with a periodically updated safety culture comparison database, facilitating longitudinal comparisons of patient safety culture between hospitals. Furthermore, numerous studies have demonstrated that HSOPSC exhibits good reliability and validity and is considered a well-established tool for measuring patient safety culture. Similarly, research from China has shown that the Chinese version of the HSOPSC questionnaire possesses good measurement properties, including strong reliability and validity (Liu et al., 2024; Wu et al., 2022). By providing healthcare organizations with a standardized tool for evaluating and improving patient safety culture, the HSOPSC questionnaire contributes to enhancing the quality and safety of healthcare services.

(2) Safety Attitudes Questionnaire (SAQ)

SAQ is mainly used to assess the safety attitudes of healthcare professionals in healthcare institutions (Malinowska-Lipień et al., 2021). It evolved from the Intensive Care Unit Management Attitudes Questionnaire (ICUMAQ) (Zwart et al., 2011) and the Flight Management Attitudes Questionnaire (FMAQ) (Thomas et al., 2003), drawing on Vincent's (1998) framework for analyzing risk and safety issues and Donabedian's (1988) conceptual model for evaluating quality. The standard version of SAQ includes six dimensions and 36 items. These dimensions include teamwork, safety atmosphere, job satisfaction, perceived stress, perceived management, and working conditions. In items 24 to 28, each question is presented in two formats: one assesses departmental management capabilities, while the other evaluates hospital management capabilities. Among the items, three are reverse-scored items. All responses are rated using a 5-point scale, where "strongly Agree" corresponds to 5 points and "strongly disagree" corresponds to 1 point. Higher scores indicate more positive safety attitudes of the healthcare professional.

SAQ has been adapted into several specialized versions, including ICU version (Raftopoulos & Pavlakis, 2013), operating room version (Göras et al., 2013), outpatient version (Modak et al., 2007), pharmacy version (Nordén-Hägg et al., 2010), emergency room version (Castilho et al., 2020), and delivery room version (Raftopoulos et al., 2011). These versions have been implemented across various healthcare institutions in many countries, demonstrating strong psychometric characteristics. Research has also shown that SAQ scores are related to patient outcomes, with higher SAQ scores associated with fewer medical errors, lower ventilator-associated pneumonia, fewer bloodstream infections, and shorter hospital stays

(Colla et al., 2005; Robb & Seddon, 2010). SAQ has been widely applied in empirical research in various countries, including the UK and the U.S. In the Asian, researchers from mainland China (K.Jiang et al., 2019; Y.Li et al., 2017), Taiwan (Jeong et al., 2019), and Malaysia (Ismail & Khalid, 2022) have also utilized SAQ for empirical studies. The results of these empirical studies indicate that the SAQ questionnaire, after being adapted according to local contexts, maintains stable reliability and validity.

(3) Manchester Patient Safety Framework (MaPSaF)

MaPSaF is a qualitative research tool developed by Parker et al. (2015) for assessing the patient safety culture of primary healthcare organizations. This framework is based on the Westrum theoretical framework, which was initially applied to assess patient safety culture in medical institutions in the UK. Later, with the support of the UK Patient Safety Management Agency, after modifications to the original version, it was expanded and applied to organizational safety culture research and applied to patient safety culture surveys of healthcare professionals in different healthcare service departments. The questionnaire has been adapted into various versions, including emergency version, first aid version, primary healthcare version, and mental health version.

MaPSaF is a multidimensional safety culture assessment tool that uses a two-dimensional matrix structure to assess patient safety culture in medical institutions. This structure displays the development stages of patient safety culture along the horizontal axis, while the vertical axis covers various dimensions of patient safety culture assessment. Taking the emergency version as an example, the vertical design of the questionnaire includes 10 dimensions, while the five stages of patient safety culture form the horizontal assessment indicators. These dimensions include commitment to quality, the importance of patient safety, systems errors and individual responsibility, patient safety attribution and reporting, investigation of safety events, organizational learning, open communication, human resource management, safety training and education, and teamwork. The five development stages of patient safety culture include the pathological stage, reactive stage, administrative stage, anticipatory stage, and generative stage (Tocco Tussardi et al., 2022).

MaPSaF typically conducts semi-structured or structured interviews with healthcare professionals, either in the form of individual interviews or group interviews, to assess the current status of patient safety culture in medical institutions. It helps teams recognize that patient safety is a complex, multidimensional concept, stimulates discussions on the strengths and weaknesses of patient safety culture, and demonstrates what a more mature patient safety culture may look like.

The application of MaPSaF is relatively broad, covering hospitals, community pharmacies, nursing homes, and primary healthcare institutions (Marshall et al., 2017; Phipps et al., 2018). It is frequently used to evaluate the current state of patient safety culture in medical institutions and has been adapted based on the local context. L. J. Wang et al. (2023) localized and modified MaPSaF and used it to evaluate the patient safety culture of a general hospital in Shanghai. Group interviews were conducted with 15 nurses in the obstetrics ward of the hospital using MaPSaF. Participants individually rated their safety practices based on each of MaPSaF's nine safety culture dimensions. Then, they collectively discussed the dimensions and agreed on a consensus score within the scope of each dimension's practice. The discussion was recorded, transcribed, and analyzed to assess patient safety in the obstetrics ward. The research results suggested that most participants found the survey and qualitative interview process acceptable and useful. MaPSaF guided the team in discussing patient safety issues, which helped to improve communication, eventually leading to changes in some safety behaviors. All participants responded positively to the discussion and regarded MaPSaF as an excellent safety culture assessment tool with clear, comprehensive, and easy-to-understand entries. MaPSaF may assist with strengthening the existing safety culture and improving overall safety through collaborative measures.

The above studies all show that MaPSaF contributes to the development of patient safety culture in medical institutions and has good applicability. As an evaluation tool, MaPSaF not only helps medical institutions understand the level of their patient safety culture, but also enables them to identify and overcome related deficiencies, eventually enhancing patient safety and the quality of medical services.

2.3.4 Application of HSOPSC in different countries

The HSOPSC questionnaire has been widely used in healthcare institutions worldwide. It has been translated into over 20 languages and applied in more than 40 countries (Palmieri et al., 2020). The HSOPSC 2.0 version allows for comparisons not only across different hospitals but also across various departments or positions within the same medical institution (Palmieri et al., 2020). The advantage of the HSOPSC questionnaire lies in its scientific rigor and standardization, providing institutions with an updated comparative database for patient safety culture, enabling hospitals to track changes over time. In the following, we will review the studies on patient safety culture in different countries and regions with the application of HSOPSC .

Imran Ho et al. (2024) translated and culturally adapted the HSOPSC 2.0 into Malay and validated it with 319 healthcare professionals from a Malaysian public university hospital. The study found that the translated tool demonstrated excellent content validity (I-CVI = 0.80 ~ 1.0, S-CVI average = 0.96) and face validity (I-FVI = 0.80 ~ 1.0, S-FVI average = 0.98). The reliability test showed acceptable results (Cronbach's $\alpha = 0.60 \sim 0.80$). A confirmatory factor analysis (CFA) was conducted, indicating satisfactory model fit (RMSEA = 0.08, GFI = 0.80, CFI = 0.80, and $\chi 2/df = 2.96$). The results suggest that the Malay version of HSOPSC 2.0, which contains 10 dimensions and 32 items, exhibits satisfactory psychometric properties, acceptable measurement reliability, and construct validity in assessing patient safety culture.

Olsen et al. (2024) translated HSOPSC 2.0 into Norwegian (N-HSOPSC 2.0) and added two outcome variables, "work pleasure" and "turnover intention". A cross-sectional survey was conducted with a convenience sample of 1,002 healthcare professionals from two hospitals. The results based on CFA showed that the overall statistical model fit was acceptable. However, five dimensions of the N-HSOPSC 2.0 had average variance explained (AVE) values below the threshold of 0.5. Except for teamwork (0.61), all dimensions met the composite reliability (CR) criteria. Regression models explained most of the variance related to patient safety rating (adjusted $R^2 = 0.38$), followed by turnover intention (adjusted $R^2 = 0.22$), work pleasure (adjusted $R^2 = 0.14$), and finally, the number of reported incidents (adjusted $R^2 = 0.06$). The study concluded that the Norwegian version of HSOPSC 2.0 has acceptable construct validity and internal consistency, making it suitable for use in Norwegian hospital settings. Additionally, the study found that the ten dimensions in HSOPSC 2.0 were more strongly associated with "overall patient safety" than with "the number of reported incidents". Furthermore, safety culture dimensions could predict "work pleasure" and "turnover intention".

Huong Tran et al. (2021) conducted a study using HSOPSC at a large autonomous public general hospital in Hanoi, Vietnam. They surveyed 638 healthcare professionals to assess their patient safety culture. The results showed a high overall positive response rate of 74.2%. The highest-rated dimensions were teamwork within units (91.3%) and organizational learning – continuous improvement (88.4%), while staffing (49.4%) and nonpunitive response to error (53.1%) were areas requiring improvement. The study suggested that hospital administrators should strengthen patient safety culture through strategies and interventions focused on adequate staffing and fostering a non-punitive work environment.

Fassi et al. (2024) conducted a multicenter study evaluating patient safety culture in two university-affiliated hospitals in Morocco. Ten departments were selected from each hospital, with 10 healthcare professionals from each department, totaling 204 participants. The study

found the highest positive response rates in teamwork (69%), followed by supervisor/manager expectations and actions promoting patient safety (59%). In contrast, staffing (34%) and nonpunitive response to error (37%) were the most underdeveloped dimensions. The results indicate that while progress has been made in teamwork and managerial support, human resource shortages and the handling of errors need urgent improvement in Moroccan primary healthcare.

Bashir et al. (2024) conducted a study at a tertiary care hospital in Mirpur Azad, Jammu and Kashmir, using non-probability convenience sampling to survey clinical healthcare professionals (e.g., nurses, doctors, pharmacists, and laboratory technicians) and administrative personnel (e.g., deans, associate deans, assistant deans, and department heads) regarding improvements in patient safety culture and adverse event reporting practices. A total of 312 valid responses were collected (with a response rate of 76%), revealing that "supervisor/manager expectations and actions promoting patient safety" had the highest positive response rate (65.16%), while "nonpunitive response to error" had the lowest (27.4%). The study also found that higher scores in "nonpunitive response to error" were associated with lower rates of medication errors, pressure ulcers, and surgical site infections, while higher scores in "frequency of events reported" were related to lower rates of medication errors, pressure ulcers, and falls. These findings suggest that establishing a non-punitive error-reporting system and increasing event reporting frequency are crucial for reducing adverse medical events.

Alkubati et al. (2024) conducted a study in the intensive care unit of a hospital in Damanhour, Egypt, surveying 200 nurses using HSOPSC to assess their perceptions of patient safety culture and its relationship with adverse medical events. The study found that the areas in need of improvement included staffing (26.6%), nonpunitive response to error (38%), handoffs and transitions (39.4%), teamwork within and across units (42.3%), and overall perceptions of patient safety (49.3%). The study also identified a significant association between lower safety culture awareness and higher rates of patient falls, adverse drug events, and patient/family complaints, indicating that teamwork and error management strategies are key factors influencing patient safety outcomes.

Pedroso et al. (2023) conducted a multinational cross-sectional study in South America, surveying four hospitals in Argentina, Brazil, Chile, and Colombia using HSOPSC V1.0. The study found that organizational learning, teamwork within units, and managerial support for patient safety were the highest-rated dimensions, while staffing and nonpunitive response to error were in need of improvement. Additionally, healthcare professionals in leadership

positions had higher mean scores, and significant differences were found across professional categories. Overall, the results suggest that the cultivation of a patient safety culture in South America requires more efforts.

Silverglow et al. (2023) conducted a cross-sectional survey of 66 municipal home care professionals across five Swedish cities. They used HSOPSC to assess patient safety culture in home care settings. The study found the highest positive response rate in teamwork within units (82%), while the lowest was in handoffs and transitions (37%) and management support for patient safety (37%). Additionally, global patient safety ratings were significantly associated with communication openness and management support for patient safety. The study also found that employees with less work experience rated patient safety higher than the experienced ones. The results highlighted the need for improvements in transitions between institutions and stronger support from the management.

Ayanaw et al. (2023) conducted a patient safety culture survey in public and private hospitals in Bahir Dar, northwest Ethiopia, to assess their patient safety culture levels and related factors. The study surveyed 448 participants using HSOPSC. The results showed significant differences in patient safety culture between public and private hospitals. Additionally, factors such as hospital type, profession, job satisfaction, participation in patient safety programs, availability of necessary equipment and materials, and shift work were significantly associated with patient safety culture. These findings suggest that different, tailored patient safety improvement strategies are needed for public and private hospitals.

Rodríguez-García et al. (2023) investigated the relationship between work environment, patient safety culture, and midwives' patient safety behaviors using standardized tools, including the Practice Environment Scale of the Nursing Work Index (PES-NWI) and HSOPSC. The study found that the total mean score of PES-NWI was significantly associated with the total mean score of HSOPSC ($r = 0.498$, $p < 0.001$), indicating that as the quality of midwives' work environments improved, the clinical safety for female patients also increased. Additionally, the study observed a significant relationship between midwives' intention to stay in hospitals and characteristics of patient safety culture. The study concluded that work environment, patient safety culture, and midwives' turnover intentions were significantly related. Creating a favorable work environment may be an effective strategy to encourage improvements in women's patient safety culture in healthcare institutions and reduce midwives' turnover intentions.

Razzani et al. (2020) conducted a study in a psychiatric inpatient unit of a hospital in Tehran, Iran, examining the impact of education on ethical principles on nurses' perceptions of patient

safety culture in psychiatric wards. Participants received training on ethical principles, and their patient safety culture awareness was measured before and after the intervention using a questionnaire on demographic characteristics and HSOPSC. The results showed that after receiving education on ethical principles, nurses' awareness of patient safety culture significantly improved, and the reporting rate of adverse medical events also increased. The study suggests that education on ethical principles positively impacts nurses' perceptions of patient safety culture and can be an effective method to enhance their awareness of this culture.

2.3.5 Application of HSOPSC in China

In China, patient safety culture is also an important research area in healthcare management. Given the scientific rigor of the HSOPSC questionnaire and its reliability and validity in cross-cultural applications worldwide, many Chinese scholars have adopted it as a measurement tool for patient safety culture research.

He et al. (2023) conducted a cross-sectional survey of 539 clinical management personnel from four tertiary hospitals in Changsha, Central China. Using, HSOPSC, the study found that the mean total score of patient safety culture was 72.5 ± 7.6. The positive response rates of "nonpunitive response to error", "staffing", and "frequency of events reported" were all below 50%, indicating the need for further improvement in these areas. The study also revealed that clinical managers from specialized hospitals, females, those with higher professional titles, higher education levels, and fewer daily working hours had higher awareness of patient safety culture. Education level, work department, "teamwork within units", "management support for patient safety", "communication openness", and "staffing" were significantly associated with patient safety ratings (all $p < 0.05$). Work experience, profession, education level, work department, hospital type, professional title, "communication openness", and "handoffs and transitions" were associated with the number of reported adverse events (all $p < 0.05$).

Zhou et al. (2022) conducted a cross-sectional study using the Chinese version of the HSOPSC online questionnaire on a sample of 152 ECMO team members from the emergency department of Xiangya Hospital in China. The results showed that the overall level of patient safety culture in this team was 47.6%, with "organizational learning—continuous improvement" and "teamwork within units" scoring the highest, whereas "nonpunitive response to error", "handoffs and transitions", "staffing", and "frequency of events reported" received lower scores. The findings suggest that while the ECMO team had strengths in organizational learning and teamwork, there were significant deficiencies in error feedback, handoff processes, and staffing,

which needed to be addressed through improved management processes and increased staffing levels so as to enhance patient safety culture.

Using HSOPSC as a measurement tool, Zhong et al. (2019) conducted a baseline assessment and comparative analysis of patient safety culture intervention measures at Peking University Cancer Hospital. The cross-sectional studies conducted in 2018 and 2019 found that "organizational learning and continuous improvement", "teamwork within units", and "hospital management support for patient safety" received higher scores, whereas "frequency of events reported", "nonpunitive response to error", "communication openness", and "staffing" scored lower. Compared to the mean scores in the U.S., Peking University Cancer Hospital scored significantly lower in "communication openness" and "frequency of events reported". After continuous targeted interventions, the hospital's patient safety culture showed significant improvement across all 12 dimensions in 2019. This study demonstrated that optimizing management processes and strengthening communication mechanisms could effectively enhance patient safety culture.

D. Zhang et al. (2020) studied the impact of implementing quality control circles (QCC) on hospital patient safety culture using HSOPSC as a measurement tool. The study surveyed healthcare professionals from 12 public hospitals in China, revealing that those from hospitals that implemented QCC reported significantly higher levels in patient safety culture awareness than those from hospitals without QCC. Furthermore, the study found a positive relationship between QCC implementation and patient safety culture, suggesting that QCC can serve as an effective tool to promote the cultivation and enhancement of patient safety culture.

Liu et al. (2024) conducted a cross-sectional study using the Chinese version of HSOPSC 2.0 on 3,062 healthcare professionals from nine private hospitals and 11 clinics across six cities in China. The CFA and internal consistency testing showed satisfactory results, confirming the applicability of the Chinese version of HSOPSC 2.0 for evaluating private hospitals in China. The study also found that "organizational learning—continuous improvement" had the highest positive response rate (89%), whereas "reporting patient safety events" had the lowest (51%). Additionally, nurses and employees with longer tenure in hospitals reported a lower overall level of patient safety culture, while those with direct patient contact reported a higher number of patient safety incidents. These findings suggest that although Chinese private hospitals perform well in organizational learning, deficiencies remain in event reporting and staffing, which require appropriate adjustments and improvements.

In summary, HSOPSC has demonstrated strong adaptability and scientific validity as a measurement tool for patient safety culture assessment and intervention evaluation in both public and private hospitals in China.

2.3.6 Factors influencing patient safety culture

Studies on patient safety culture across different cultural backgrounds have revealed several common global challenges in this area:

(1) Insufficient staffing

Studies in China, Morocco, Pakistan, South America, Sweden, Ethiopia, and Vietnam have identified staffing as one of the most critical factors influencing patient safety culture that require improvement. Workforce shortages not only affect the efficiency and quality of medical services but also increase the likelihood of medical errors and adverse medical events. Addressing staffing issues is key to improving patient safety culture.

(2) Lack of non-punitive response to error

Many studies have reported low scores for non-punitive responses to errors, indicating that healthcare institutions often take punitive measures when handling errors. Such practices may lead staff to conceal errors, preventing timely identification and correction of potential safety risks. Establishing a non-punitive error-reporting system is crucial for improving patient safety culture.

(3) Lack of openness in communication

Poor communication has been identified as a factor hindering patient safety culture in multiple studies. Ineffective communication can lead to information transmission errors, weak teamwork, and neglecting or underreporting of patient safety issues. Enhancing communication openness and promoting information sharing and collaboration among team members are essential strategies for improving patient safety culture.

(4) Lack of management support

Studies in China, Sweden, and Ethiopia have highlighted the low level of management support for patient safety culture, which may hinder the advancement and implementation of safety culture initiatives. Management support should encompass resource allocation, policy formulation, employee training, and fostering a fair and non-punitive culture within healthcare institutions.

2.4 Patient centeredness self-efficacy

2.4.1 The patient-centered care model

2.4.1.1 Definition and essence

Patient-centered care (PCC) is a healthcare model that emphasizes organizing and delivering medical services based on patients' needs, preferences, and values (M.Chen et al., 2024). The core of this concept lies in respecting patients' medical autonomy, ensuring they play an active role in healthcare decisions related to their conditions, and providing personalized, coordinated, and sustainable medical services (M.Chen et al., 2024).

The core principles of patient-centered care include: (1) Respecting patients' values, needs, and preferences: physicians should fully consider patients' individual needs when formulating treatment plans, ensuring their vision and expectations are valued (Arshad et al., 2024). (2) Providing coordinated and holistic care: this principle emphasizes interdisciplinary collaboration to ensure smooth transitions between different healthcare institutions and stages of care, reducing information gaps and care interruptions (Peer & Koren, 2022). (3) Encouraging patient engagement and self-management: patients should be empowered to participate in medical decision-making and enhance their ability to manage their conditions, thereby improving treatment adherence and overall quality of life (Sousa et al., 2024). (4) Improving communication and information sharing: medical teams should maintain open, transparent, and effective communication with patients and their families, ensuring they fully understand their health conditions and treatment options. This can reduce misunderstandings caused by information asymmetry, foster a more harmonious doctor-patient relationship, and help prevent conflicts (Sheeran et al., 2023). (5) Enhancing healthcare accessibility: efforts should be made to minimize barriers that hinder patients from accessing medical services (e.g., financial, geographical, and cultural factors), ensuring that individuals from different socioeconomic backgrounds can equitably receive high-quality healthcare resources (Khan et al., 2024).

2.4.1.2 Application in healthcare

Early medical models were primarily physician-centered, focusing on technology and disease treatment. However, modern medical models have gradually shifted toward making patients the central decision-makers, requiring physicians to consider patients' preferences and encourage patients' participation. Zolnierek and Dimatteo (2009) found a significant positive relationship

between physician-patient communication and patient adherence to medical instructions. Patients with poor physician communication were 19% more likely to be non-adherent to medical instructions than those with good communication. Additionally, their study revealed that patient adherence significantly improved after communication skills trainings on physicians, with adherence rates 1.62 times higher after training compared to before. With the rise of humanistic and communication-based medicine, the concept of patient-centered care has further driven a shift in physicians' role in healthcare services (Tokumasu et al., 2024).

The patient-centered care model has been widely applied in various medical fields, such as chronic disease management, geriatric care, and oncology treatment. Studies have shown that patient-centered care can significantly improve patient satisfaction, enhance health outcomes, reduce healthcare costs and burdens, strengthen doctor-patient relationships, and decrease medical disputes (Degenhardt et al., 2024; Farooqi et al., 2024).

In the area of chronic disease management, research has indicated that patient-centered care enables patients to actively participate in medical decision-making and receive personalized care, leading to improved control of chronic conditions (e.g., diabetes and hypertension) while reducing the occurrence of acute complications (Raslan et al., 2024). In terms of cancer care, patient-centered care has been shown to enhance patients' quality of life, reduce unnecessary invasive procedures, and provide crucial psychological support (Cerqueira et al., 2025). Regarding elderly and patient care, patient-centered care supports coordinated and continuous care with personalized health plans for elderly patients, which can improve their self-care abilities, reduce unnecessary hospitalizations, and enhance their social participation, thereby promoting their overall physical and mental well-being (Porcel-Gálvez et al., 2025).

In recent years, the rapid development of artificial intelligence and digital healthcare has played a crucial role in advancing patient-centered care (Song et al., 2024; Supramaniam et al., 2024; Veyron et al., 2024).. The specific applications include the following:

Electronic health records: Optimizing information management facilitates the sharing of health data between patients and physicians, which can increase patient engagement in the treatment process, thereby improving patient adherence, treatment efficiency, and safety (Naef et al., 2024)

Mobile health applications: These applications can assist with patients' self-management. For example, diabetes patients can use smartphone applications to monitor blood glucose levels and receive personalized health recommendations, which helps them improve lifestyle habits, enhance adherence to medical visits, and ultimately achieve better health outcomes (Yoon et al., 2024).

AI-assisted decision-making: By integrating big data analysis, AI helps physicians develop more precise and personalized treatment plans, thus improving the scientific accuracy and rationality of clinical decisions, ultimately leading to better treatment outcomes (Saikali et al., 2025)

2.4.1.3 Evaluation and challenges in healthcare

The effectiveness of the patient-centered care model is primarily assessed through the following indicators (M. Chen et al., 2024):

(1) Patient satisfaction: It measures the extent to which patients recognize their healthcare experience, including the quality of communication with the medical team and the quality of personalized care.

(2) Health outcomes: This indicator evaluates the impact of the patient-centered care model on disease management and recovery, such as disease control rates, hospitalization rates, and improvements in quality of life.

(3) Healthcare costs: This indicator analyzes whether the patient-centered care model helps reduce expenses related to readmissions, excessive medical interventions, and unnecessary treatments.

(4) Doctor-patient relationship: It examines whether the patient-centered care model fosters trust and cooperation between doctors and patients, as well as enhancing patients‘ confidence in the healthcare system.

Studies have indicated that implementing a patient-centered care model in healthcare institutions often lead to higher patient adherence, reduced misdiagnoses and medical errors, and healthcare professionals' higher job satisfaction, ultimately leading to an overall enhancement in healthcare quality (Degenhardt et al., 2024).

Despite its advantages, the patient-centered care model faces several challenges in practice: 1) In regard to resource allocation, personalized healthcare often requires greater investment in personnel, equipment, and funding, making it difficult to implement when there are limited resources, particularly in developing countries and regions facing healthcare workforce shortages (Farooqi et al., 2024). 2) Regarding variability in patient engagement, patients with limited health literacy or different cultural backgrounds may struggle to participate in medical decision-making, which can affect the effectiveness of patient-centered care implementation (Ju et al., 2024). 3) In terms of medical team training, since healthcare professionals play a leading role in service delivery, it is essential to strengthen their training in the patient-centered

care model, so as to enhance their communication skills and personalized care capabilities to meet the diverse needs of patients (Lee et al., 2024).

2.4.2 Self-efficacy

2.4.2.1 Definition

Self-efficacy, a psychological concept proposed by Bandura (1986), is originated from Bandura's social cognitive theory. It is defined as an individual's belief in their ability to perform specific behaviors. This belief influences an individual's goal setting, commitment, and the level of effort and persistence when facing challenges. Self-efficacy affects behavior through four processes: cognition, motivation, emotion, and choice. It reflects an individual's internal beliefs about their interaction with behavior and environmental factors and serves an evaluation of one's ability to perform a specific task, rather than a reflection of actual ability. Bandura emphasized that self-efficacy judgments can vary depending on the context involved and whether the capabilities are task- and domain-specific.

Specifically, self-efficacy encompasses four aspects: 1) Subjectivity—self-efficacy is an individual's or group's subjective assessment and self-evaluation of their behavioral capabilities, reflecting their belief in their ability to complete a task. 2) Self-generation—self-efficacy is reflected in an individual's ability to integrate and generate information about one's specific capabilities. 3) Domain specificity—self-efficacy is notably domain-specific, meaning an individual's evaluation of their ability to achieve specific goals or complete tasks will differ across different domains. 4) Intrinsic self-belief—once formed, self-efficacy becomes a firm internal belief that profoundly influences behavior and decision-making (Xie & Wang, 2009).

The formation of self-efficacy depends on four key conditions, including both internal personal factors and external environmental factors. 1) Direct experience—individuals gain direct knowledge of their abilities through their actions and practices. This condition has the most significant influence on the formation of self-efficacy and is the most important factor among the sources of self-efficacy information. 2) Vicarious experience—vicarious experience comes from observing the behavior and outcomes of others, which provides insight into one's own potential abilities. 3) Social persuasion—also known as verbal persuasion, it involves encouragement, suggestions, advice, and hints from others to help individuals believe in their ability to achieve specific results. 4) Physiological and psychological state—when evaluating their own abilities, individuals also take into account their emotional and physiological states

as bodily feedback. These four factors jointly shape an individual's self-efficacy, which further influences their behavioral choices and life outcomes (Van der Bijl & Shortridge-Baggett, 2001)

2.4.2.2 Self-efficacy theory

Self-efficacy theory, initially proposed by Albert Bandura (1977) and gradually developed throughout the 1970s, forms one of the core components of social cognitive theory. As an extension of social cognitive theory, it is a crucial framework in contemporary psychology for studying and explaining individuals' confidence, perceptions, and beliefs about their abilities. This theory not only reflects unique cultural characteristics but has also proven widely applicable across different cultural contexts globally. Furthermore, self-efficacy theory is interconnected with other psychological theories. For instance, both self-determination theory and expectancy-value theory intersect with self-efficacy, together explaining the relationship between motivation and behavior. Self-efficacy also plays an important role in health promotion and disease prevention. It is linked to the concept of "sense of coherence" in Salutogenic theory, which emphasizes how individuals utilize resources to combat stress and promote health (Williams & Rhodes, 2016).

Self-efficacy theory has broad applications in various fields, including health promotion, education, and management. In the field of health promotion, self-efficacy is considered a key predictor of behavior change and self-management. For patients with chronic diseases, high self-efficacy is associated with higher health-related quality of life, reduced perceived stress, fewer symptoms of anxiety and depression, and lower symptom severity. Additionally, self-efficacy is closely related to patient empowerment, serving as a crucial mechanism for effective self-management (Williams & Rhodes, 2016). In the field of education, self-efficacy is recognized as a critical factor for learning motivation and academic achievement. Academic self-efficacy is positively associated with students' efforts, persistence, and academic performance. By improving students' self-efficacy, educators can enhance their learning motivation and achievements. In the field of management, self-efficacy theory provides insights into leadership, employee development, and organizational behavior. Managers can improve work performance and job satisfaction by enhancing employees' self-efficacy (Artino, 2012).

2.4.2.3 Measurement of self-efficacy

Self-efficacy measurement methods include the traditional approach, proposed by Bandura, and the Likert scale, which has been widely used due to its convenience in application (Ulfert-Blank & Schmidt, 2022). Research has shown that these different measurement methods have high similarity in terms of reliability and validity (Dahlberg et al., 2022; Dennis et al., 2024). An

accurate self-efficacy scale should be based on multiple structural dimensions of self-efficacy. The measurement of self-efficacy is multidimensional rather than unidimensional, primarily focusing on three core dimensions: level, strength, and scope (Van der Bijl & Shortridge-Baggett, 2001). The level of self-efficacy refers to the degree of difficulty an individual or group can overcome when facing a task or the level of mastery over personal ability information while completing the task. The strength of self-efficacy refers to an individual‘s confidence in their ability to complete tasks or activities of varying difficulty and complexity. The scope of self-efficacy describes how the success or failure of an individual's behavior impacts the expected self-efficacy for specific, limited actions. Currently, most studies primarily choose the strength of self-efficacy as an indicator when measuring self-efficacy. This selection reflects the emphasis on an individual's confidence when faced with challenges (Sherer et al., 1982).

2.4.3 Patient-centeredness self-efficacy

2.4.3.1 Definition

The patient-centeredness self-efficacy theory is an application of the general self-efficacy theory in a specific context. Zachariae et al. (2015) applied the self-efficacy framework to patient-centered healthcare practices and formally introduced the concept of patient-centeredness self-efficacy. According to these authors, patient-centeredness self-efficacy refers to the belief held by medical students or physicians that they can perform specific medical behaviors in a patient-centered manner. This belief is primarily reflected in three dimensions: 1) the ability to focus on and integrate the patient's personal experiences, needs, and perspectives; 2) providing patients with opportunities to engage in their healthcare; and 3) fostering a partnership between the patient and physician. This study follows Zachariae's definition of patient-centeredness self-efficacy.

2.4.3.2 Measurement of patient centeredness self-efficacy

Currently, academic consensus regarding the measurement of patient-centeredness self-efficacy remains divided into two primary orientations. The first approach, represented by Luszczynska et al. (2005), advocates for the use of universal scales to examine individuals‘ self-efficacy at a general level. The General Self-Efficacy Scale (GSES), developed by Weinman. J et al. (1995) is a unidimensional scale consisting of 10 items and has been widely applied across various countries. For instance, X.H.Huang, Gao, et al. (2022) used this scale to explore the influence of hospital culture, self-efficacy, and achievement motivation on healthcare professionals'

"patient-centered" medical services. C. K. Wang (2001) localized the scale in the Chinese context, and the Chinese version has been shown to exhibit strong reliability and validity.

However, some studies hold opposing views, arguing that general self-efficacy is less effective in predicting specific behaviors compared to domain-specific self-efficacy. Represented by Bandura (2006), this perspective advocates for targeted measurement of self-efficacy tailored to the specific characteristics of the contexts or fields.

Recently, self-efficacy scales have garnered increasing attention in the healthcare industry, leading to the development of various domain-specific scales, such as the "Participatory Strategies Self-Efficacy Scale" and the "Professional Self-Efficacy Scale". In the domain of "patient-centered" care, self-efficacy measurement often refers to the work of Zachariae et al. (2015), who developed the "*Self-Efficacy in Patient-Centeredness Questionnaire*" (SEPCQ) from the perspectives of physicians and medical students. SEPCQ encompasses three dimensions: exploring the patient perspective, sharing information and power, and dealing with communicative challenges. Comprising 27 items, the scale has gained widespread recognition for its validity and reliability (Karger et al., 2022).

D. X. Chen et al. (2023) translated SEPCQ into Chinese and created a Chinese version of the questionnaire. Employing stratified random sampling technique, they selected 26 tertiary general hospitals from the Pearl River Delta, as well as the eastern, western, and northern regions of Guangdong, China. A survey involving 1,318 clinical physicians was conducted to evaluate the psychometric properties of the scale. The results indicated that the questionnaire exhibited excellent internal consistency (Cronbach's α = 0.988) and split-half reliability (Guttman coefficient = 0.961). The construct validity of the scale was established through both exploratory factor analysis (EFA) and CFA. Confirming that the scale is highly reliable and valid for assessing the patient-centeredness self-efficacy of physicians in China.

2.4.4 The relationship between patient-centeredness self-efficacy and healthcare professionals' patient safety behavior

Self-efficacy, as a core variable in organizational behavior, has strong practical significance for driving individual behavior. The study of self-efficacy has long been a debate over its "general" and "specific" domains. The positive relationship between general self-efficacy and "patient-centered" diagnosis and treatment behavior has been confirmed by numerous scholars. For instance, Jeon and Choi (2021), while exploring factors influencing the implementation of "patient-centered" healthcare services among nursing undergraduates in South Korea, found

that general self-efficacy was related to "patient-centered" diagnosis and treatment behavior. Similarly, (X.H.Huang, Gao, et al., 2022) pointed out that social environment could directly and indirectly influence healthcare professionals' "patient-centered" diagnosis and treatment behavior through general self-efficacy. In addition, these authors also confirmed the mediation effect of general self-efficacy in the relationship between hospital culture and healthcare professionals' "patient-centered" diagnosis and treatment behaviors.

However, some studies have contradictory findings. For instance, J. Wang et al. (2021) conducted empirical research and found a negative impact of general self-efficacy on nurses' "patient-centered" communication behaviors. They also introduced burnout during the learning process as a mediator to examine the influence mechanism. Through a survey with 318 healthcare professionals in Italy, Sommaruga et al. (2017) found that self-efficacy and patient-centered clinical behaviors were not related to each other.

Regarding the reasons for the divergence of research conclusions, previous studies have indicated that general self-efficacy exhibits limited predictive power for individual behavior in specific task domains, making its role in influencing such behavior unclear (J. D. Li, 2011). In contrast, self-efficacy in specific domains can more accurately predict individual performance within those domains. Since Zachariae et al. (2015) proposed the concept of patient-centeredness self-efficacy, this area has garnered increasing scholarly attention. Michael et al. (2022) demonstrated that the patient-centeredness self-efficacy of pharmacy professionals was significantly positively associated with their "patient-centered" attitudes, which serves a reference for future research.

2.5 Adverse effects of medical treatment and physician's patient safety behavior

2.5.1 Adverse effects of medical treatment

2.5.1.1 Definition, risk factors, and current status

Adverse effects of medical treatment (AEMT) in healthcare refers to incidents that occur during medical procedures which do not meet expectations and may cause harm or damage to a patient's health (Kong et al., 2024). These events can occur in various healthcare settings such as hospitals, clinics, pharmacies, and nursing facilities, or in non-professional medical environments such as home care or self-medication. Adverse medical events can be classified into two categories: preventable and non-preventable. Preventable events include patient harm

caused by human errors by healthcare professionals or improper maintenance of medical equipment. These events can be prevented through improvements in medical processes and equipment management. Non-preventable events are those that may still occur despite correct actions by healthcare professionals and the proper functioning of equipment. These types of harm are difficult to avoid with current medical standards (Shojania, 2008).

Risk factors for adverse medical events include medication errors, surgical errors, healthcare-associated infections, sepsis, diagnostic errors, patient falls, venous thromboembolism, pressure ulcers, unsafe blood transfusion practices, and patient misidentification. Research has shown that medication errors are the most common and preventable cause of patient harm among all types of adverse medical events. These errors often involve incorrect drugs, doses, administration routes, or incorrect patient prescriptions. It has been reported that the incidence of medication errors in acute care hospitals is approximately 6.5 per 100 admissions (Tariq et al., 2024).

These risk factors operate at multiple levels, including individual patient characteristics, medical processes, medical environment, and healthcare systems. WHO (2023) indicates that that patient harm is often caused by a combination of interrelated factors, and a single patient safety incident typically involves multiple contributing factors:

(1) Systemic and organizational factors: the complexity of medical interventions, inadequate processes and procedures, disruptions in workflow and nursing coordination, limited resources, inadequate staffing, and lack of capacity development.

(2) Information technology-related factors: the errors caused by malfunctions in medical information systems, such as failures in electronic health records and medication management systems.

(3) Human factors and behaviors: communication interruptions, ineffective teamwork, fatigue, burnout, and cognitive biases among healthcare professionals, as well as interactions within healthcare teams and with patients and their families.

(4) Patient-related factors: limited health literacy, lack of patient involvement, and non-compliance with treatment plans.

(5) External factors: lack of policies, inconsistent regulations, economic and fiscal pressures, and challenges related to the natural environment.

The Institute of Medicine (IOM) Healthcare Quality Committee defines "medical errors" as the failure of a planned action to be completed as intended, or the use of an incorrect plan to achieve a goal. According to the International Organization for Migration, medical errors are identified as a leading cause of death and injury. Based on WHO's 2019 Overview of Patient

Safety, unsafe patient care-related adverse events are among the top ten causes of death and disability globally. In the U.S., preventable adverse events result in approximately 44,000 to 98,000 hospital deaths annually, surpassing the number of deaths caused by motor vehicle accidents. These events are estimated to incur additional healthcare costs, disability, and productivity losses ranging from $37.6 billion to $50 billion (Tariq et al., 2024).

A retrospective analysis has revealed that from 1990 to 2019, global patient harm events related to medical practices such as surgery and medication increased by 59%, from 11 million to 18 million cases. This growth outpaced the increase in global population during the same period (45%). The elderly patient population was the most affected group. This increase is not only related to global population growth but also reflects improvements in the reporting and identification of adverse medical events (Lin, 2024). In China, an analysis of the current status of medical safety (adverse) event management indicates that managing medical safety (adverse) events is a crucial pathway for healthcare institutions to strengthen self-management, identify potential risks in medical services, prevent negative events, and ensure medical quality (Huo & Yin, 2021).

Globally, reports on the incidence of adverse medical events vary across countries. The public disclosure of data on medical errors and adverse medical events has sparked widespread attention within the international medical community and prompted serious responses from governments around the world. To effectively reduce the incidence of medical errors and adverse medical events, many countries and regions have established reporting systems. These reporting systems aim to improve medical safety by collecting and analyzing relevant data, identifying issues, and taking preventive measures.

2.5.1.2 Related research

In the medical field, the study of adverse events is crucial for improving patient safety and healthcare quality. Research on adverse medical events worldwide commonly employs methods such as analysis of reported adverse events, qualitative interviews with healthcare professionals, and questionnaire surveys to collect data from healthcare professionals. The development of these research methods can be traced back to 1984, when professors at the Harvard School of Public Health conducted a groundbreaking study. Brennan et al. (1991) retrospectively analyzed emergency departments in 51 randomly selected hospitals in New York State, reviewing 30,121 patient medical records. They found that 3.7% of hospitalized patients experienced adverse medical events due to negligence, with 70.5% of these events resulting in disabilities lasting six months or less, 2.6% resulting in sustained permanent disabilities, and 13.6% resulting in death.

The findings emphasized that reducing the incidence of adverse medical events requires identifying their specific causes and implementing targeted preventive measures.

In a meta-analysis encompassing 70 studies and 337,025 patients, Panagioti et al. (2019) found that the overall prevalence of preventable patient harm was 6%. Of these harms, 12% were classified as severe or fatal. Medication-related patient harm events accounted for 25% of preventable patient injuries, while other treatment-related patient injury events accounted for 24%, making them the most significant contributors to preventable patient injuries. The analysis also indicated that preventable patient harm occurs more frequently in specialized fields such as intensive care and surgery. Haynes et al. (2009) argued that medical errors and mistakes are not random occurrences but can be mitigated through preventive measures. Therefore, it is recommended to establish a patient safety system centered on protecting patients and preventing human-caused harm. Such a system should include new policies, programs, and technical guidelines aimed at helping healthcare professionals reduce and prevent medical errors. These findings demonstrate that research on adverse medical events not only helps identify and understand the causes of such events but also contributes to developing effective prevention strategies and improving patient safety. These studies provide valuable data and insights for healthcare institutions, contributing to the creation of safer medical environments.

2.5.2 Patient safety behavior

2.5.2.1 Definition

Patient safety behavior (PSB) refers to a series of actions taken by physicians in medical practice aimed at preventing and reducing medical errors and adverse events, ensuring patient safety (Bashir et al., 2024). These behaviors include hand hygiene adherence, proper medication use, effective communication, and timely reporting of adverse events (Friedewald et al., 2022). Such safety behaviors have been shown to be associated with the occurrence of preventable adverse medical events and are influenced by various factors, including work pressure, resource limitations, and insufficient training (Yaghoubi et al., 2016).

2.5.2.2 Measurement of patient safety behavior

Neal and Griffin (2006) categorized safety behavior into two types: participative safety behavior and compliance safety behavior. Participative safety behavior refers to actions that do not directly involve safety incidents but contribute to creating a supportive safety environment, while compliance safety behavior involves employees adhering to systems and procedures to ensure safety. Cook et al. (2004) analyzed patient safety risk factors in healthcare institutions

and identified erroneous patient safety behaviors by healthcare professionals as a significant risk factor. Therefore, they proposed that to enhance patient safety, it is necessary to involve all healthcare personnel within the institution. To change unsafe behaviors among physicians, it is essential first to assess the current status of their patient safety behaviors. By evaluating these behaviors, identifying common causes of unsafe actions, and conducting in-depth analysis, hospitals can continually improve their medical safety management systems and strategies.

The domino theory of accident causation is a classic framework in safety behavior research, positing that unsafe events occur as a chain reaction triggered by interrelated factors, with unsafe behavior by personnel being the critical link leading to the entire unsafe event (Flotta et al., 2012). The core objective of safety culture is to encourage employees to adhere to safety protocols and processes, actively engage in safety-related activities, and gradually foster the idea that safe behavior is valuable. This process aims to cultivate habitual safe practices, ultimately ensuring patient safety. Furthermore, Hofmann et al. (2003) categorized unsafe behaviors into six major types: improper use of tools, inadequate personal risk management measures, neglecting the use of personal protective equipment, improper placement of tools, and other risks arising from erroneous work strategies. These factors significantly increase the likelihood of accidents. In the medical field, research on healthcare professionals' safety behavior is relatively scarce, indicating the need for more studies to explore how theoretical guidance can enhance the practice of safety behaviors and improve patient safety.

Current research on patient safety behaviors often focuses on testing specific behaviors, such as hand hygiene (Cutter & Jordan, 2012; Freeman et al., 2012; White et al., 2012) and standard precautionary behaviors (Cutter & Jordan, 2012). However, these studies often lack comprehensive evaluation tools for systematically assessing the safety behaviors of members within medical organizations. This limitation restricts comparative analysis of the relative strengths and weaknesses of various safety behaviors. Shih et al. (2008) explored the relationship between patient safety behaviors and safety culture by employing a self-developed safety behavior scale. The scale, based on the safety behavior theory proposed by Neal and Griffin (2006), includes 11 items without distinguishing dimensions. Ron (2009) also used this scale in their studies, translating it into Chinese for measuring patient safety behaviors among healthcare professionals in Chinese-speaking medical institutions in Taiwan. Their findings demonstrated the scale's strong measurement performance, reliability, and validity.

2.6 The relationship between patient safety culture, patient-centeredness self-efficacy, and patient safety behavior

2.6.1 Patient safety culture and patient-centeredness self-efficacy

Patient safety culture (PSC) and Patient-centeredness self-efficacy (PCSE) are crucial for improving the quality of healthcare services and ensuring patient safety (Harsul et al., 2020). Previous research has indicated a significant relationship between patient safety culture and the self-efficacy of healthcare professionals. In a positive patient safety culture, healthcare professionals are more likely to report medical errors and participate in safety improvement measures, thereby enhancing their self-efficacy (Berdida & Alhudaib, 2024). Furthermore, the strength of patient safety culture is positively associated with the self-efficacy of healthcare professionals, suggesting that a strong patient safety culture can enhance the self-efficacy of healthcare professionals, thereby improving patient safety (Alabdaly et al., 2024).

When exploring the role of patient involvement in patient safety culture, Girnius et al. (2024) found that patient participation plays a crucial role in enhancing patient safety and healthcare quality. Patients are not only recipients of healthcare services but also important resources for monitoring and improving patient safety. They can identify safety-related issues that the medical team might overlook. Through direct participation and feedback, patients can help healthcare institutions identify potential risks and correct errors.

The results of Abrishami et al. (2024) suggested a positive relationship between patient safety culture and patient experience. Communication and teamwork are the most influential factors in this relationship. Positive perceptions of safety by both managers and physicians are associated with improved patient experience, whereas this relationship is absent if such views are solely held by managers. Patient engagement can enhance patient safety culture, as patient participation and feedback are crucial for building trust, fostering open communication, and promoting a collaborative environment. Some indicators that measure patient experience, such as physical comfort and a safe environment, are also parts of patient safety culture. As the recipients of medical care, patients' active involvement can promote the development and implementation of patient safety culture.

Patient safety and patient participation in safety-related activities are considered pivotal in healthcare, as they impact a range of individual and organizational outcomes. X. Wang and Zhao (2023) surveyed 456 patients and found that patient participation in safety initiatives had a significant positive impact on patient safety. Moreover, self-efficacy demonstrated a

significant mediation effect therein. Therefore, it was concluded that self-efficacy mediates the relationship between patient participation and patient safety. Overall, current research findings indicate that patient participation in patient safety practices can be predicted by patients' self-efficacy levels.

The research of Alabdaly et al. (2024) underscores the importance of patient participation in safety practices, highlighting that patients' perceptions of safety practices and their views on their own health may influence their level of participation. Furthermore, self-efficacy is shown to act as a potential mediator in the relationship between patient participation in safety activities and overall patient safety. These findings suggest that by increasing patients' self-efficacy, their participation in the healthcare process can be enhanced, thereby improving patient safety outcomes.

In summary, there is a close relationship between a positive patient safety culture and patient-centeredness self-efficacy. A positive safety culture can enhance healthcare professionals' patient-centeredness self-efficacy, enabling them to adopt more patient-centered safety behaviors, thereby enhancing patient safety.

2.6.2 The impact of self-efficacy on patient safety behavior

In the field of healthcare, patient safety behavior (PSB) is vital for ensuring patient safety, reducing medical errors, and improving the quality of medical services. Research has shown that the self-efficacy of healthcare professionals, especially patient-centeredness self-efficacy, has a significant impact on patient safety behavior. In patient-centered care models, the influence of healthcare professionals' patient-centeredness self-efficacy on patient safety behavior is especially pronounced (X. H. Huang, Wang, et al., 2022).

Healthcare professionals with higher self-efficacy are more likely to engage in patient safety behaviors, such as accurately reporting medical errors and actively participating in safety improvement initiatives (X. H. Huang, Wang, et al., 2022). Moreover, self-efficacy may influence patient safety behavior through some mediators, such as healthcare professionals' perceptions of patient safety culture (X. Wang & Zhao, 2023). Yang et al. (2024) indicated that individual differences, including gender, marital status, age, professional title, tenure, and geographic location, significantly impacted healthcare professionals' patient-centeredness self-efficacy. These factors may affect their confidence and ability to provide patient-centered care, thereby influencing patient safety behavior.

Physicians' patient safety behavior is critical to patient safety, while patient-centeredness self-efficacy has a significant impact on such behaviors. Research on patient-centeredness self-

efficacy provides a theoretical foundation for developing effective interventions to improve physicians' patient safety behavior, thereby advancing healthcare safety and the quality of patient care.

2.6.3 The impact of patient safety culture on physicians' patient safety behavior

The research of Rahmani et al. (2023) showed that patient safety culture was significantly associated with healthcare professionals' patient safety behavior, and a strong patient safety culture could enhance the self-efficacy of healthcare professionals, thereby improving patient safety. Patient safety culture has a direct impact on the behavior of healthcare professionals.

In a positive patient safety culture, healthcare professionals are more likely to report medical errors, participate in safety improvement initiatives, and consequently strengthen their self-efficacy and patient safety behavior. Furthermore, the strength of patient safety culture is positively associated with healthcare professionals' self-efficacy, such that a strong patient safety culture can improve the self-efficacy of healthcare professionals, thus ensuring patient safety (Layne et al., 2019).

The key factors influencing patient safety culture include organizational leadership, teamwork, error reporting, and non-punitive responses. These factors jointly create an environment that supports patient safety and encourages healthcare professionals to adopt safe behaviors. Bashir et al. (2024) revealed a significant association between various dimensions of patient safety culture and healthcare professionals' patient safety behavior. For example, teamwork, management's response to error, and the frequency of events reported were positively associated with healthcare professionals' patient safety behavior.

Furthermore, the non-punitive response dimension of patient safety culture is related to lower rates of medical errors. Patient safety culture is often assessed through surveys, such as HSOPSC. These tools help evaluate healthcare professionals' perceptions of patient safety culture and identify areas for improvement, thereby enhancing patient safety behavior (He et al., 2023)

In summary, patient safety culture significantly impacts healthcare professionals' patient safety behavior. Strengthening the dimensions of patient safety culture can directly enhance the patient-centeredness self-efficacy of healthcare professionals. This improved self-efficacy, in turn, improves their patient safety behavior, reduces medical errors, and enhances the quality of healthcare services.

2.7 Theoretical framework and hypotheses

Based on the literature review and considering the primary research questions of this study, we chose social cognitive theory and person-situation interaction theory as the theoretical foundation for this study. In accordance with these two theories, a theoretical model was constructed to explore the mechanisms of influence between patient safety culture perception and physicians' patient safety behavior, with patient-centeredness self-efficacy as a mediator. The relationships among these three variables are illustrated in Figure 2.2. There is a dynamic and continuous interaction between individual cognition, the environment, and individual behavior. Self-efficacy, as an important variable in individual cognition, plays an indispensable role in shaping individual behavior. In healthcare service, the patient safety culture within medical institutions, as organizational culture, serves as an external driving force, while patient-centeredness self-efficacy acts as an internal driver (Layne et al., 2019). They jointly determine the occurrence of physicians' safe diagnosis and treatment behavior (Tett & Burnett, 2003). When physicians are situated in a hospital environment with a strong patient safety culture, they experience the organization's commitment, support, and encouragement for patient safety. That will enhance their belief in their own "patient-centered" abilities, thereby fostering safe medical behaviors that align with organizational expectations (Rahmani et al., 2023).

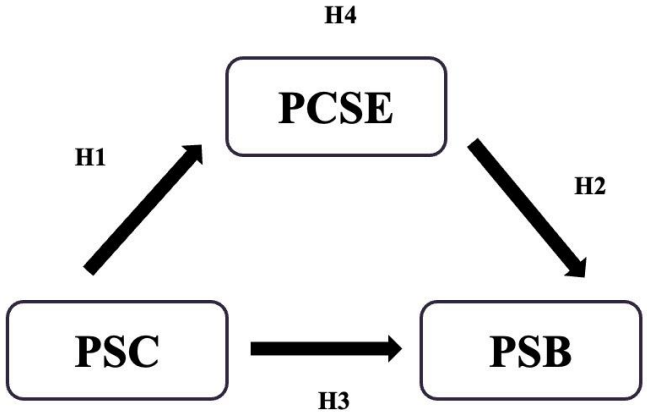

Figure 2.2 Research theoretical model

Note. PSC = Patient safety culture; PSB= Patient safety behavior; PCSE = Patient-centeredness Self-efficacy.

According to person-situation interaction theory, individual behavior is shaped by the interaction between personal traits and external contexts (Tett & Burnett, 2003). For physicians, safe diagnostic and treatment behavior is embedded within the organizational context and social relationships they are part of, influenced by the interaction between the individual and the

situational subsystem. In the same organizational context, individuals with different characteristics will form distinct psychological environments, leading to different behavioral outcomes (Chao et al., 2023). Therefore, this study primarily explores the influence of patient safety culture as an organizational culture and patient-centeredness self-efficacy as an individual trait on physicians' patient safety behavior.

Based on the literature review and the theoretical foundation outlined above, we propose the following hypotheses:

H1: *Patient safety culture has a significant positive impact on physicians' patient-centeredness self-efficacy*.

H2: *Physicians' patient-centeredness self-efficacy has a significant positive impact on their patient safety behavior*.

H3: *Patient safety culture has a significant positive impact on physicians' patient safety behavior*.

H4: *Patient-centeredness self-efficacy mediates the relationship between patient safety culture in healthcare institutions and physicians' patient safety behavior*.

Chapter 3: Research Methods

This chapter primarily outlines the research methods employed in this study, including the questionnaire design, variable measurement, data collection, and data analysis methods.

3.1 Questionnaire design

This study employs a quantitative analysis approach to thoroughly explore the impact of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behavior. To achieve the research objectives, we used well-established and widely accepted scales related to patient safety culture, patient-centeredness self-efficacy, and physicians' patient safety behavior to design the questionnaire for this study. This approach ensures that the data collected accurately reflects healthcare professionals' actual circumstances and perceptions in these areas.

To further enhance the quality and reliability of the data, we implemented several rigorous control measures. 1) We only allowed participants who met the selection criteria to participate, effectively excluding samples that could skew the research findings. 2) Prior to the formal distribution of the questionnaire, we conducted a pilot test. During this phase, a small group of healthcare professionals who met the selection criteria completed the questionnaire, and based on their feedback, we adjusted and refinements to the questionnaire. These measures effectively ensured the accuracy and reliability of the data collected.

Through these efforts, we aimed to gather reliable and accurate data to support research on physicians' patient safety behavior management. Additionally, the findings from the questionnaire survey can provide hospital administrators with deeper insights into the patient safety behaviors of healthcare professionals. This will help them formulate more effective patient safety management strategies to improve healthcare service quality, reduce adverse medical events and the burden of disease, foster harmonious physician-patient relationships, and promote the sustainable development of healthcare institutions.

3.1.1 Questionnaire design principles

The questionnaire design was guided by the research model, which involves three key variables: patient safety culture, patient-centeredness self-efficacy, and physicians' patient safety behavior.

The variables were selected based on the core research objectives and target population, as informed by an extensive literature review. Priority was given to internationally well-established scales with proven reliability and validity, particularly those validated in the Chinese context. To ensure their applicability and relevance, the original scales were translated into Chinese with permission from the source institutions, so as to facilitate comprehension and response accuracy among Chinese physicians.

Regarding the questionnaire format, we prioritized simplicity and clarity. The layout was crafted to enable participants to quickly grasp the content and provide answers efficiently. Additionally, we employed clear and easy-to-understand language in the Chinese translation to ensure participants could accurately comprehend the questions and offer genuine responses. These efforts ensured the efficiency of questionnaire completion and minimized potential misunderstandings or errors during data collection.

Moreover, ethical considerations were taken during the questionnaire design process. A detailed informed consent form was included on the first page of the questionnaire, outlining the study's purpose, significance, potential risks, and participants' rights and responsibilities. This ensured participants were fully informed and voluntarily engaged in the study.

In the final stage of questionnaire design, we conducted a small-scale pilot test tailored to the specific circumstances of Chinese physicians. By analyzing the pilot test data and collecting feedback from participants, we identified problems and deficiencies in the questionnaire and made adjustments accordingly, further enhancing the questionnaire's scientific rigor and practical applicability. The final questionnaire was developed after repeated revisions and refinements to ensure that it not only aligns with the core objectives of this study but also demonstrates high levels of reliability and validity.

Based on the above design principles and ideas, we conducted a thorough review and analysis of relevant literature on the measurement of the three key variables of this study: patient safety culture, patient-centeredness self-efficacy, and physicians' patient safety behaviors. Drawing on well-established scales with high reliability and validity in related fields, we selected widely used and extensively validated measurement tools for this research. This ensured strong scientific rigor and rationality of the questionnaire for collecting reliable data, laying analytical foundations for subsequent research.

3.1.2 Questionnaire design process

Based on a comprehensive literature review, we selected three well-established and extensively validated scales to form the initial draft of the questionnaire: the Hospital Survey on Patient

Safety Culture 2.0 (HSOPSC 2.0)) (Agency for Healthcare Research and Quality U.S. Department of Health and Human Services, 2019), the Self-Efficacy in Patient-Centeredness Questionnaire (SEPCQ) (Zachariae et al., 2015), and the Physicians' Patient Safety Behavior Survey (Shih et al., 2008). Additionally, the questionnaire included questions about the participants' basic information. To ensure the questionnaire's applicability and scientific rigor, we sought feedback from experts in hospital management from both China and Portugal and incorporated their suggestions to refine and adjust the questionnaire. Special attention was also given to the questionnaire's formatting and layout. We ensured that the font size and line spacing were appropriate for ease of reading and organized the sequence and arrangement of questions in a clean and orderly way to make the questionnaire more reader-friendly. After completing these steps, the final version of the questionnaire was established.

3.1.3 Questionnaire structure

The questionnaire consists of several key sections, including an informed consent form, a preface, basic information, and measurement scales for the relevant research variables.

3.1.3.1 Informed consent form

The informed consent form is a critical document that proves the voluntary participation of the participants in this study. In the informed consent form, we provided a detailed explanation of all relevant aspects of the research, including its objectives and background, to ensure that the participants make an informed voluntary decision to take part in the survey.

First, the core objective of the study is clearly stated: Our goal is to systematically and comprehensively collect data on the current state of clinical physicians' patient safety behaviors and the influencing factors to provide a reference for improving patient safety management strategies and measures.

Second, we fully respect the privacy of personal information. The informed consent form explained the potential risks that the participants might face and outlined our response measures. We emphasized that the survey is anonymous, and all collected information would only be used for the purpose of academic research. Additionally, we implemented strict data encryption and storage protocols to ensure the confidentiality of all collected data and prevent any data leakage or misuse.

Moreover, in the informed consent form, we emphasized the protection of participants' rights and interests. We explicitly stated that there were no right or wrong answers to the questions in the survey. Participants were encouraged to answer genuinely based on their actual

work situations. They also have the right to withdraw from the study at any time and to refuse to answer any questions they are uncomfortable with, ensuring the protection of their legal rights and privacy.

Finally, we provided a detailed explanation of the expected outcomes and contributions of the study.

3.1.3.2 Preface

In the preface, we focused on clearly communicating the approximate time required to complete the entire questionnaire, allowing participants to plan their time accordingly and make an informed decision to voluntarily participate in the survey. Additionally, we expressed our sincere gratitude to each participant for taking the time to complete the questionnaire. Their active participation not only provides significant support to our research but also plays an essential role in advancing patient safety management.

3.1.3.3 Basic information

Based on the literature review, this study systematically collected relevant basic information from the participants, including gender, age, marital status, education level, department in the healthcare institution, professional title, whether they hold administrative positions, average daily working hours, and tenure. This information is crucial for understanding individual differences among the participants, providing a solid foundation for subsequent data analysis and result interpretation. A thorough analysis of the participants' basic information enabled us to more accurately explain the causes behind the research findings and offered strong support for generalizing the results to a broader population or specific groups, thereby enhancing the reliability and generalizability of the study. The specific details of this section are as follows:

1. Gender: A. Male B. Female

2. Age: ( ) years old

3. Marital status: A. Married B. Single C. Divorced D. Widowed

4. Education level: A. College degree or below B. Bachelor's degree C. Master's degree D. Doctorate

5. Department: A. Internal Medicine (please specify the department name) B. Surgery (please specify the department name) C. Obstetrics and Gynecology D. Pediatrics E. Emergency F. Others (please specify the department name)

6. Professional title: A. Junior B. Intermediate C. Associate Senior D. Senior

7. Do you hold an administrative position? A. Yes B. No

8. Average daily working hours: A. <8 hours B. 8~<10 hours C. 10~<12 hours D. ⩾12 hours

9. Tenure: ( ) years

3.2 Variable measurement

3.2.1 Measurement of patient safety culture

For the section on physicians' perceptions of patient safety culture, we used the Hospital Survey on Patient Safety Culture (HSOPSC) 2.0, developed by the Agency for Healthcare Research and Quality (AHRQ) (Agency for Healthcare Research and Quality U.S. Department of Health and Human Services, 2019). This survey contains 10 dimensions and a total of 32 items. The 10 dimensions are as follows: (1) Teamwork; (2) Staffing and work pace; (3) Organizational learning – continuous improvement; (4) Response to error; (5) Supervisor or clinical leader support for patient safety; (6) Communication about error; (7) Communication openness; (8) Reporting patient safety events; (9) Hospital management support for patient safety; (10) Handoffs and information exchange.

Additionally, two independent items were included to assess the number of adverse event reports in the previous year and the overall status of patient safety in the department. All items were measured on a 5-point Likert scale, with 5 = "strongly agree" or "always" rated 5, and 1 = "strongly disagree" or "never". Among these items, 13 are reverse-scored, that is, their scores need to be recalculated in reverse. The option "does not apply or do not know" was also included. The responses for any item where this option was selected were considered invalid.

HSOPSC 2.0 has been translated into over 20 languages and is widely used in more than 40 countries today, with good psychometric qualities (Palmieri et al., 2020). Wu et al. (2022) translated the English version of HSOPSC 2.0 into Chinese, following the translation guidelines for patient safety culture surveys. After conducting back-translation, expert discussions, and a pilot test, they developed the first Chinese version of the survey and applied it to nurses from five large general hospitals in Shanghai, China, collecting 1,013 valid responses. The validity and reliability of the questionnaire were analyzed, and the results indicated that the Chinese version had satisfactory construct validity, convergent validity, and discriminant validity. Based on these results, the researchers concluded that the Chinese version of HSOPSC 2.0 has high reliability and validity, making it suitable for evaluating patient safety culture in Chinese healthcare institutions.

The Chinese version of HSOPSC 2.0 by Wu et al. (2022) was primarily used for investigating nurse populations. Considering that our study focuses on frontline physicians, after obtaining permission for use and translation from the questionnaire's source institution, we independently translated the English version of HSOPSC 2.0 into Chinese for our research.

3.2.2 Measurement of patient-centeredness self-efficacy

This study employed the Self-Efficacy in Patient-Centeredness Questionnaire (SEPCQ), which was developed by Zachariae et al. (2015) to assess healthcare professionals' confidence in demonstrating patient-centered behaviors. The questionnaire consists of 27 items designed to explore patient-centeredness self-efficacy across three dimensions: (1) exploring the patient perspective, (2) sharing information and power, and (3) dealing with communicative challenges. Each item begins with "I am confident that I am able to", a 5-point Likert scale was used for scoring, ranging from 0 = "totally disagree" to 4 = "completely agree". Higher total scores indicate a higher level of patient-centeredness self-efficacy. The questionnaire has been widely recognized in practice. For example, D.X.Chen et al. (2023) translated it into Chinese to create a Chinese version of SEPCQ, and conducted a survey using stratified random sampling, involving 1,318 physicians from 26 tertiary hospitals in the Pearl River Delta, eastern, western, and northern regions of Guangdong, China. The psychometric properties of the scale were evaluated, and the results demonstrated excellent internal consistency (Cronbach's $\alpha = 0.988$) and split-half reliability (Guttman coefficient = 0.961). Both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) indicated good construct validity. The Chinese version retained 26 items divided into three dimensions: exploring the patient perspective, sharing information and power, and dealing with communicative challenges, aligning closely with the structure of the original questionnaire. The cumulative explained variance was 85.162%, and the CFA confirmed good model fit. The findings indicated that the Chinese version of SEPCQ is a reliable tool with strong validity for assessing Chinese physicians' patient-centeredness self-efficacy. Based on the translated version by (D.X.Chen et al., 2023), this study retained all 27 items from the original questionnaire.

3.2.3 Measurement of physicians' patient safety behavior

Unsafe behaviors of physicians are a significant source of patient safety risks. Evaluating the current state of physicians' patient safety behaviors can help identify the causes of unsafe behaviors. Analyzing these causes can assist hospitals with improving safety management

systems and strategies. Neal and Griffin (2006) proposed that safety behaviors can be divided into two categories: safety participation behaviors and compliance behaviors. Safety participation behaviors refer to those actions that do not directly impact patient safety but promote behaviors that support the development of patient safety. Compliance behaviors involve following rules and procedures, which are key actions in maintaining patient safety. Based on Neal et al.'s (2006) safety behavior theory, Shih et al. (2008) developed a patient safety behavior measurement questionnaire to study the relationship between patient safety behaviors and patient safety culture among healthcare professionals in Taiwan, where Mandarin Chinese is primarily spoken. The questionnaire, consisting of 10 items, is a unidimensional scale with good testing results. This study used this questionnaire for the measurement of patient safety behavior. Each item has six response options, with scores ranging from 1 = "never" to 6 = "always". A higher total score indicates a higher level of safety behavior among physicians.

3.3 Data collection methods

3.3.1 Data collection tools

The questionnaire consists of four sections with a total of 80 items, including (1) basic information, (2) patient safety culture perception scale, (3) patient-centeredness self-efficacy scale, and (4) patient safety behavior scale. An electronic version of the questionnaire was created using a specialized online survey platform (https://www.wjx.cn) and linked to a corresponding QR code. Participants could access the survey by scanning the QR code on their mobile devices, allowing for easy online completion. Once completed, the data was automatically saved and uploaded to the platform's server. After the data collection was finalized, the database was downloaded for subsequent data analysis and processing.

3.3.2 Sampling method and dimensions

The expected sample size for this study was calculated based on the principle of 5–10 times the number of questionnaire items. Since the questionnaire of this study contained 80 items, the minimum sample size was determined as five times the number of items, that is, 400. Considering a 20% non-response rate, the estimated required sample size is 480 participants. Proportional stratified sampling and convenient sampling methods were employed. Following the *China Health Statistical Yearbook*, which analyzed Chinese hospitals by dividing the

country into eastern, central, and western regions, we selected three provinces from each of these regions, with 1–2 tertiary hospitals from each selected province.

According to the 2022 ratio of tertiary hospitals across the regions (4.3:2.7:3.0) , as reported by the China Statistical Information Center (2023), a total of five hospitals from the eastern region, four from the central region, and four from the western region were selected using convenience sampling. From July to August 2024, 50 clinical physicians from each hospital were surveyed using questionnaires. The inclusion criteria for participants are as follows: they should be formal employees of the surveyed hospitals working on the clinical front line, have been informed about the questionnaire's content, and voluntarily agreed to participate in the survey.

3.3.3 Quality control

To ensure the rigor of the study and the quality of the data, several measures were implemented. In the questionnaire design, we included the contact information of the researcher in the introduction section so that respondents could seek prompt clarification if they encountered any questions.

To further enhance the quality of the data, we conducted a thorough review of the responses. During subsequent data analysis, responses with illogical answers, patterned answering, completion times of less than two minutes, or answers such as "does not apply or do not know" to items in the patient safety culture sale were deemed invalid and excluded from the analysis.

3.4 Ethical review

Prior to conducting this study, we submitted an ethical application to the Ethics Committee of the Affiliated Hospital of Nantong University and received official approval (Approval No.: 2024-K174-01). This study strictly adheres to ethical principles and complies with the requirements of ethical review, ensuring that the rights and interests of all participants are fully protected.

3.5 Data analysis

This study utilized statistical analysis tools such as SPSS 25.0 and AMOS 22.0 to quantitatively process and analyze the collected questionnaire data. In particular, Cronbach's α coefficient was used to test the reliability of the scales, followed by CFA to evaluate their convergent and

discriminant validity. All collected data were subjected to the Kolmogorov-Smirnov normality test. Variables conforming to a normal distribution were expressed as mean ± standard deviation (M ± SD), and we employed t-tests for comparisons between two groups and one-way analysis of variance (ANOVA) for differences among multiple groups. Variables not conforming to a normal distribution were expressed as medians (P25, P75), and we performed Mann-Whitney U tests for two-group comparisons and Kruskal-Wallis H tests for multi-group comparisons. Additionally, Spearman correlation analysis was conducted to explore relationships among various factors. Finally, AMOS 22.0 was used for structural equation modeling (SEM), and a bias-corrected nonparametric percentile bootstrap method was used to examine the mediation of patient-centeredness self-efficacy between patient safety culture and patient safety behavior.

3.5.1 Reliability analysis

Reliability, also referred to as the consistency of a measurement, is a key indicator for evaluating the performance of measurement tools. It assesses the stability and consistency of results obtained through repeated measurements under varying conditions or at different time points. The purpose of reliability analysis is to ensure that the measurement tool demonstrates sufficient consistency, stability, and reliability, enabling it to accurately reflect the true characteristics of the subjects being measured. When the reliability coefficient reaches a high level, we can have greater confidence that the results provided by the measurement tool are accurate and reliable. It is generally considered that a Cronbach's α coefficient > 0.5 is acceptable, between 0.6 and 0.8 indicates good reliability, and ≥ 0.9 signifies excellent reliability, suggesting that the measurement tool has a high level of reliability (Xu et al., 2020).

3.5.2 Validity analysis

Validity is a key indicator for assessing whether a measurement tool or method accurately reflects the essence of the subject being measured. Validity analysis evaluates the extent to which these tools or designs precisely capture the target concept or variable, focusing on their accuracy and effectiveness. Validity encompasses multiple types, such as face validity, content validity, criterion validity, and construct validity. They jointly form a comprehensive framework for evaluating the overall validity of a measurement tool.

In the development and evaluation of measurement tools, content validity and construct validity are particularly critical. To ensure content validity, which involves covering all essential aspects of the measured concept, researchers often employ methods such as expert consultation,

group discussions, and bidirectional translation. These methods were applied in this study, where the questionnaire incorporated well-established scales and was carefully revised based on expert opinions to ensure its comprehensiveness and accuracy. Construct validity, on the other hand, focuses on whether the measurement tool accurately reveals the internal structure of the measured concept. To verify this, researchers commonly perform EFA and CFA. CFA is used to validate the stability and rationality of the measurement structure of well-established scales across different populations.

This study primarily adopted the following indices to evaluate model fit (Gunduz et al., 2018; Sanz-Martín et al., 2022; L. Wang et al., 2022):

(1) Parsimony fit indices: The chi-square to degrees of freedom ratio (χ^2/df). A ratio closer to 1 indicates better model fit, with an acceptable range typically between 1 and 5.

(2) Incremental fit indices: Comparative Fit Index (CFI), Normed Fit Index (NFI), and Tucker-Lewis Index (TLI). These indices range from 0 to 1, with 0.8 as the acceptable threshold and values above 0.9 indicating a good model fit.

(3) Absolute fit indices: Root Mean Square Error of Approximation (RMSEA), Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), and Standardized Root Mean Square Residual (SRMR). GFI and AGFI values range from 0 to 1, with an acceptable threshold of 0.7 and a value above 0.9 indicating good fit. For RMSEA and SRMR, lower values indicate better model fit, with RMSEA below 0.1 and SRMR below 0.08 being acceptable, and RMSEA below 0.06 and SRMR below 0.05 indicating good fit.

Before conducting factor analysis, we performed the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity to assess the suitability for factor analysis. Only when the KMO value exceeded 0.70 and Bartlett's test showed significance was the data deemed appropriate for subsequent factor analysis. After confirming these prerequisites, factor analysis was conducted to extract common factors and validate the scale's construct validity. Based on a well-fitting CFA model, the study further examined the scales' convergent and discriminant validity to ensure consistency when measuring similar concepts and differentiation when measuring distinct concepts. These rigorous steps of validity analysis helped to demonstrate the accuracy and effectiveness of the measurement tool, providing robust support for subsequent research.

3.5.3 Descriptive analysis

Descriptive statistics is a technical method that uses mathematical and statistical principles to comprehensively summarize and meticulously characterize data. Its primary purpose is to help

researchers gain deeper insights into the intrinsic properties of data and to facilitate reasonable inferences and analyses. In descriptive statistics, particular attention is given to measures of central tendency and variability, as these two aspects comprehensively reveal the distribution and key characteristics of the data. In this study, we employed various descriptive statistical measures. For continuous variables, we used indicators such as mean, standard deviation, median, and interquartile range. For categorical variables, frequency indicators were utilized. The descriptive statistical variables covered core demographic characteristics such as age, gender, education level, tenure, marital status, and professional title, providing a comprehensive and multidimensional portrait of the research sample. Through these detailed descriptive statistics, we gained a view of the overall characteristics of the study population, laying a solid foundation for subsequent in-depth analysis and interpretation of results. Furthermore, this approach enabled uncovering additional valuable information from this data.

3.5.4 Correlation analysis

The purpose of correlation analysis is to explore the relationships between two or more variables in depth. This method focuses on evaluating the strength and direction of associations among variables. At the core of correlation analysis is the correlation coefficient, which serves as a critical measure of the strength and direction of the relationships. The correlation coefficient ranges from -1 to 1 (Sherkatghanad et al., 2020). A value close to 1 or -1 indicates a strong linear relationship between the variables, while a value near 0 suggests a weak or no linear relationship. Since the data in this research did not follow a normal distribution, Spearman's correlation analysis was specifically employed as the primary method to examine to relationships among the variables. By examining the absolute values of the correlation coefficients, we could directly assess the strength of associations between the measured variables. In general, the greater the absolute value of the correlation coefficient, the stronger the relationship between the variables being examined (García-Galicia et al., 2024; Mira Quirós et al., 2022). This provides a strong quantitative foundation for understanding and interpreting the interactions among variables.

3.5.5 Common method variance analysis

Common method variance (CMV), also referred to as common method bias (CMB), occurs when an artificially inflated relationship between predictor variables and criterion variables arises due to high similarity in data sources, evaluators, measurement contexts, item framing,

or item characteristics. This bias typically results from the complex interplay of factors such as shared data sources or evaluators, questionnaire item properties, and the measurement environment. Its presence can significantly undermine the credibility and accuracy of model analysis results, further misleading research conclusions.

To minimize the potential impact of using the same methods or data sources on research findings, we employed Harman's single-factor test (Widodo et al., 2022) to systematically assess the presence of common method bias. Specifically, all variables in the study were included in an EFA, with the minimum number of factors needed to explain variable variance determined. If the analysis reveals only one factor or an unusually high proportion of variance explained by a single factor (generally over 50%), significant common method bias is assumed to exist. In this study, we conducted a thourough EFA on the questionnaire data. The results showed that principal component analysis extracted 10 factors with eigenvalues greater than 1, collectively explaining 69.80% of the total variance. Among these, the first factor accounted for 41.14% of the variance, which is below the critical threshold of 50% (Widodo et al., 2022). Thus, it can be concluded that there was no significant common method bias in the data.

Chapter 4: Results

This chapter reports the results obtained from the statistical analysis of the data collected in this study. First, we present a general overview of the research data, including the demographic characteristics of the survey participants, the common method bias of the research data, and tests for normal distribution. Then, we analyze and report the results of the reliability and validity tests on the scales used in this study for measuring the key variables. That is followed by a report of the overall scores of the three variables—patient safety culture, patient-centeredness self-efficacy, and patient safety behavior—along with differences in these scores across various demographic, professional, and regional characteristics of the participants. Finally, we provide a descriptive analysis and report on the relationships between patient safety culture, patient-centeredness self-efficacy, and patient safety behavior, as well as the relevant paths of influence.

4.1 Sample descriptive statistics

4.1.1 Demographic characteristics

847 physicians voluntarily participated in the survey if this study, and 635 valid responses were obtained, with an effective response rate of 74.97%. The regional distribution was relatively balanced, with most participants coming from Eastern and Central China, accounting for 36.54% and 33.70%, respectively. As shown in Table 4.1, the proportion of male and female participants in this survey was quite balanced, with males and females accounting for 46.93% and 53.07% respectively. The majority of the participants were married, accounting for 77.80%. Regarding the age, 44.41% of the participants were between (30, 40] years old, followed by the age group of (40, 50] years old, accounting for 27.74%. The education level of participants was generally at a high level, with the vast majority having master's or doctoral degrees, accounting for 48.51% and 32.28% respectively. In terms of departments, surgery had the largest number of participants, reaching 22.68%, followed by gynecology and obstetrics, and pediatrics, accounting for 18.11% and 16.38% respectively. Further, 51.97% of the participants had a work experience of at least 10 years, and 39.05% of the participants worked more than 10 hours a day on average. In addition, most participants held intermediate or higher professional titles

(77.32%). Finally, only 13.39% were in administrative positions. Therefore, there were no abnormalities in the overall distribution of the survey participants, and the distribution was relatively balanced in terms of geography, gender, department, and other characteristics. This indicates that the sample has certain representativeness and research value, making it suitable for further data analysis. More details are shown in Table 4.1.

Table 4.1 Basic information of participants

Variables	Categories	Frequency (N)	Proportion (%)
Gender	Male	298	46.93
	Female	337	53.07
Age	[18,30]	128	20.16
	(30,40]	282	44.41
	(40,50]	173	27.24
	(50,61]	52	8.19
Marital status	Single	141	22.20
	Married	494	77.80
Educational level	Bachelor or below	122	19.21
	Master	308	48.51
	Doctorate	205	32.28
Geographic location	East	232	36.54
	Central	214	33.70
	West	189	29.76
Department	Internal medicine	102	16.06
	Surgery	144	22.68
	Gynecology and obstetrics	104	16.38
	Pediatrics	115	18.11
	Emergency	80	12.60
	Others	90	14.17
Professional title	Junior	144	22.68
	Intermediate	227	35.75
	Associate senior	180	28.34
	Senior	84	13.23
Administrative position	No	550	86.61
	Yes	85	13.39
Average daily working hours	(0,8)	45	7.09
	[8,10)	342	53.86
	[10,12)	183	28.82
	[12,24]	65	10.23
Tenure (years)	(0,10]	305	48.03
	(10,20]	211	33.23
	(20,39]	119	18.74

4.1.2 Analysis of common method bias

Common method bias, as a systematic error, refers to the artificial covariation between predictor variables and criterion variables caused by a unified data source or rater, the same measurement environment, project context, and the characteristics of the project itself during the questionnaire measurement process. This bias may mislead results and conclusions

(Wingate et al., 2018; Xu et al., 2020). To minimize common method bias, this study implemented preemptive measures, such as anonymous responses and the inclusion of reverse-scored items in the questionnaire, which helped reduce common variance bias to some extent. However, due to limitations in the survey conditions, all scales in this study were measured from the same participant source, which might lead to potential homoscedasticity. Therefore, it is still necessary to verify and control the quality of the questionnaire.

Harman's single-factor test was employed to examine common method bias in this study. The principal component analysis extracted 10 factors with eigenvalues greater than 1, explaining 69.80% of the total variance. Among them, the first factor explained 41.14% of the variance, which is less than the critical threshold of 50% (Widodo et al., 2022). Based on these results, it can be concluded that there is no serious common method bias in this study.

4.1.3 Analysis of the normal distribution

As the non-normal distribution of data can affect the subsequent structural equation modeling (SEM), the normal distribution of the sample should be tested before conducting formal data analysis. In this study, the Kolmogorov–Smirnov test was performed to determine whether the measurement data conformed to the normal distribution. The scores for patient safety culture, patient-centeredness self-efficacy, and patient safety behavior, as well as their dimensions were found to be non-normally distributed based on the Kolmogorov–Smirnov test results ($p < 0.05$). More details are shown in Table 4.2.

Table 4.2 Results of the Kolmogorov–Smirnov test

Variables	K-S test	
	Z	*p*
Patient Safety Culture	0.043	0.008
Teamwork	0.142	<0.001
Staffing and Work Pace	0.079	<0.001
Organizational Learning—Continuous Improvement	0.160	<0.001
Response to Error	0.076	<0.001
Supervisor or Clinical Leader Support for Patient Safety	0.145	<0.001
Communication About Error	0.129	<0.001
Communication Openness	0.082	<0.001
Reporting Patient Safety Events	0.149	<0.001
Hospital Management Support for Patient Safety	0.132	<0.001
Handoffs and Information Exchange	0.161	<0.001
Patient Centeredness Self-Efficacy	0.116	<0.001
Exploring the Patient Perspective	0.152	<0.001
Sharing Information and Power	0.180	<0.001
Dealing with Communicative Challenges	0.163	<0.001
Patient Safety Behavior	0.133	<0.001

4.2 Reliability and validity analysis

4.2.1 Reliability analysis

Reliability refers to the consistency of results obtained from repeated measurements of the same survey subject using a measurement tool. In this study, the reliability of the Cronbach's α coefficient was evaluated. A greater value of Cronbach's α coefficient indicates higher internal consistency of the measurement tool. It is generally considered acceptable when Cronbach's α is greater than 0.5, with good reliability between 0.6 and 0.8. A coefficient greater than or equal to 0.9 is considered to indicate excellent reliability (Xu et al., 2020).

The reliability test results of the scales are shown in Table 4.3. The Cronbach's α coefficients for the Hospital Survey on Patient Safety Culture (HSOPSC) 2.0, Self-Efficacy in Patient-Centeredness Questionnaire (SEPCQ), and the Patient Safety Behavior Scale for physicians were 0.922, 0.984, and 0.961, respectively—values all greater than 0.9, indicating excellent consistency and stability. In particular, the Cronbach's α coefficient for the Teamwork dimension in HSOPSC 2.0 was 0.468, slightly lower than the acceptable threshold of 0.5. Further exploration revealed that two items in this construct had Cronbach's α coefficients below 0.5: Item 1 ("In this unit, we work together as an effective team") and Item 2 ("During busy times, staff in this unit help each other"). For empirical analysis, each dimension should contain at least three items. To ensure the completeness of the scale and the reproducibility of the research, we decided to retain these two items in the Teamwork dimension.

Table 4.3 Reliability analysis results

Variable	Dimensions	Number of items	Cronbach's α for each dimension	Cronbach's α for each scale	Cronbach's α for all scales
Patient Safety Culture	Teamwork	3	0.468	0.922	0.972
	Staffing and Work Pace	4	0.697		
	Organizational Learning—Continuous Improvement	3	0.609		
	Response to Error	4	0.705		
	Supervisor or Clinical Leader Support for Patient Safety	3	0.618		
	Communication About Error	3	0.696		
	Communication Openness	4	0.743		
	Reporting Patient Safety Events	2	0.827		
	Hospital Management Support for Patient Safety	3	0.767		
	Handoffs and Information Exchange	3	0.729		

Patient Centeredness Self-Efficacy	Exploring the Patient Perspective	10	0.961	0.984
	Sharing Information and Power	10	0.976	
	Dealing with Communicative Challenges	7	0.945	
Patient Safety Behavior	Patient Safety Behavior	10	0.961	0.961

4.2.2 Validity analysis

Validity analysis, also known as factor analysis, is conducted based on the reliability of the scale to further examine whether the scale used in the study can accurately measure the intended latent variables and whether the items for each variable are reliable. Typically, content validity and construct validity are employed as indicators for validity evaluation. The better the validity, the higher the extent to which the measurement reflects the true level of the measured object.

Since the scales in this study were designed based on well-established instruments, the content validity was strong, and exploratory factor analysis (EFA) was not required for construct validity. Instead, confirmatory factor analysis (CFA) was directly performed. Construct validity can be further divided into convergent validity and discriminant validity. Convergent validity refers to the extent to which individual items measure the same construct, while discriminant validity refers to the degree to which different constructs are distinguishable from one another. This study employed CFA to assess the convergent and discriminant validity of the constructs, ensuring a solid foundation for subsequent model validation.

4.2.2.1 Content validity

Content validity refers to the extent to which measurement items or content reflect the construct being measured. If a scale used in a study is derived from well-established theories and has demonstrated strong measurement performance in extensive practice, it can be considered to have good content validity. If a scale requires modifications but has been adjusted based on expert opinions, it can also be regarded as having good content validity (Mokhtaryan-Gilani et al., 2021). The scales selected for this study are well-established scales that have been widely used and cited in high-quality studies. The research design process involved expert consultation, research team discussions, and a pilot test to ensure cultural appropriateness in the Chinese context. Thus, the scales used in this study are considered to have good content validity.

4.2.2.2 KMO and Bartlett's test of sphericity

To assess whether factor analysis could be conducted, the KMO test and Bartlett's test of sphericity were conducted on the scales used in the study. The two tests are commonly used for assessing the appropriateness of factor analysis. Generally, the KMO value ranges from 0 to 1, and the closer it is to 1, the higher the correlation between the items. When the KMO value exceeds 0.5, it indicates that the sample data is appropriate for factor analysis (KAISER, 1974). Bartlett's test of sphericity is used to examine the correlation between the variables measured by the questionnaire and to evaluate their validity based on the significance of the analysis results.

The tests revealed that the KMO values for the patient safety culture scale, patient-centeredness self-efficacy scale, and patient safety behavior scale were all greater than 0.5, indicating good relationships between the item variables. The Bartlett's test results for all scales showed *p*-values lower than 0.001, suggesting that the scales used in this study are suitable for factor analysis and CFA can be proceeded. The detailed test results are presented in Table 4.4.

Table 4.4 Results of KMO Test and Bartlett's test of sphericity for each variable

Variables and dimensions	KMO	χ^2	df	*p*
Patient Safety Culture	0.918	9637.164	496	<0.001
Teamwork	0.524	221.534	3	<0.001
Staffing and Work Pace	0.710	458.468	6	<0.001
Organizational Learning—Continuous Improvement	0.571	309.520	3	<0.001
Response to Error	0.691	510.082	6	<0.001
Supervisor or Clinical Leader Support for Patient Safety	0.543	473.761	3	<0.001
Communication About Error	0.552	603.530	3	<0.001
Communication Openness	0.701	803.852	6	<0.001
Reporting Patient Safety Events	0.500	434.387	1	<0.001
Hospital Management Support for Patient Safety	0.638	634.491	3	<0.001
Handoffs and Information Exchange	0.624	512.350	3	<0.001
Patient Centeredness Self-Efficacy	0.981	21787.225	351	<0.001
Exploring the Patient Perspective	0.953	6970.386	45	<0.001
Sharing Information and Power	0.967	8422.114	45	<0.001
Dealing with Communicative Challenges	0.928	4019.500	21	<0.001
Patient Safety Behavior	0.949	6875.770	45	<0.001

4.2.2.3 Construct validity analysis

Based on the reliability and validity tests mentioned above, the KMO and Bartlett's sphericity test results met the criteria, indicating that the scales are suitable for CFA. This study employed Amos 22.0 to establish a CFA model for construct validity analysis of each scale.

(1) Patient safety culture scale

The commonly used fit indices in CFA include three categories: absolute fit index, incremental fit index, and parsimonious fit index. To avoid the limitations of relying on a single index, this study primarily selected the following indices to evaluate model fit surfreedom ratio (χ^2/df). Generally, the closer χ^2/df is to 1, the better the model fit, with an acceptable range typically between 1 and 5. (2) Incremental fit index**:** The comparative fit index (CFI), normed fit index (NFI), and Tucker-Lewis index (TLI), all of which typically range from 0 to 1. The acceptable threshold for these indices is 0.8, while values above 0.9 indicate a well-fitting model. (3) Absolute fit index: Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Adjusted Goodness-of-fit Index (AGFI), and Standardized Root Mean Square Residual (SRMR). The values of GFI and AGFI are within the range of 0-1, and the acceptable critical values for both are 0.7; when they are greater than 0.9, the model is considered to have excellent fit. The lower the RMSEA and SRMR values, the higher the fitting degree. It is generally believed that RMSEA below 0.1 and SRMR below 0.08 are sufficient, and when RMSEA is below 0.06 and SRMR is below 0.05, the model is considered to have excellent fit.

The measurement model for patient safety culture is shown in Figure 4.1, with the fit results presented in Table 4.5. According to the fit indices, χ^2/df = 5.011, CFI = 0.820, NFI = 0.786, TLI = 0.787, RMSEA = 0.080, GFI = 0.793, AGFI = 0.739, and SRMR = 0.099. Since some indices fell outside the acceptable range, the model required further modification. Typically, model parameter adjustments are made by adding or removing paths, constraining paths, or setting residual covariances (L. Wang et al., 2022). To preserve as much of the original model structure as possible, this study modified the model by setting residual covariances. Based on the highest modification index (MI) values generated by Amos 22.0, residual items with high MI values were adjusted. After modifying the residuals between e10 and e16, as well as e29 and e30, all indices met the acceptable standards except for SRMR. While the SRMR value did not meet the widely recognized criteria, some studies suggest that the acceptability of a model should be judged comprehensively by considering other fit statistics (K. Zhang et al., 2024). Overall, the measurement model of the patient safety culture scale demonstrated good fit and construct validity.

Table 4.5 Fit indices of CFA model for patient safety culture

Fit index		χ^2/df	CFI	NFI	TLI	RMSEA	GFI	AGFI	SRMR	*p*
Reference value	Excellent	<3.00	>0.90	>0.90	>0.90	<0.06	>0.90	>0.90	<0.05	<0.001
	Acceptable	<5.00	>0.80	>0.80	>0.80	<0.10	>0.70	>0.70	<0.08	
Model value		5.011	0.820	0.786	0.787	0.080	0.793	0.739	0.099	<0.001
Model value (corrected)		4.674	0.836	0.801	0.804	0.076	0.814	0.764	0.099	<0.001

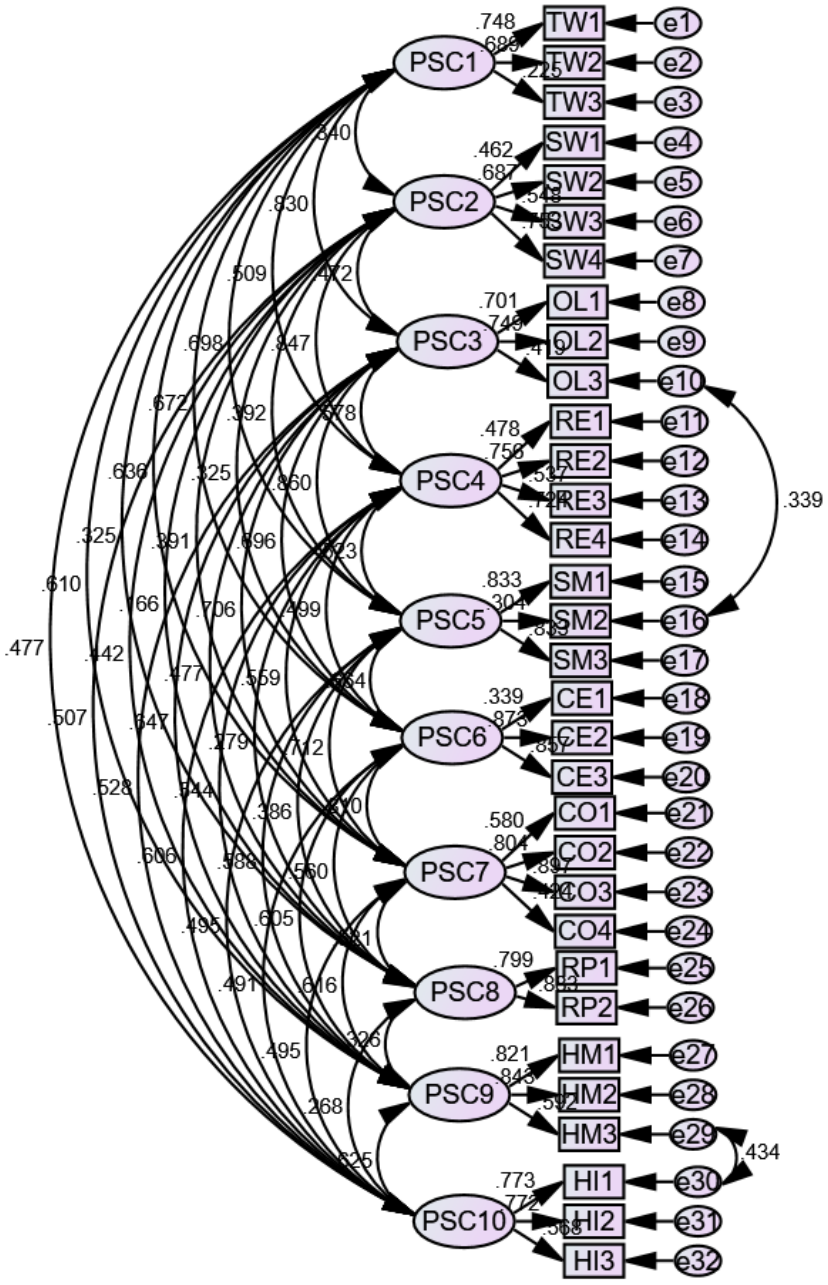

Figure 4.1 Measurement model of patient safety culture

Convergent validity, also known as construct validity, examines whether items measuring the same latent trait load onto the same factor. According to the CFA method, the convergent validity of the scale can be analyzed through factor loading, average variance extracted (AVE), and composite reliability (CR). Factor loadings reflect the extent to which observed variables

contribute to latent variables. The greater the absolute value of the standardized factor loading, the stronger the relationship between the observed and latent variables. Standardized factor loadings between 0.50 and 0.95 indicate high representativeness of the items for their respective latent variables, while values between 0.30 and 0.50 are also acceptable (Mokhtaryan-Gilani et al., 2021). The CR value, calculated from factor loadings, assesses whether all measurement items within a latent variable consistently explain that variable. A CR value greater than 0.6 indicates sufficient CR (Bagozzi & Yi, 1988). The AVE value serves as an indicator of convergent validity, measuring the proportion of variance in the observed variables explained by the latent construct. An AVE value above 0.36 is considered acceptable (Chin, 1998).

As shown in Table 4.6, the standardized factor loadings of the revised patient safety culture measurement model were mostly between 0.304 and 0.897, within the acceptable range, except for item TW3, which had a loading of 0.225. Although the standardized factor loading for TW3—"There is a problem with disrespectful behavior by those working in this unit"—was below 0.3, it inversely reflected the level of teamwork within the department, aligning well with the content of the teamwork dimension. Considering the contribution of item TW3 to the content validity of teamwork and the completeness of the measurement, this item was retained. Additionally, while the teamwork dimension of the patient safety culture scale had a CR of 0.591, slightly below the 0.6 threshold, all other dimensions exceeded this critical value. Similarly, the AVE values for all dimensions surpassed the 0.36 threshold, indicating that the patient safety culture scale exhibited good convergent validity.

Table 4.6 Results of convergence validity test for patient safety culture

Dimensions	Items	Factor Loadings	AVE	CR
Teamwork (SC1)	TW1	0.748	0.362	0.591
	TW2	0.689		
	TW3	0.225		
Staffing and Work Pace (SC2)	SW1	0.462	0.388	0.710
	SW2	0.687		
	SW3	0.548		
	SW4	0.753		
Organizational Learning—Continuous Improvement (SC3)	OL1	0.701	0.409	0.663
	OL2	0.749		
	OL3	0.419		
Response to Error (SC4)	RE1	0.478	0.403	0.723
	RE2	0.756		
	RE3	0.537		
	RE4	0.724		
Supervisor or Clinical Leader Support for Patient Safety (SC5)	SM1	0.833	0.493	0.719
	SM2	0.304		
	SM3	0.833		
Communication About Error (SC6)	CE1	0.339	0.537	0.755
	CE2	0.873		
	CE3	0.857		

Communication Openness (SC7)	CO1	0.580	0.4920.783
	CO2	0.804	
	CO3	0.897	
	CO4	0.424	
Reporting Patient Safety Events (SC8)	RP1	0.799	0.7090.829
	RP2	0.883	
Hospital Management Support for Patient Safety (SC9)	HM1	0.821	0.5780.801
	HM2	0.843	
	HM3	0.592	
Handoffs and Information Exchange (SC10)	HI1	0.773	0.5050.751
	HI2	0.772	
	HI3	0.568	

Discriminant validity was assessed using CFA. This study tested different combinations of the ten factors of patient safety behavior, forming a total of nine models. To compare the fit indices of these models, we evaluated the fit of the nine-factor model, eight-factor model, and seven-factor model, gradually reducing to a single-factor model. The composition of these models is shown in Table 4.7. Compared to the original ten-factor model, the fit indices of all alternative models worsened. The $\chi 2$ test results indicated that the ten-factor model provided a significantly better fit to the data than the alternative models ($p < 0.05$), demonstrating that the ten-factor model of patient safety culture exhibited strong discriminant validity.

Table 4.7 Comparison results of CFA of patient safety culture

No.	Model	χ^2	df	χ^2/df	CF1	NFI	TLI	RMSEA	GFI	AGFI	SRMR	Model comparison	$\Delta\chi^2$	Δdf
1	Original model	2099.494	419	5.011	0.820	0.786	0.787	0.080	0.793	0.739	0.099			
2	Nine-factor model	2435.529	428	5.690	0.785	0.752	0.750	0.086	0.743	0.683	0.102	2 VS 1	336.035***	9
3	Eight-factor model	2534.391	436	5.813	0.775	0.742	0.744	0.087	0.725	0.667	0.099	3 VS 1	434.897***	17
4	Seven-factor model	2600.770	443	5.871	0.768	0.735	0.741	0.088	0.713	0.658	0.098	4 VS 1	501.276***	24
5	Six-factor model	2717.216	449	6.052	0.757	0.723	0.731	0.089	0.696	0.643	0.093	5 VS 1	617.722***	30
6	Five-factor model	3094.805	454	6.817	0.717	0.685	0.690	0.096	0.667	0.613	0.098	6 VS 1	995.311***	35
7	Four-factor model	3273.683	458	7.148	0.698	0.666	0.673	0.098	0.654	0.601	0.098	7 VS 1	1174.189***	39
8	Three-factor model	3605.693	461	7.821	0.663	0.633	0.637	0.104	0.637	0.585	0.102	8 VS 1	1506.199***	42
9	Two-factor model	3875.483	463	8.370	0.634	0.605	0.608	0.108	0.630	0.578	0.102	9 VS 1	1775.989***	44
10	Single-factor model	4053.409	464	8.736	0.615	0.587	0.588	0.110	0.619	0.567	0.099	10 VS 1	1953.915***	45

Note: Nine-factor model: SC1+SC2, SC3, SC4, SC5, SC6, SC7, SC8, SC9, SC10; Eight-factor model: SC1+SC2+SC3, SC4, SC5, SC6, SC7, SC8, SC9, SC10; Seven-factor model: SC1+SC2+SC3+SC4, SC5, SC6, SC7, SC8, SC9, SC10; Six-factor model: SC1+SC2+SC3+SC4+SC5, SC6, SC7, SC8, SC9, SC10; Five-factor model: SC1+SC2+SC3+SC4+SC5+SC6, SC7, SC8, SC9, SC10; Four-factor model: SC1+SC2+SC3+SC4+SC5+SC6+SC7, SC8, SC9, SC10; Three-factor model: SC1+SC2+SC3+SC4+SC5+SC6+SC7+SC8, SC9, SC10; Two-factor model: SC1+SC2+SC3+SC4+SC5+SC6+SC7+SC8+SC9, SC10***; $p < 0.001$

(2) Patient centeredness self-efficacy scale

According to Table 4.8 and Figure 4.2, the preliminary analysis of the fit indices of the patient centeredness self-efficacy model showed χ^2/df=5.011, CFI=0.820, NFI=0.786, TLI=0.787, RMSEA=0.080, GFI=0.793, AGFI=0.739, SRMR=0.099, with χ^2/df =5.011>5. This study selected residual terms with higher modification indices for model correction in sequence. After correcting residual terms e1 and e2, e26 and e27, all fit indices of the model improved and met acceptable thresholds. Therefore, the model of patient-centeredness self-efficacy exhibited a good fit and construct validity.

Table 4.8 Fit indices of CFA model for patient centeredness self-efficacy

Fit index		χ^2/df	CFI	NFI	TLI	RMSEA	GFI	AGFI	SRMR	*p*
Reference value	Excellent	<3.00	>0.90	>0.90	>0.90	<0.06	>0.90	>0.90	<0.05	<0.001
	Acceptable	<5.00	>0.80	>0.80	>0.80	<0.10	>0.70	>0.70	<0.08	
Model value		5.513	0.933	0.920	0.927	0.084	0.803	0.768	0.035	<0.001
Model value (corrected)		4.838	0.944	0.930	0.938	0.078	0.830	0.799	0.031	<0.001

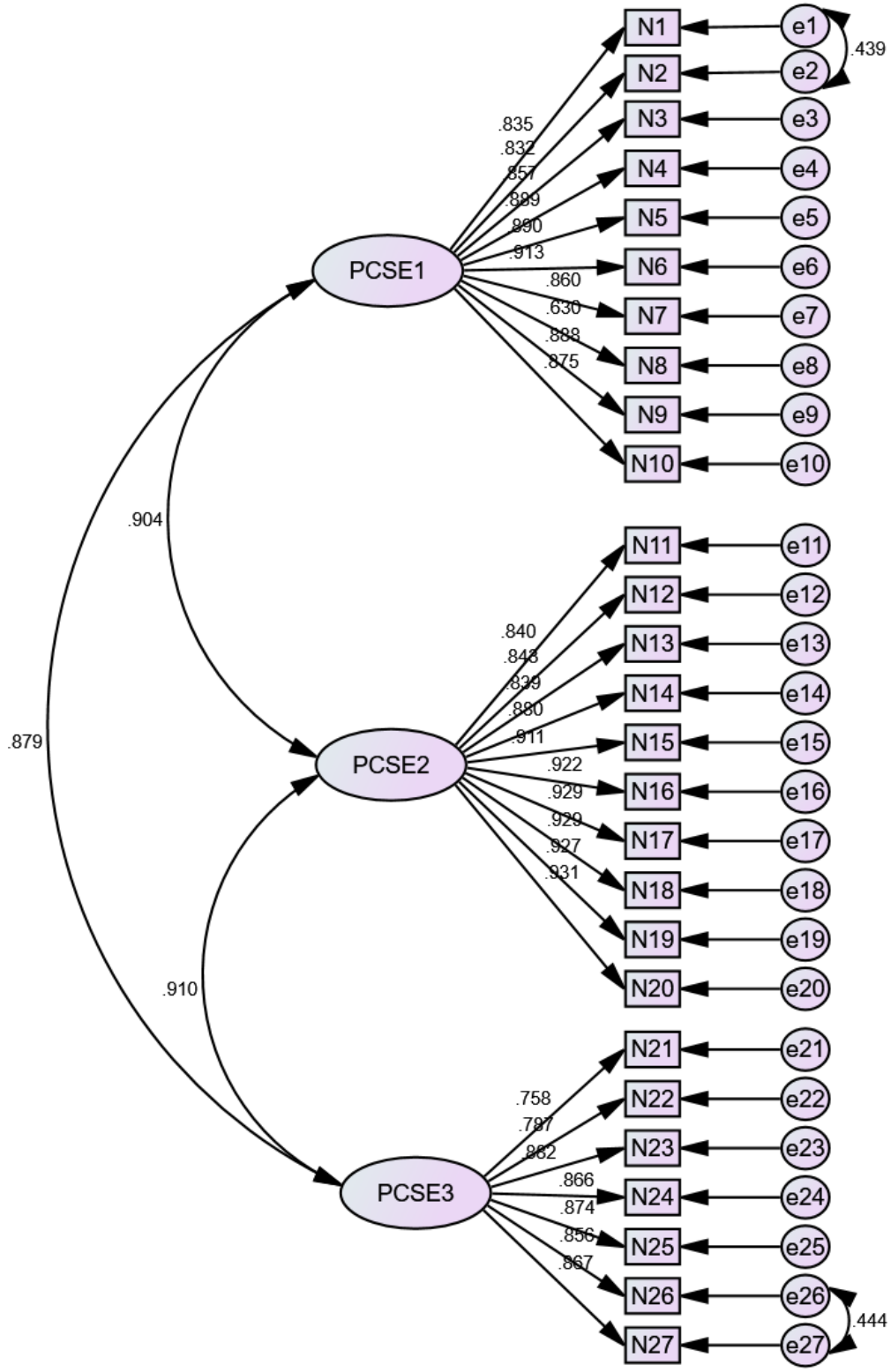

Figure 4.2 Measurement model for patient centeredness self-efficacy

According to the analysis results in Table 4.9, the standardized factor loadings for each item in the patient centeredness self-efficacy scale were between 0.630 and 0.930, with AVE values above 0.5 and CR values above 0.9, meeting the criteria. Therefore, it can be concluded that the patient centeredness self-efficacy scale has good convergent validity.

Table 4.9 Convergence validity test results of patient centeredness self-efficacy

Dimensions	Items	Standardized factor loading	AVE	CR
Exploring the Patient Perspective (SE1)	N1	0.835	0.723	0.963
	N2	0.832		
	N3	0.857		
	N4	0.889		
	N5	0.890		
	N6	0.913		
	N7	0.860		
	N8	0.630		
	N9	0.888		
	N10	0.875		
Sharing Information and Power (SE2)	N11	0.840	0.803	0.976
	N12	0.843		
	N13	0.839		
	N14	0.880		
	N15	0.911		
	N16	0.922		
	N17	0.929		
	N18	0.929		
	N19	0.927		
	N20	0.931		
Dealing with Communicative Challenges (SE3)	N21	0.758	0.710	0.945
	N22	0.787		
	N23	0.882		
	N24	0.866		
	N25	0.874		
	N26	0.856		
	N27	0.867		

In the discriminant validity test, four alternative models, namely two-factor model (a), two-factor model (b), two-factor model (c), and single-factor model, were compared with the original model. The results showed that compared to the original model, the indices of the alternative models were worse, such as χ^2/df, CFI, NFI, and TLI, and passed the χ^2 test at a significance level of 0.001, indicating that the three-factor model of patient-centeredness self-efficacy has good discriminant validity, as shown in Table 4.10.

Table 4.10 Comparison results of CFA of patient centeredness self-efficacy

Number	Model	χ^2	df	$\chi^{2/}$df	CFI	NFI	TLI	RMSEA	GFI	AGFI	SRMR	Model Comparison	$\Delta\chi^2$	Δdf
1	Original model	1769.746	321	5.513	0.933	0.920	0.927	0.084	0.803	0.768	0.035			
2	Two-factor model (a)	2812.577	323	8.708	0.886	0.873	0.876	0.110	0.662	0.604	0.041	2 VS 1	1042.831***	2
3	Two-factor model (b)	2608.264	323	8.075	0.895	0.882	0.886	0.106	0.694	0.642	0.042	3 VS 1	838.518***	2
4	Two-factor model (c)	2396.641	323	7.420	0.905	0.892	0.897	0.101	0.729	0.683	0.038	4 VS 1	626.895***	2
5	Single-factor model	3386.061	324	10.451	0.859	0.847	0.848	0.122	0.622	0.560	0.045	5 VS 1	1616.315***	3

Note: Two factor model (a): SE1+SE2, SE3; Two factor model (b): SE1+SE3, SE2; Two factor model (c): SE2+SE3, SE1; Single factor model: SE1+SE2+SE3; $^{***}p < 0.001$.

(3) Patient safety behavior scale

According to Table 4.11 and Figure 4.3, the model fit indices for patient safety behavior were χ^2/df = 17.190, CFI = 0.918, NFI = 0.913, TLI = 0.894, RMSEA = 0.160, GFI = 0.825, AGFI = 0.724, and SRMR = 0.040. However, two indices, χ^2/df and RMSEA, were still not ideal, indicating that the model required further modification. According to the modification indices, after four rounds of modifications, RMSEA improved to 0.098 (< 0.1), meeting the acceptable threshold. Given the significant influence of sample size on χ^2/df, the acceptability of a discriminant model with a large sample size should be evaluated based on its fit indices (F.Huang et al., 2020). Considering the large sample size of this study and a comprehensive evaluation of other indices, the χ^2/df ratio of 7.112 was considered acceptable. Therefore, given the complexity and sample size of the model, the overall construct validity of the patient safety behavior scale was considered to be acceptable.

Table 4.11 Fit indices of CFA for patient safety behavior

Fit index		χ^2/df	CFI	NFI	TLI	RMSEA	GFI	AGFI	SRMR	*p*
Reference value	Excellent	<3.00	>0.90	>0.90	>0.90	<0.06	>0.90	>0.90	<0.05	<0.001
	Acceptable	<5.00	>0.80	>0.80	>0.80	<0.10	>0.70	>0.70	<0.08	
Model value		17.190	0.918	0.913	0.894	0.160	0.825	0.724	0.040	<0.001
Model value (corrected)		7.112	0.972	0.968	0.960	0.098	0.932	0.879	0.027	<0.001

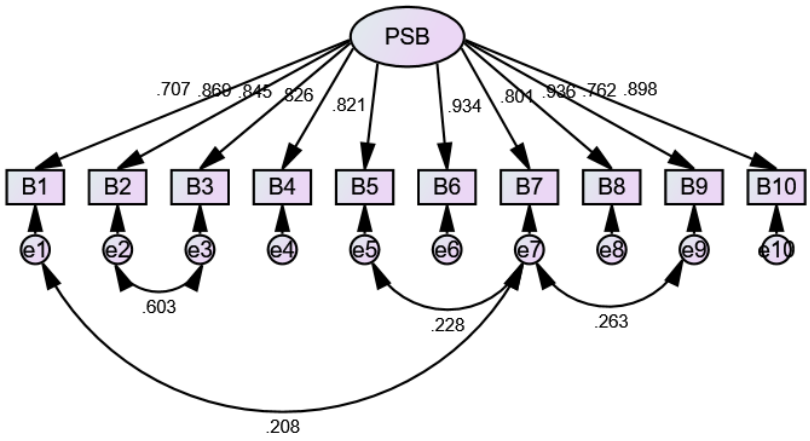

Figure 4.3 Measurement model for patient safety behavior

As shown in Table 4.12, the standardized factor loadings of this scale ranged from 0.707 to 0.936, all exceeding 0.3. The CR values also fell within this range, meeting the recommended threshold of greater than 0.6. Additionally, the AVE value was 0.710 > 0.5, indicating that the patient safety behavior scale demonstrated good convergent validity. Since the scale is unidimensional, discriminant validity testing was not required.

Table 4.12 Results of convergence validity test for patient safety behavior

Variable	Items	Standardized factor loading	AVE	CR
Patient Safety Behavior	B1	0.707	0.710	0.961
	B2	0.869		
	B3	0.845		
	B4	0.826		
	B5	0.821		
	B6	0.934		
	B7	0.801		
	B8	0.936		
	B9	0.762		
	B10	0.898		

4.3 Characteristics of patient safety culture, patient-centeredness self-efficacy, and patient safety behavior

4.3.1 Descriptive statistics of patient safety culture

4.3.1.1 Scores of patient safety culture

To investigate the status of patient safety culture, this study conducted descriptive statistics on the overall level and various dimensions of patient safety culture, as shown in Table 4.13. Overall, the median value of patient safety culture was 3.66, which is relatively high, but there were slight differences across its various dimensions. Specifically, the median values of the dimensions of patient safety culture were all above 3.50, except for "response to error" (3.25) and "staffing and work pace" (3.00).

Table 4.13 Scores of patient safety culture

Variable and dimensions	Number of items	M (P25, P75)	Positive response rate (%)	Positive response rate ranking
Patient Safety Culture	32	3.66 (3.28,4.00)	62.56	
Teamwork	3	4.00 (3.67,4.33)	77.69	1
Staffing and Work Pace	4	3.00 (2.50,3.50)	39.88	10
Organizational Learning – Continuous Improvement	3	4.00 (3.67,4.33)	76.64	2
Response to Error	4	3.25 (2.75,3.75)	45.79	9
Supervisor or Clinical Leader Support for Patient Safety	3	4.00 (3.33,4.33)	73.65	3
Communication About Error	3	4.00 (3.33,4.33)	68.03	6
Communication Openness	4	3.75 (3.25,4.25)	64.21	7
Reporting Patient Safety Events	2	3.50 (3.00,4.00)	49.53	8
Hospital Management Support for Patient Safety	3	4.00 (3.33,4.33)	70.08	4
Handoffs and Information Exchange	3	4.00 (3.33,4.33)	68.35	5

HSOPSC 2.0 uses the positive response rate as the main evaluation indicator: the positive response rate = the number of positive responses/ (the total number of participants - the number of missing responses). The positive response rate for positive questions is the number of choices for "agree/often" or "strongly agree/ always". The positive response rate for negative questions is the number of choices for "disagree/rarely" or "strongly disagree/ never". The missing response rate is the number of answers for "does not apply or do not know" or unanswered questions. A higher positive response rate indicates a better patient safety culture. A rate above 75% signifies an advantageous area, while a rate below 50% highlights an area for improvement.

In this study, the overall positive response rate for patient safety culture was 62.56%. The positive response rates for teamwork (77.69%) and organizational learning–continuous improvement (76.64%) exceeded 75%, making them as advantageous areas. However, three areas for improvement in patient safety culture were identified: reporting patient safety events (49.53%), response to error (45.79%), and staffing and work pace (39.88%), all with positive response rates below 50%. These findings indicate that while the overall level of patient safety culture is relatively high, improvements are still needed in response to error, reporting patient safety events, and staffing and work pace.

In addition, HSOPSC 2.0 includes two individual items asking participants to evaluate the level of patient safety culture in their hospital and the number of patient safety events they have reported. The positive response rate for evaluating the level of patient safety culture in the hospital is calculated by adding the number of participants who answered "excellent" or "very good" and dividing it by the total number of responses to the item. In this study, the positive response rate for this evaluation was 72.28%. The majority of participants gave a high evaluation of their hospital's patient safety culture, with the highest proportion (37.80%) rating it as "very good", followed by 34.49% who rated it as "excellent".

The positive response rate for patient safety event reporting frequency was calculated by summing the number of participants who reported one or more incidents in the past year and then dividing this by the total number of responses to the item. In this study, the positive response rate for hospital patient safety event reporting frequency was 51.02%, meaning that nearly half of the participants reported not having reported any patient safety events in the past year.

4.3.1.2 Differences in patient safety culture scores by demographic characteristics

For variables following a normal distribution, data are expressed as M±SD, with t-tests used to compare means between two groups. If variance is homogeneous, one-way analysis of variance

(ANOVA) is employed to compare means across multiple groups. For variables that do not follow a normal distribution, data are described using M (P25, P75), with the Mann-Whitney U test used for comparisons between two groups and the Kruskal-Wallis H test for comparisons across multiple groups.

The results of this study indicated statistically significant differences in overall patient safety culture scores across gender ($Z = -2.473$, $p < 0.05$), age ($F = 3.911$, $p < 0.05$), marital status ($t = -2.337$, $p < 0.05$), geographic location ($H = 12.995$, $p < 0.05$), professional title ($F = 2.756$, $p < 0.05$), and average daily working hours ($H = 11.474$, $p < 0.05$).

Specifically, gender differences were found in median scores for overall hospital patient safety culture, staffing and work pace, communication about error, hospital management support for patient safety, and handoffs and information exchange ($p < 0.05$), with female physicians scoring higher than male physicians. Age differences were observed in overall hospital patient safety culture and dimensions such as teamwork, communication about error, communication openness, reporting patient safety events, and handoffs and information exchange ($p < 0.05$). Generally, apart from reporting patient safety events, physicians aged above 40 reported higher median scores than those under 30. Marital status differences were found in overall hospital patient safety culture and dimensions such as supervisor or clinical leader support for patient safety, communication about error, and communication openness ($p < 0.05$), with married physicians scoring higher than unmarried physicians.

Moreover, physicians from different geographical locations exhibited significant differences ($p < 0.05$) in overall patient safety culture and the dimensions of teamwork, staffing and work pace, response to error, supervisor or clinical leader support for patient safety, communication openness, and reporting patient safety events. Except for staffing and work pace, the median scores of physicians from Western China were lower than those from Eastern China.

Significant differences ($p < 0.05$) were also found among physicians from different departments in the dimensions of staffing and work pace, as well as handoffs and information exchange. Regarding professional titles, physicians at different levels showed statistically significant differences ($p < 0.05$) in overall patient safety culture and the dimensions of communication about error, communication openness, reporting patient safety events, and handoffs and information exchange. More specifically, physicians with junior professional titles reported lower overall patient safety culture scores, and their median scores for communication openness and reporting patient safety events were lower than those of physicians with associate senior professional titles. Additionally, physicians with senior professional titles reported lower

median scores than those with intermediate professional titles in the dimensions of communication about error and handoffs and information exchange.

Furthermore, statistically significant differences ($p < 0.05$) were observed among physicians with different average daily working hours in overall patient safety culture and the dimensions of staffing and work pace, response to error, supervisor or clinical leader support for patient safety, communication about error, communication openness, and reporting patient safety events.

Finally, significant differences ($p < 0.05$) were found in the median scores for communication openness among physicians with different tenures. In general, physicians with fewer than 10 years of experience reported lower median scores than those with 10 to 20 years of experience. The comparison of patient safety culture and its dimensions across different sociodemographic groups is presented in Table 4.14.

Table 4.14 Scores of patient safety culture and its dimensions among physicians by demographic characteristics

Characteristics	Frequency (N)	Overall patient safety culture in the hospital	Teamwork	Staffing and work pace	Organizational learning – continuous Improvement	Response to error	Supervisor or clinical leader support for patient safety	Communication about error	Communication openness	Reporting patient safety events	Hospital management support for patient safety	Handoffs and information exchange
Gender												
Male	298	3.63 (3.22,3.94)	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.33,4.33)	3.25 (2.50,3.50)	4.00 (3.33,4.33)	4.00 (3.33,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	3.83 (3.33,4.33)	4.00 (3.00,4.33)
Female	337	3.69 (3.34,4.06)	4.00 (3.67,4.33)	3.00 (2.75,3.75)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.67,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.67)	4.00 (3.33,4.33)
Z		-2.473**	-0.629	-2.642**	-1.224	-2.165	-0.560	-2.101**	-1.587	-0.387	-2.606**	-2.105**
Post hoc Test		1<2		1<2				1<2			1<2	1<2
Age												
[18,30]	128	3.53±0.49	4.00 (3.33,4.33)	3.00 (2.50,3.50)	4.00 (3.33,4.33)	3.00 (2.50,3.75)	3.83 (3.33,4.00)	3.67 (3.00,4.00)	3.50 (3.00,4.00)	3.00 (3.00,4.00)	4.00 (3.00,4.33)	3.67 (3.00,4.00)
(30,40]	282	3.68±0.51	4.00 (3.67,4.33)	3.25 (2.50,3.75)	4.00 (3.33,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.67,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
(40,50]	173	3.70±0.51	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.67,4.33)	4.00 (3.67,4.33)	3.75 (3.25,4.50)	4.00 (3.00,4.50)	4.00 (3.67,4.33)	4.00 (3.33,4.33)
(50,61]	52	3.74±0.51	4.00 (3.67,4.33)	3.13 (2.50,3.50)	4.00 (3.67,4.33)	3.25 (2.75,3.63)	4.00 (3.67,4.50)	4.00 (3.67,4.50)	4.00 (3.50,4.50)	3.50 (2.50,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
F/H		3.911**	10.539**	7.117	4.949	1.904	5.550	17.961***	20.104***	10.865**	2.060	12.306**
LSD/Post hoc Test		1<2,3,4	1<3,4					1<2,3,4	1<2,3,4	1<3; 2<3		1<3,4
Marital status												
Single	141	3.57±0.53	4.00 (3.33,4.33)	3.00 (2.50,3.50)	4.00 (3.33,4.33)	3.25 (2.75,3.50)	3.67 (3.33,4.00)	3.67 (3.00,4.33)	3.50 (3.00,4.00)	3.50 (3.00,4.00)	4.00 (3.33,4.67)	3.67 (3.00,4.33)
Married	494	3.68±0.50	4.00 (3.67,4.33)	3.00 (2.50,3.75)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.67,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
t/Z		-2.337**	-1.753	-1.826	-0.988	-0.580	-2.439**	-2.658**	-3.302**	-0.807	-0.402	-1.702
LSD/ Post hoc Test		1<2					1<2	1<2	1<2			
Education level												

Bachelor or Below	122	3.64 (3.28,3.97)	4.00 (3.67,4.33)	3.00 (2.75,3.50)	4.00 (3.33,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.00)	4.00 (3.33,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	3.83 (3.00,4.00)
Master	308	3.69 (3.31,4.00)	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.33,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
Doctorate	205	3.66 (3.25,4.00)	4.00 (3.67,4.33)	3.00 (2.50,3.75)	4.00 (3.33,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.33,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
H		0.413	2.509	0.910	3.056	0.129	1.649	0.270	0.794	0.840	1.414	2.891
Geographic location												
Eastern Region	232	3.72 (3.31,4.06)	4.00 (3.67,4.67)	3.00 (2.50,3.75)	4.00 (3.67,4.67)	3.25 (2.75,3.75)	4.00 (3.33,4.67)	4.00 (3.33,4.33)	3.75 (3.25,4.50)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
Central Region	214	3.69 (3.41,4.03)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.33,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.67)	4.00 (3.33,4.33)
Western Region	189	3.47 (3.16,3.91)	4.00 (3.33,4.33)	2.75 (2.50,3.50)	4.00 (3.33,4.33)	3.00 (2.50,3.50)	3.67 (3.33,4.00)	4.00 (3.33,4.00)	3.50 (3.25,4.00)	3.00 (2.50,4.00)	4.00 (3.33,4.33)	3.67 (3.00,4.33)
H		12.995**	7.997**	15.691***	5.368	11.756**	8.485**	2.959	10.351**	12.247**	2.063	4.149
Post hoc Test		3<1,2	3<1	3<2		3<1,2	3<1		3<1,2	3<1,2		
Department												
Internal Medicine	102	3.69±0.55	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	3.25 (3.00,3.75)	4.00 (3.33,4.33)	4.00 (3.33,4.33)	4.00 (3.25,4.50)	3.50 (3.00,4.00)	4.00 (3.33,4.67)	3.67 (3.00,4.33)
Surgery	144	3.57±0.48	4.00 (3.33,4.33)	3.00 (2.50,3.50)	4.00 (3.33,4.33)	3.00 (2.50,3.75)	3.67 (3.33,4.00)	3.67 (3.33,4.33)	3.5 (3.25,4.00)	3.50 (3.00,4.00)	3.67 (3.33,4.33)	3.67 (3.00,4.00)
Gynecology and Obstetrics	104	3.70±0.52	4.00 (3.67,4.33)	3.00 (2.75,3.75)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.67,4.67)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.67,4.33)
Pediatrics	115	3.74±0.48	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.67,4.33)	4.00 (3.67,4.50)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.67,4.67)	4.00 (3.33,4.33)
Emergency	80	3.68±0.53	4.00 (3.67,4.67)	3.00 (2.50,3.50)	4.00 (3.67,4.50)	3.25 (2.50,3.50)	4.00 (3.33,4.67)	4.00 (3.67,4.33)	3.75 (3.25,4.50)	3.50 (2.50,4.50)	4.00 (3.33,4.33)	4.00 (3.00,4.33)
Others	90	3.60±0.50	4.00 (3.67,4.33)	3.00 (2.50,3.75)	4.00 (3.33,4.33)	3.00 (2.75,3.75)	4.00 (3.33,4.00)	4.00 (3.33,4.33)	3.75 (3.25,4.00)	3.00 (2.50,4.00)	4.00 (3.33,4.00)	3.67 (3.33,4.00)
F/H		1.996	8.132	11.564**	6.564	8.420	7.859	9.329	7.601	8.664	10.310	12.368**
Professional title												

Junior	144	3.55±0.50	4.00 (3.33,4.33)	3.00 (2.50,3.50)	4.00 (3.33,4.33)	3.00 (2.63,3.63)	4.00 (3.33,4.00)	3.67 (3.00,4.00)	3.50 (3.00,4.00)	3.00 (3.00,4.00)	4.00 (3.17,4.33)	3.67 (3.00,4.00)
Intermediate	227	3.70±0.51	4.00 (3.67,4.33)	3.25 (2.50,3.75)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.67,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
Associate senior	180	3.69±0.50	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.50,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.67,4.33)	4.00 (3.38,4.25)	3.75 (3.00,4.50)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
Senior	84	3.65±0.52	4.00 (3.67,4.33)	3.00 (2.38,3.50)	4.00 (3.33,4.33)	3.25 (2.75,3.75)	4.00 (3.67,4.33)	4.00 (3.33,4.33)	3.75 (3.25,4.50)	3.50 (3.00,4.00)	3.83 (3.33,4.33)	4.00 (3.17,4.33)
F/H		2.756**	5.844	6.218	2.469	3.244	5.023	11.063**	12.067**	8.620**	3.017	10.447**
LSD/Post hoc Test		1<2,3					1<2	1<3	1<3		1<2	
Administrative Position												
No	550	3.66 (3.31,3.97)	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.33,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
Yes	85	3.63 (3.13,4.06)	4.00 (3.67,4.33)	3.00 (2.25,3.50)	4.00 (3.33,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	3.67 (3.33,4.33)	3.75 (3.25,4.50)	3.50 (2.50,4.00)	4.00 (3.33,4.33)	4.00 (3.00,4.33)
Z		-0.507	-0.452	-1.925	-0.031	-0.573	-0.284	-1.437	-0.222	-0.501	-0.134	-0.608
Average daily working hours												
(0,8)	45	3.63 (3.06,3.97)	4.00 (3.33,4.33)	3.25 (2.75,4.00)	4.00 (3.33,4.33)	3.25 (3.00,3.75)	4.00 (3.33,4.33)	3.67 (3.00,4.33)	3.50 (3.00,4.00)	3.00 (2.00,3.50)	4.00 (3.00,4.33)	3.67 (3.00,4.00)
[8,10)	342	3.69 (3.34,4.03)	4.00 (3.67,4.33)	3.25 (2.50,3.75)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.67,4.33)	4.00 (3.67,4.33)	3.75 (3.25,4.50)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
[10,12)	183	3.69 (3.25,3.97)	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.33,4.33)	3.25 (2.63,3.75)	4.00 (3.33,4.00)	4.00 (3.33,4.33)	3.75 (3.25,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.17,4.33)
[12,24]	65	3.47 (3.09,3.81)	4.00 (3.33,4.00)	2.75 (2.25,3.25)	4.00 (3.33,4.33)	3.00 (2.50,3.50)	3.67 (3.33,4.00)	3.67 (3.33,4.00)	3.50 (3.25,4.00)	3.00 (2.50,4.00)	4.00 (3.33,4.33)	3.67 (3.33,4.00)
H		11.474**	5.341	16.943**	5.491	11.333**	14.510**	8.192**	8.107**	13.336**	3.115	2.135
Post hoc Test		4<2		4<1,2		4<2	4<2			1<2,3		
Tenure												
(0,10]	305	3.59 (3.25,3.97)	4.00 (3.33,4.33)	3.00 (2.50,3.50)	4.00 (3.33,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.33,4.33)	3.75 (3.25,4.00)	3.00 (3.00,4.00)	4.00 (3.33,4.33)	3.67 (3.33,4.33)
(10,20]	211	3.72 (3.34,4.00)	4.00 (3.67,4.33)	3.00 (2.63,3.75)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.67,4.33)	3.75 (3.50,4.25)	3.50 (3.00,4.00)	4.00 (3.33,4.67)	4.00 (3.33,4.33)
(20,39]	119	3.66 (3.28,4.03)	4.00 (3.67,4.33)	3.00 (2.50,3.50)	4.00 (3.67,4.33)	3.25 (2.75,3.75)	4.00 (3.33,4.33)	4.00 (3.50,4.33)	3.75 (3.25,4.50)	3.50 (3.00,4.00)	4.00 (3.33,4.33)	4.00 (3.33,4.33)
H		3.135	5.032	5.198	0.192	0.444	2.597	5.966	10.072**	3.945	1.962	1.997

Post hoc Test	1<2

Note: ** $p < 0.05$, *** $p < 0.001$

4.3.2 Descriptive statistics of patient centeredness self-efficacy

4.3.2.1 Scores of patient-centeredness self-efficacy

To understand physicians' patient-centeredness self-efficacy, descriptive statistics were performed on their scores. The results showed that the median value of overall patient-centeredness self-efficacy was 81.00. Considering the score range of 0 to 108, the physicians' patient-centeredness self-efficacy was at a moderate level. Further analysis revealed that the median value of the dimensions sharing information and power, exploring the patient perspective, and dealing with communicative challenges were all 3.00, at a relatively high level. More details are shown in Table 4.15.

Table 4.15 Scores of patient-centeredness self-efficacy

Variable and dimensions	Items	Score range	Total score, M (P25, P75)	Item median score, M (P25, P75)
Patient Centeredness Self-Efficacy	27	0~108	81.00 (77.00,96.00)	3.00 (2.85,3.56)
Exploring the Patient Perspective	10	0~40	30.00 (28.00,35.00)	3.00 (2.80,3.50)
Sharing Information and Power	10	0~40	30.00 (30.00,37.00)	3.00 (3.00,3.70)
Dealing with Communicative Challenges	7	0~28	21.00 (20.00,25.00)	3.00 (2.86,3.57)

4.3.2.2 Differences in patient-centeredness self-efficacy scores by demographic characteristics

There were no statistically significant differences in the median values of overall patient-centeredness self-efficacy and its dimensions among physicians of different genders, education levels, departments, administrative positions, or average daily working hours.

More specifically, significant differences ($p < 0.05$) were found in the median values of patient-centeredness self-efficacy and its dimensions among physicians of different ages and marital statuses. Physicians aged 18–30 years reported lower median values in patient-centeredness self-efficacy and its three dimensions compared to older physicians, while married physicians reported higher median values than single physicians.

Moreover, significant differences ($p < 0.05$) were observed among physicians with different professional titles and tenures in the median values of overall patient-centeredness self-efficacy and its dimensions. Physicians with junior professional titles and those with a tenure of 0~10 years reported lower median scores compared to others. Additionally, there were statistically significant differences ($p < 0.05$) in the median values of the dimension exploring the patient perspective across different geographical locations, with physicians in the eastern region

scoring higher than those in the western region. The results of the Mann–Whitney U test and the Kruskal–Wallis H test are shown in Table 4.16.

Table 4.16 Scores of patient-centeredness self-efficacy and its dimensions among physicians by demographic characteristics

Characteristics	Frequency (N)	Overall Patient-centeredness self-efficacy	Exploring the Patient Perspective	Sharing Information and Power	Dealing with Communicative Challenges
Gender					
Male	298	81.00 (75.00,94.00)	30.00 (27.00,35.00)	30.00 (29.00,36.00)	21.00 (19.00,24.00)
Female	337	81.00 (78.00,98.00)	30.00 (29.00,36.00)	30.00 (30.00,37.00)	21.00 (20.00,25.00)
Z		-1.525	-1.734	-1.194	-1.179
Age					
[18,30]	128	81.00 (65.50,83.00)	30.00 (24.00,31.00)	30.00 (25.00,30.00)	21.00 (16.00,21.00)
(30,40]	282	81.00 (77.00,95.00)	30.00 (28.00,35.00)	30.00 (30.00,36.00)	21.00 (20.00,25.00)
(40,50]	173	82.00 (79.00,99.00)	30.00 (29.00,37.00)	31.00 (30.00,39.00)	21.00 (20.00,27.00)
(50,61]	52	90.00 (80.50,104.50)	34.00 (30.00,39.00)	34.00 (30.00,39.50)	22.00 (21.00,27.00)
H		31.047***	31.228***	41.348***	20.869***
Post hoc Test		1<2,3,4; 2<4	1<2,3,4; 2<4	1<2,3,4	1<2,3,4
Marital Status					
Single	141	81.00 (71.00,85.00)	30.00 (26.00,31.00)	30.00 (26.00,31.00)	21.00 (17.00,22.00)
Married	494	81.00 (78.00,99.00)	30.00 (29.00,36.00)	30.00 (30.00,38.00)	21.00 (20.00,25.00)
Z		-4.162***	-4.203***	-4.804***	-3.484***
Post hoc Test		2>1	2>1	2>1	2>1
Education Level					
Bachelor or Below	122	81.00 (75.00,95.00)	30.00 (28.00,35.00)	30.00 (28.00,38.00)	21.00 (19.00,25.00)
Master	308	81.00 (77.00,94.50)	30.00 (28.00,35.00)	30.00 (30.00,36.00)	21.00 (19.00,25.00)
Doctorate	205	81.00 (77.00,97.00)	30.00 (28.00,37.00)	30.00 (30.00,38.00)	21.00 (20.00,25.00)
H		0.413	0.797	2.179	0.440
Geographic Location					
Eastern Region	232	81.00 (78.00,99.00)	30.00 (29.00,37.00)	30.00 (30.00,39.00)	21.00 (19.00,26.00)
Central Region	214	81.00 (78.00,93.00)	30.00 (29.00,34.00)	30.00 (30.00,36.00)	21.00 (20.00,24.00)
Western Region	189	81.00 (75.00,94.00)	30.00 (27.00,35.00)	30.00 (29.00,36.00)	21.00 (19.00,24.00)
H		5.634	7.061**	5.477	2.199
Post hoc Test			3<1		
Department					
Internal Medicine	102	81.00 (76.00,99.00)	30.00 (28.00,37.00)	30.00 (30.00,39.00)	21.00 (19.00,26.00)
Surgery	144	81.00 (74.50,94.00)	30.00 (27.00,35.00)	30.00 (29.00,36.00)	21.00 (19.00,24.00)

Gynecology and Obstetrics	104	81.00 (79.00,103.00)	30.00 (29.50,37.00)	30.00 (30.00,39.00)	21.00 (21.00,26.00)
Pediatrics	115	81.00 (77.50,94.00)	30.00 (28.00,35.00)	30.00 (30.00,36.50)	21.00 (20.00,25.00)
Emergency	80	81.00 (75.00,91.00)	30.00 (27.50,35.50)	30.00 (28.50,36.00)	21.00 (19.00,24.00)
Others	90	81.00 (78.00,93.00)	30.00 (27.00,35.00)	30.00 (29.00,35.00)	21.00 (20.00,25.00)
H		3.411	5.792	4.177	4.297
Professional Title					
Junior	144	81.00 (69.50,84.50)	30.00 (25.00,30.50)	30.00 (25.50,30.00)	21.00 (16.50,22.00)
Intermediate	227	81.00 (77.00,99.00)	30.00 (28.00,36.50)	30.00 (30.00,38.00)	21.00 (19.00,25.00)
Associate senior	180	81.00 (79.00,99.50)	30.00 (29.00,37.00)	30.00 (30.00,38.00)	21.00 (20.00,26.00)
Senior	84	86.50 (80.00,102.00)	31.50 (29.00,38.00)	31.00 (30.00,39.00)	21.50 (21.00,26.00)
H		23.998***	23.623***	34.140***	18.189***
Post hoc Test		1<2,3,4	1<2,3,4	1<2,3,4	1<2,3,4
Administrative Position					
No	550	81.00 (77.00,95.00)	30.00 (28.00,35.00)	30.00 (30.00,37.00)	21.00 (19.00,25.00)
Yes	85	83.00 (79.00,100.00)	30.00 (29.00,38.00)	30.00 (30.00,38.00)	21.00 (21.00,26.00)
Z		-1.405	-1.464	-1.044	-1.785
Average daily working hours					
(0,8)	45	85.00 (74.00,102.00)	30.00 (24.00,39.00)	31.00 (29.00,39.00)	21.00 (16.00,27.00)
[8,10)	342	81.00 (77.00,95.00)	30.00 (28.00,35.00)	30.00 (30.00,37.00)	21.00 (20.00,25.00)
[10,12)	183	81.00 (77.00,94.50)	30.00 (28.00,35.50)	30.00 (30.00,36.00)	21.00 (19.00,24.00)
[12,24]	65	81.00 (78.00,93.00)	30.00 (29.00,36.00)	30.00 (30.00,36.00)	21.00 (20.00,22.00)
H		0.642	0.044	1.465	1.056
Tenure					
(0,10]	305	81.00 (74.00,88.00)	30.00 (27.00,32.00)	30.00 (28.00,33.00)	21.00 (18.00,23.00)
(10,20]	211	82.00 (79.00,101.00)	30.00 (29.00,38.00)	31.00 (30.00,39.00)	21.00 (21.00,27.00)
(20,39]	119	84.00 (78.50,101.00)	31.00 (29.00,38.00)	31.00 (30.00,39.00)	21.00 (20.00,25.00)
H		25.572***	25.831***	32.870***	21.152***
Post hoc Test		1<2,3	1<2,3	1<2,3	1<2,3

Note: ** $p < 0.05$, *** $p < 0.001$

4.3.3 Descriptive statistics of patient safety behavior

4.3.3.1 Scores of patient safety behavior

Descriptive analysis was performed to examine the median values of patient safety behavior and its individual items to gain a better understanding of the overall status of patient safety behavior. The results showed that the median value of patient safety behavior was above average, at 51.00, indicating that physicians demonstrated strong patient safety behaviors. Among the items, Item 2 ("I strive for ensuring safety on the job.") had the highest median value (6.00). More details are provided in Table 4.17.

Table 4.17 Scores of patient safety behavior

Variable	Items	Score Range	M (P25, P75)
Patient Safety Behavior		6~60	51.00 (49.00,58.00)
	1. I pay attention to the colleague who doesn't comply with safety regulation or procedure book.	1~6	5.00 (4.00,5.00)
	2. I strive for ensuring safety on the job.	1~6	6.00 (5.00,6.00)
	3. I am sure to take safety into consideration when I have some doubts about judgment at work.	1~6	5.00 (5.00,6.00)
	4. I try to be mentally and physically fit for work.	1~6	5.00 (5.00,6.00)
	5. I look at the operation procedure book or safety regulations before work.	1~6	5.00 (5.00,6.00)
	6. I remember the lessons learned from past contingencies which prevent accidents from reoccurring in the same operation procedures.	1~6	5.00 (5.00,6.00)
	7. When someone's behavior does not comply with safety regulation, even if that person is an executive, I still pay attention to the colleague.	1~6	5.00 (5.00,6.00)
	8. I am careful to observe the instructions in the safety regulations and operation procedure book.	1~6	5.00 (5.00,6.00)
	9. I am able to keep having no record of contingency occurrence.	1~6	5.00 (5.00,6.00)
	10. I ask my director or person in charge when there is doubt at work.	1~6	5.00 (5.00,6.00)

4.3.3.2 Differences in patient safety behavior scores by demographic characteristics

Tthe Mann-Whitney U test and the Kruskal-Wallis H test were employed to examine the differences in patient safety behavior among participants with different demographic characteristics. There were no statistically significant differences in the median value of patient safety behavior among physicians with different education levels (H = 0.917, p = 0.172), geographical locations (H = 3.155, p = 0.207), departments (H = 8.139, p = 0.149),

administrative positions (Z = -1.521, p = 0.128), or average daily working hours (H = 1.256, p = 0.740).

However, statistically significant differences were found in the median value of patient safety behavior among physicians of different genders (Z = -2.153, p = 0.031), ages (H = 25.881, p < 0.001), and marital statuses (Z = -3.681, p < 0.001). In general, female and married physicians reported higher median scores than male and unmarried physicians. Additionally, physicians aged 18-30 years reported lower median scores than those aged 40-61 years.

Moreover, statistically significant differences were observed in the median value of patient safety behavior among physicians with different professional titles (H = 21.627, p < 0.001) and tenures (H = 20.682, p < 0.001). Physicians with junior professional titles and a tenure of 0-10 years reported lower median scores of patient safety behavior than other physicians.

Overall, significant differences in the median value of patient safety behavior were found across gender, age, marital status, professional titles, and tenure. More details are presented in Table 4.18.

Table 4.18 Patient safety behavior among the physicians by demographic characteristics

Characteristics	Frequency (N)	M (P25, P75)	*Z/H*	*p*	Post hoc Test
Gender			-2.153	0.031	2>1
Male	298	51.50 (48.00,57.00)			
Female	337	51.00 (49.00,59.00)			
Age			25.881	<0.001	1<3
[18,30]	128	50.00 (47.00,54.00)			1,2<4
(30,40]	282	51.00 (49.00,57.00)			
(40,50]	173	54.00 (50.00,59.00)			
(50,61]	52	57.00 (50.00,59.00)			
Marital Status			-3.681	<0.001	2>1
Single	141	50.00 (46.00,56.00)			
Married	494	53.00 (49.00,58.00)			
Educational Level			0.172	0.917	
Bachelor or Below	122	50.00 (48.00,59.00)			
Master	308	51.50 (49.00,58.00)			
Doctorate	205	52.00 (49.00,58.00)			
Geographic Location			3.155	0.207	
Eastern Region	232	53.00 (49.00,59.00)			
Central Region	214	51.00 (49.00,57.00)			
Western Region	189	51.00 (48.00,58.00)			
Department			8.139	0.149	
Internal Medicine	102	51.50 (49.00,59.00)			
Surgery	144	51.00 (48.00,57.00)			
Gynecology and Obstetrics	104	53.00 (49.00,59.00)			
Pediatrics	115	51.00 (50.00,58.50)			
Emergency	80	52.50 (47.50,59.00)			
Others	90	50.00 (47.00,57.00)			

Professional Title			21.627	<0.001	1<2,3,4
Junior	144	50.00 (47.00,54.00)			
Intermediate	227	51.00 (48.00,58.00)			
Associate senior	180	53.00 (49.00,59.00)			
Senior	84	55.00 (50.00,59.00)			
Administrative Position			-1.521	0.128	
No	550	51.00 (49.00,58.00)			
Yes	85	54.00 (50.00,59.00)			
Average daily working hours			1.256	0.740	
(0,8)	45	54.00 (48.00,59.00)			
[8,10)	342	51.00 (49.00,59.00)			
[10,12)	183	52.00 (49.00,57.00)			
[12,24]	65	51.00 (48.00,57.00)			
Tenure			20.682	<0.001	1<2,3
(0,10]	305	50.00 (48.00,56.00)			
(10,20]	211	54.00 (50.00,59.00)			
(20,39]	119	55.00 (49.50,59.00)			

4.4 The relationship between patient safety culture, patient centeredness self-efficacy, and patient safety behavior

4.4.1 Correlation analysis between variables

To explore the relationships between variables in the model, it is necessary to conduct a correlation analysis. Correlation analysis results are categorized as low, moderate, and high correlation, generally represented by the correlation coefficient r. When $0 < |r| < 0.3$, the correlation is low; when $0.3 \leq |r| < 0.7$, it is moderate correlation; and when $0.7 \leq |r| < 1$, it is high (Day et al., 2021).

In this study, the correlations between variables were analyzed using Spearman's correlation analysis. The results showed a significant positive correlation ($p < 0.01$) between overall patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. The correlation coefficient between patient safety culture and patient-centeredness self-efficacy was 0.545, the correlation coefficient between patient safety culture and patient safety behavior was 0.534, and the correlation coefficient between patient-centeredness self-efficacy and patient safety behavior was 0.755. All values are greater than 0.3, indicating a significant correlation.

4.4.2 The mechanism by which patient safety culture and patient-centeredness self-efficacy affect patient safety behavior

4.4.2.1 Direct impact of patient safety culture and patient-centeredness self-efficacy on patient safety behavior

Based on research hypotheses, we constructed SEM using Amos 22.0 to explore the relationship between patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. The model diagram is shown in Figure 4.4. The fit indices of the model are shown in Table 4.20, and the initial results showed that $\chi 2/df = 5.952$, CFI = 0.911, NFI = 0.895, TLI = 0.901, RMSEA = 0.088, GFI = 0.826, AGFI = 0.788, SRMR = 0.051. Since $\chi 2/df > 5$, this indicates poor model fit, requiring model modification. Based on the modification indices, after one revision of the hypothetical model, the updated results showed that $\chi 2/df = 4.823$, CFI = 0.931, NFI = 0.915, TLI = 0.923, RMSEA = 0.078, GFI = 0.855, AGFI = 0.823, and SRMR = 0.050. The absolute fit index, incremental fit index, and parsimonious fit index all met the corresponding criteria, indicating good model fit.

Table 4.19 SEM adaptation table

Fit index	$\chi 2/df$	CFI	NFI	TLI	RMSEA	GFI	AGFI	SRMR	*p*
Reference value	<3	>0.9	>0.9	>0.9	<0.06	>0.9	>0.9	<0.05	<0.001
	<5	>0.8	>0.8	>0.8	<0.1	>0.7	>0.7	<0.08	
Model value	5.952	0.911	0.895	0.901	0.088	0.826	0.788	0.051	<0.001
Model value (corrected)	4.823	0.931	0.915	0.923	0.078	0.855	0.823	0.050	<0.001

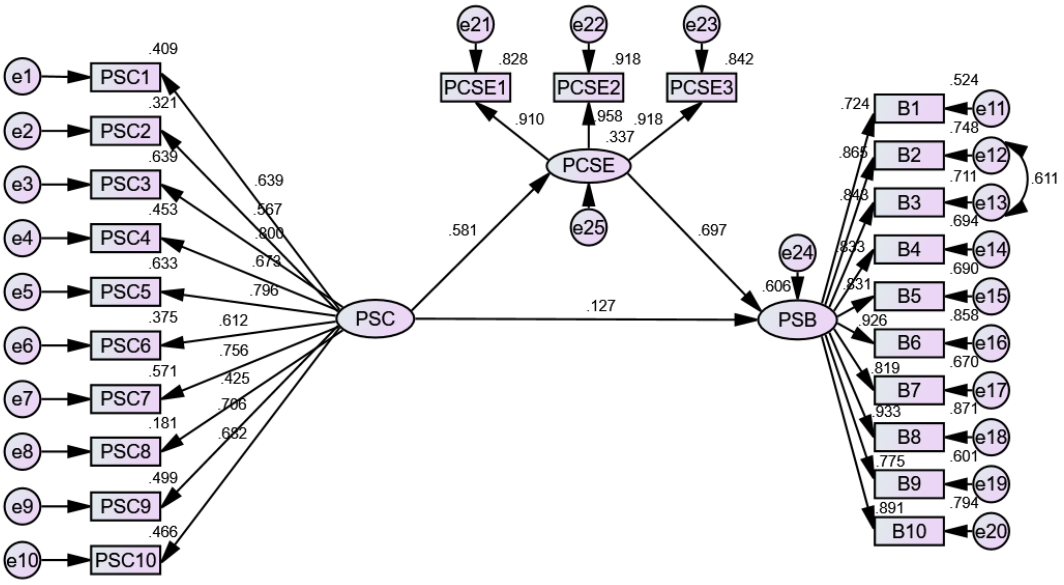

Figure 4.4 Path analysis diagram of SEM

From the results of the path analysis (see Table 4.21), all path coefficients were found to be statistically significant ($p < 0.001$), and the 95% confidence interval (CI) did not include 0. These results indicated that patient safety culture was significantly and positively associated with patient-centeredness self-efficacy ($\beta = 0.581$, $p < 0.001$), confirming Hypothesis 1 (H1). Additionally, patient-centeredness self-efficacy had a significant positive impact on patient safety behavior ($\beta = 0.697$, $p < 0.001$), supporting Hypothesis 2 (H2). Patient safety culture also had a significant positive impact on patient safety behavior ($\beta = 0.127$, $p < 0.001$), supporting Hypothesis 3 (H3).

Table 4.20 Estimation of parameters for the overall SEM and hypothesis testing results

Path	Unstandardized Estimate	Standardized Estimate	Standard Error	Critical Value	95% CI BootLLCI	BootULCI	*p*
H1: Patient Safety Culture → Patient Centeredness Self-Efficacy	8.549	0.581	0.693	12.341	0.501	0.648	<0.001
H2: Patient Centeredness Self-Efficacy → Patient Safety Behavior	0.080	0.697	0.005	15.366	0.620	0.769	<0.001
H3: Patient Safety Culture → Patient Safety Behavior	0.215	0.127	0.062	3.468	0.058	0.195	<0.001

4.4.2.2 Mediation of patient-centeredness self-efficacy in the relationship between patient safety culture and patient safety behavior

The mediation effect was tested using the bias-corrected nonparametric percentile Bootstrap method, with 5000 bootstrap random samples, to further examine the mediation of patient-centeredness self-efficacy in the relationship between patient safety culture and patient safety behavior. If the 95% CI does not contain 0, it indicates that the corresponding direct, indirect, and total effects are significant. The analysis results in this study showed that the 95% CI for direct, indirect, and total effects did not include 0, indicating that the direct effect and the indirect effect of patient-centeredness self-efficacy between patient safety culture and patient safety behavior were statistically significant.

The statistics for the direct effect, indirect effect, and total effect in the mediation model are presented in Table 4.22. The estimate for the indirect effect was 0.405, the direct effect was 0.127, and the total effect was 0.532, with the indirect effect accounting for 76.13% of the total effect. Therefore, there exists both a direct path of "patient safety culture → patient safety behavior" and an indirect path mediated by patient-centeredness self-efficacy, namely, "patient safety culture → patient-centeredness self-efficacy → patient safety behavior". The results

indicated that patient-centeredness self-efficacy had a partial mediating effect in the relationship between patient safety culture and physicians' patient safety behavior, supporting Hypothesis 4 (H4).

Table 4.21 Mediating effect of patient-centeredness self-efficacy in the overall SEM

Path	Standardized Estimate	95% CI		*p*	Effect quantity (%)
		BootLLCI	BootULCI		
Indirect effect (H4: Patient Safety Culture → Patient Centeredness Self-Efficacy → Patient Safety Behavior)	0.405	0.341	0.473	< 0.001	76.13%
Direct effect	0.127	0.058	0.195	< 0.001	23.87%
Total effect	0.532	0.447	0.603	0.001	100.00%

Chapter 5: Discussion

This chapter focuses on discussing and analyzing the findings presented in Chapter 4. It primarily includes a descriptive overview of the current state of patient safety in large tertiary hospitals in China and a discussion on the influence of organizational patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behaviors.

5.1 Current state of patient safety culture in tertiary hospitals in China

This study surveyed 13 large tertiary hospitals across eastern, central, and western regions of China, ultimately collecting 635 valid responses from physicians working in these healthcare institutions. Analysis of participants' demographic, regional, and professional characteristics demonstrated a relatively balanced data distribution. Statistical testing and analysis further confirmed the absence of significant common method bias, as well as good reliability and validity of the data. These findings indicate that the research data is representative and has research value.

5.1.1 Organizational patient safety culture scores and dimensional analysis

Based on the overall results, the median score for patient safety culture was 3.66, indicating a relatively high level of organizational patient safety culture in large tertiary hospitals in China. However, there were slight variations across the dimensions. More specifically, the highest median score was observed in *teamwork* (M = 3.97). Except for *communication about error* (3.25) and *staffing and work pace* (3.00), all other dimensions had median scores exceeding 3.5.

The positive response rate (PRR), a key indicator in assessing patient safety culture (Azyabi et al., 2021), indicates better organizational safety culture as it increases, with rates above 75% representing strengths and those below 50% signaling areas for improvement. In this study, the overall positive response rate for patient safety culture was 62.56%. Notably, the positive response rate for *teamwork* (77.69%) and *organizational learning–continuous improvement* (76.64%) exceeded 75%, identifying these as strength areas. Conversely, three dimensions were identified as areas for improvement, with positive response rates below 50%: *reporting patient safety events* (49.53%), *response to error* (45.79%), and *staffing and work pace* (39.88%). These findings indicate that challenges remain in building a culture that emphasizes error reporting, responding to error, and addressing staffing and work pace issues. Alabdullah and

Karwowski (2024) analyzed 75 global studies on patient safety culture conducted between 2010 and 2024, providing a broader context. Their research utilized the standardized Hospital Survey on Patient Safety Culture (HSOPSC) tools, including versions 1.0 and 2.0. Following the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) guidelines for systematic review and meta-analysis, the analysis highlighted consistent global strengths and weaknesses. Across regions, "*teamwork within units*" and "*focus on continuous learning*" emerged as key strengths, particularly in studies from Asian countries. Conversely, the weaknesses of "*barriers to error reporting*" and "*staffing shortages*" are particularly concerning. These two critical issues, which require our attention, are also evident among the subjects investigated in this study.

Therefore, the alignment between these global findings and the current study's results suggest the importance of fostering a just culture that encourages error reporting, addressing staffing shortages, promoting open communication among healthcare professionals, and tailoring interventions to address regional disparities. These actions are critical to creating a safer and more supportive environment for patients worldwide.

5.1.2 The impact of sociodemographic characteristics on patient safety culture

We also found that there were differences in the level of patient safety culture among the survey participants with different sociodemographic characteristics. Firstly, regarding general demographic characteristics, female physicians scored higher than male physicians in the median ratings of overall patient safety culture in the hospital, staffing and work pace, communication about error, hospital management support for patient safety, and handoffs and information exchange, with statistically significant differences. Physicians over the age of 30 reported higher median scores than those under 30 in overall hospital patient safety culture and the dimensions of teamwork, communication about error, communication openness, reporting patient safety events, and handoffs and information exchange, with significant statistical differences. Marital status also had a significant impact on scores of overall patient safety culture and the dimensions of supervisor or clinical leader support for patient safety, communication about error, and communication openness, with married physicians scoring higher than unmarried ones.

Secondly, from a regional perspective, data analysis revealed significant differences in the scores for overall hospital patient safety culture and various dimensions among physicians from different geographic locations. Notably, physicians from the economically more developed eastern region of China reported significantly lower scores in overall patient safety and five

dimensions (teamwork, response to error, supervisor or clinical leader support for patient safety, communication openness, and reporting patient safety events) compared to their counterparts from the less economically developed western region. Findings from global patient safety culture surveys also indicated lower scores in economically disadvantaged regions, such as Sub-Saharan Africa (Alabdullah & Karwowski, 2024). This suggests that regional economic conditions and the allocation of healthcare resources may influence the status of patient safety culture in local healthcare institutions (Dong et al., 2022).

Moreover, survey participants with different professional characteristics exhibited significant differences in their patient safety culture scores. Physicians from different departments showed significant differences in median scores for staffing and work pace, as well as handoffs and information exchange. For instance, internal medicine physicians scored higher than surgeons, obstetricians, and pediatricians on staffing and work pace. However, obstetrics, pediatrics, and emergency department physicians reported higher median scores in handoffs and information exchange compared to internal medicine and surgery physicians.

In addition, physicians with different professional titles also exhibited statistical differences in scores for overall patient safety culture and the dimensions of communication about error, communication openness, reporting patient safety events, and handoffs and information exchange, with junior physicians scoring lower than those with intermediate or senior titles in overall patient safety culture and the dimensions of communication openness and reporting patient safety events. However, in the dimensions of response to error and handoffs and information exchange, senior physicians reported lower median scores than those with intermediate titles.

Furthermore, physicians with different daily working hours showed significant differences in scores for overall patient safety culture and the dimensions of staffing and work pace, response to error, supervisor or clinical leader support for patient safety, communication about error, communication openness, and reporting patient safety events, with those working 8-10 hours daily reporting higher patient safety culture scores.

Finally, tenure also affected patient safety culture scores, with physicians having less than 10 years of experience scoring lower in communication about error and communication openness compared to those with 10-20 years of experience.

The differences in patient safety culture scores among survey participants with different sociodemographic characteristics align with findings from previous similar studies. He et al. (2023) conducted research in Central China and also found that female participants, those with shorter overtime hours, and those with higher professional titles reported better patient safety

culture scores. Research by Ayisa et al. (2021) showed that divorced/widowed individuals and healthcare professionals from emergency and pediatrics departments reported lower patient safety culture scores. Doris et al. (2022) also highlighted that different specialties and tenures influenced patient safety culture scores.

In summary, demographic, professional, and regional characteristics all impact patient safety culture. These findings suggest that strategies for improving patient safety culture should be tailored to specific groups, and appropriate measures should be developed to enhance the patient safety culture atmosphere within organizations, ultimately improving healthcare service quality and reducing the occurrence of adverse medical events.

5.2 The current status and influencing factors of patient-centeredness self-efficacy among physicians in large tertiary hospitals in China

Self-efficacy plays a crucial role in influencing individuals' confidence in their ability to utilize professional skills to accomplish specific tasks. In the medical field, physicians' self-efficacy, particularly patient-centeredness self-efficacy, significantly impacts patient safety. It affects clinical decision-making, patient communication, and the reporting of medical errors.

5.2.1 The current status of patient-centeredness self-efficacy among physicians

In our study of physicians from 13 large tertiary hospitals in China, the median score for patient-centeredness self-efficacy was found to be 81.00. Given that the total possible score for patient-centeredness self-efficacy ranges from 0 to 108, this indicates that the participants' patient-centeredness self-efficacy levels are above the medium range. The median scores for the three dimensions "exploring the patient perspective", "sharing information and power", and "dealing with communicative challenges" were all 3, which are relatively high.

The relatively high patient-centeredness self-efficacy among this study's participants may be related to their professional background as frontline clinical physicians in large tertiary hospitals in China. In large hospitals, physicians typically have better access to continuing education opportunities and more options regarding medical equipment and pharmaceutical resources. These medical resources not only enhance treatment outcomes but also boost physicians' confidence in their professional skills, thereby increasing their self-efficacy. Our data further confirmed that physicians in large tertiary hospitals in China exhibit relatively strong patient-centeredness self-efficacy. Previous research suggested that enhancing

physicians' self-efficacy can increase their active participation in patient safety activities (X. Wang & Zhao, 2023). Our findings also indicate a close relationship between physicians' self-efficacy, patient safety culture, and patient safety behaviors.

5.2.2 Differences in patient-centeredness self-efficacy across different groups

Unlike the differences observed in patient safety culture scores, the analysis of data measuring patient-centeredness self-efficacy revealed no statistically significant differences based on demographic and professional characteristics such as gender, education level, department, whether the physician holds an administrative position, and daily working hours. However, significant differences in overall score for patient-centeredness self-efficacy and its dimensions were found in relation to age and marital status. Physicians aged over 30 reported higher median scores for patient-centeredness self-efficacy compared to those under 30, and married physicians reported higher scores than unmarried ones. The results are aligned with previous findings. For instance, Witkowski et al. (2024) also identified age and marital status as factors contributing to differences in self-efficacy.

Similar to the findings for patient safety culture, physicians with higher professional titles and longer tenure tended to have better patient-centeredness self-efficacy, with junior physicians and those with less than 10 years of experience reporting lower scores compared to their counterparts. This finding aligns with previous similar research, which indicated that accumulated professional experience can enhance technical professionals' self-efficacy (Thombs et al., 2024).

From a regional perspective, although the overall score for patient-centeredness self-efficacy did not show significant statistical differences, we observed that physicians in Eastern China reported higher median scores in the "exploring the patient perspective" dimension compared to physicians in other regions. This regional disparity may be linked to the better economic conditions and healthcare resource allocation in Eastern China (Dong et al., 2022).

5.3 The current status and analysis of differences in patient safety behavior among physicians in large tertiary hospitals in China

In medical practice, physicians' behaviors related to patient safety—such as adherence to hand hygiene, proper medication use, effective communication, and timely reporting of adverse events—are critical for preventing medical errors and adverse outcomes, ensuring patient safety.

The assessment of physicians' patient safety behavior is considered an important measure to improve their safety behavior. In this study, the overall score of the patient safety behavior among the participants was 51, indicating that physicians from large tertiary hospitals across different regions of China exhibit relatively good patient safety behaviors.

5.3.1 Measurement of patient safety behaviors among physicians

One of the classic theories in safety behavior research, the domino theory of accident causation, posits that unsafe incidents result from a chain reaction of related factors, with the personnel's unsafe behaviors being the key trigger. Therefore, in patient safety management, improving physicians' patient safety behavior is a crucial focus. A core goal of safety culture is to cultivate and sustain employees' adherence to safety behaviors to prevent unsafe incidents. Measuring safety behaviors is a critical step in identifying safety risks and improving adherence to safety protocols.

For this study, we used a patient safety behavior questionnaire to assess the patient safety behavior of physicians from 13 large tertiary hospitals in China. Our findings indicated that participants generally demonstrated good patient safety behaviors, with a median score of 51, placing them above the medium range. The median scores for all ten items in the questionnaire were 5 or higher, with Item 2, "I strive for ensuring safety on the job", having a median score of 6. These results confirm that physicians in large tertiary hospitals across different regions of China exhibit strong patient safety behaviors. Furthermore, our findings suggest a strong connection between good patient safety behaviors and high scores of patient safety culture and patient-centeredness self-efficacy. That is in line with previous findings, as Berdida (2024) also suggested that healthcare professionals' self-efficacy is related to their patient safety behavior.

5.3.2 Differences in patient safety behaviors across different groups

Although the overall score indicated that the patient safety behavior of the survey participants is relatively good, differences were also observed among physician groups with different characteristics. Regarding the demographic characteristics, male, unmarried, and physicians aged 30 or below scored significantly lower in patient safety behavior compared to female, married, and physicians aged 40-61. Similar to the results of patient-centeredness self-efficacy, physicians with junior titles and less than 10 years of tenure scored lower in patient safety behavior compared to other physician groups. In contrast to the scores for patient safety culture and patient-centeredness self-efficacy, we found that physicians from the eastern region of

China had an overall score of 53 in patient safety behavior. While this is slightly higher than the overall score of 51 for physicians from Central and Western China, the differences were not statistically significant.

5.4 The relationship among patient safety culture, patient-centeredness self-efficacy, and patient safety behavior

5.4.1 Significant positive correlation between patient safety culture, patient-centeredness self-efficacy, and patient safety behavior

Patient safety culture, as one of the most important organizational cultures in the medical field, is considered a significant influencing factor for medical safety, particularly for patient safety behavior (Churruca et al., 2021). Constructing a strong patient safety culture can improve overall hospital performance and patient satisfaction (X. Wang & Zhao, 2023). Patient safety culture is regarded as the external environment and force that influences healthcare professionals' safe medical behaviors for patients (S. Weaver et al., 2013). On the other hand, patient-centeredness self-efficacy is viewed as the intrinsic driving force for healthcare professionals to offer higher quality, safer, and more satisfying patient-centered medical services. At the same time, a positive patient safety culture within the organization is believed to foster the positive development of physicians' self-efficacy (Rahmani et al., 2023). Numeral studies have also found that healthcare professionals' self-efficacy can, in turn, foster the improvement of patient safety culture within organizations (Katz-Navon et al., 2007; Rahmani et al., 2023).

Through the correlation analysis of our research data, we found that the overall scores of patient safety culture, patient-centeredness self-efficacy, and patient safety behavior all showed significant positive correlations. We also constructed a structural equation model (SEM) to analyze the relationships between patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. The path analysis diagram of this model confirmed our hypotheses proposed in the earlier stages of the study, as follows: H1 "Patient safety culture has a significant positive impact on physicians' patient-centeredness self-efficacy"; H2 "Physicians' patient-centeredness self-efficacy has a significant positive impact on their patient safety behavior"; H3 "Patient safety culture has a significant positive impact on physicians' patient safety behavior".

Therefore, it is recommended that policymakers promote healthcare professionals' self-efficacy by formulating supportive programs and providing a positive practice environment, namely a higher-quality organizational patient safety culture atmosphere, to deliver better healthcare services and foster the positive development of patient safety behaviors.

5.4.2 Mediation of patient-centeredness self-efficacy between patient safety culture and patient safety behavior

Katz-Navon et al. (2007) suggested that self-efficacy may influence patient safety behavior through mediators, for example, physicians' self-efficacy may affect their perception of patient safety culture, which in turn impacts their safety behavior. Based on the proposed hypotheses in this study, we used the bias-corrected nonparametric percentile Bootstrap method with 5000 random samples to test for the mediation effect of patient-centeredness self-efficacy in the relationship between patient safety culture and patient safety behavior. If the 95% confidence interval (CI) does not include 0, it indicates the existence of corresponding direct, indirect, and total effects. In this study, the 95% CI for the direct effect, indirect effect, and total effect did not include 0, indicating that both the direct effect and the indirect effect of patient-centeredness self-efficacy in the relationship between patient safety culture and patient safety behavior were statistically significant. The estimate for the indirect effect in the mediation model was 0.405, the estimate for the direct effect was 0.127, and that for the total effect was 0.532, with the indirect effect accounting for 76.13% of the total effect. Therefore, H4 "Patient-centeredness self-efficacy mediates the relationship between patient safety culture in healthcare institutions and physicians' patient safety behavior" is supported. Based on our data analysis results and supported by the literature, we propose that the impact of patient safety culture on physicians' patient safety behavior includes both a direct path, "patient safety culture → patient safety behavior", and a path mediated by patient-centeredness self-efficacy, "patient safety culture → patient-centeredness self-efficacy → patient safety behavior".

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Chapter 6: Conclusions

The main objective of this chapter is to present the key findings from this research, primarily summarizing the influence of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behavior, as well as the relationships between these three. This chapter aims to provide a theoretical foundation for the development of support policies and measures to promote safer and higher-quality healthcare services.

We conducted a cross-sectional survey of physicians from 13 large tertiary hospitals in Eastern, Central, and Western China. Using extensively validated and well-established scales, we measured the patient safety culture, the participants' patient-centeredness self-efficacy, and their patient safety behavior. Subsequently, we built a structural equation model (SEM) to analyze the impact of patient safety culture and patient-centeredness self-efficacy on patient safety behavior, and to test our research hypotheses.

Moreover, this chapter will discuss the contributions of this research to the existing theoretical framework. Against the backdrop of global challenges in patient safety, our research provides multiple perspectives and recommendations for establishing a better organizational safety culture, guiding the physician community toward improved patient-centeredness self-efficacy, and promoting better patient safety behaviors.

Additionally, the chapter offers practical recommendations based on the research findings to address patient safety management challenges in China. These recommendations aim to assist healthcare system administrators in developing more effective strategies to support patient safety, reduce the occurrence of adverse medical events, and decrease both the national and individual disease burdens. Finally, this chapter will discuss the limitations of the research and propose potential directions for future research.

6.1 Key research findings

Patient safety is a crucial issue in hospital management, and the medical practices of physicians are key factors in the occurrence of adverse medical events. Physicians' patient safety behaviors are influenced not only by individual factors such as age, gender, marital status, and tenure but also by external factors such as work environment and geographic location. This study aims to explore the factors influencing physicians' patient safety behavior from the perspectives of

patient safety culture and patient-centeredness self-efficacy and to seek effective strategies to improve physicians' patient safety behaviors, thereby reducing adverse medical events.

Through an extensive literature review, this study is grounded in social cognitive theory and the person-situation interaction theory. It employed the triadic reciprocal determinism (TRD) model to construct a theoretical framework exploring the relationships among patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. We also incorporated patient-centeredness self-efficacy as a mediator in this model to examine the mechanism by which physicians' perception of patient safety culture influences their safety practices.

Given the current global and China's challenges in patient safety, we proposed research questions and hypotheses. A survey was conducted among frontline clinical physicians from 13 large tertiary hospitals in Eastern, Central, and Western China, yielding 635 valid responses. The research model and hypotheses were tested empirically through statistical analysis and SEM, leading to the following key findings:

(1) Scores of patient safety culture, patient-centeredness self-efficacy, and patient safety behavior

Physicians from large tertiary hospitals in China generally reported high scores in organizational patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. However, these scores were closely related to both personal factors and external environmental factors. In the assessment of patient safety culture, the dimensions of teamwork and organizational learning–continuous improvement were identified as strengths, while reporting patient safety events, response to error, and staffing and work pace were found to be areas that need improvement. Additionally, demographic characteristics such as gender, age, and marital status, along with professional characteristics such as professional title, daily working hours, and tenure, as well as geographic location, influenced patient safety culture scores. Physicians who were female, over 30 years old, married, held senior titles, had more than 10 years of experience, and were working in economically advantegeous eastern regions with rich medical resources scored higher in patient safety culture.

In the assessment of patient safety behavior, differences were also observed among physicians with varying characteristics. Gender, age, marital status, professional title, and tenure significantly influenced patient safety behavior scores. Specifically, male, unmarried, and physicians under 30 years old reported lower scores in patient safety behavior compared to their female, married, and 40–61-year-old counterparts. Junior physicians and those with less

than 10 years of tenure also reported lower patient safety behavior scores compared to their counterparts.

(2) Research hypotheses testing

Based on a literature review and the theoretical framework, this study proposed four hypotheses: H1 "Patient safety culture has a significant positive impact on physicians' patient-centeredness self-efficacy"; H2 "Physicians' patient-centeredness self-efficacy has a significant positive impact on their patient safety behavior"; H3 "Patient safety culture has a significant positive impact on physicians' patient safety behavior"; H4 "Patient-centeredness self-efficacy mediates the relationship between patient safety culture in healthcare institutions and physicians' patient safety behavior".

Then, we empirically tested each hypothesis. Correlation analysis showed significant positive relationships among patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. SEM and path analysis results indicated that patient safety culture had a significant positive effect on patient-centeredness self-efficacy ($\beta = 0.581$, $p < 0.001$), supporting H1; patient-centeredness self-efficacy significantly positively affected patient safety behavior ($\beta = 0.697$, $p < 0.001$), supporting H2; and patient safety culture had a significant positive impact on patient safety behavior ($\beta = 0.127$, $p < 0.001$), supporting H3. Furthermore, in analyzing the influence mechanisms of patient safety culture and patient-centeredness self-efficacy on patient safety behaviors, both a direct path (patient safety culture → patient safety behavior) and a mediated path (patient safety culture → patient-centeredness self-efficacy → patient safety behavior) were identified, confirming that patient-centeredness self-efficacy partially mediated the relationship between patient safety culture and physicians' patient safety behavior, thereby supporting H4.

In conclusion, this study, based on social cognitive theory and person-situation interaction theory, adopted the TRD model and empirically validated the proposed hypotheses. The findings not only provide empirical support for the influence of patient safety culture and patient-centeredness self-efficacy on patient safety behavior but also offer new perspectives and directions for future research. By gaining a deeper understanding of the factors affecting clinical physicians' patient safety behavior, this study provides theoretical insights into patient safety, thereby promoting high-quality safety development in hospitals.

6.2 Theoretical contributions

This study focuses on physicians working in large, tertiary public hospitals in China, aiming to deeply examine the relationships between patient safety culture, patient-centeredness self-efficacy, and patient safety behavior. Its theoretical contributions are two folds: First, by focusing on the impact of patient safety culture on physicians' patient safety behavior, this study validated the social cognitive theory. As the key agents in patient safety, physicians can improve their self-efficacy and patient safety behaviors under the influence of an organizational patient safety culture. Through empirical research, this study provides new evidence supporting this view.

Second, the study confirmed the mediating effect of patient-centeredness self-efficacy in the relationship between patient safety culture and physicians' patient safety behavior. This finding further validated the perspective of the person-situation interaction theory, which posits that individual behavior is shaped by the interaction between individual traits and external contexts. Organizational culture influences self-efficacy and, subsequently, individual behavior, while self-efficacy also exerts a reciprocal influence on the organizational culture, mediating its effect on individual behavior.

Finally, within the unique economic and cultural context of China, this study conducted a cross-cultural validation of social cognitive theory and person-situation interaction theory. By accounting for the distinctiveness of China's social environment and the unique characteristics of healthcare professionals in large public hospitals, this research not only enriched the existing theoretical framework but also laid a solid foundation for the localized application of social cognitive theory and person-situation interaction theory in the medical field in China.

6.3 Management recommendations

Patient safety is one of the most frequently discussed topics in healthcare management. This study explored the relationship between patient safety culture, patient-centeredness self-efficacy, and physicians' patient safety behavior through a questionnaire survey conducted among physicians from 13 large tertiary hospitals across different regions of China. Based on empirical analysis results, we propose several recommendations for patient safety management in large public hospitals, aiming to contribute to fostering patient safety and high-quality development of these hospitals.

6.3.1 Regular assessment of patient safety culture, timely improvements and adjustments, and the cultivation of a non-punitive culture

Patient safety culture is a core element in ensuring the quality of healthcare services and protecting patients' health rights. In the healthcare industry, organizational culture—especially patient safety culture—plays a crucial role in maintaining medical safety. Our empirical analysis revealed that patient safety culture within hospitals is one of the key factors influencing medical safety. Therefore, enhancing patient safety culture is an important measure for improving patient safety levels. Conducting regular assessments of patient safety culture to identify areas of weakness, implementing targeted corrective actions, and introducing relevant preventive measures are essential approaches to strengthening patient safety culture in healthcare institutions.

This study found that while the overall patient safety culture score in the surveyed large tertiary hospitals in China falls within the upper-middle range, certain areas still require improvement. Specifically, reporting patient safety events, responses to error, and staffing and work pace all showed positive response rates below 50%, indicating room for improvement in these aspects. Based on our findings, we propose the following management recommendations:

(1) Regular assessments of patient safety culture

Healthcare institutions and departments should select appropriate patient safety culture measurement tools based on their specific conditions and conduct regular assessments of the medical environment to identify strengths and weaknesses. Best practices from high-performing areas should be standardized, systematized, and institutionalized. For weaker areas, healthcare institutions should further investigate underlying causes and implement targeted interventions. Additionally, they can learn from other healthcare institutions' successful experiences in handling similar challenges and refine their internal structures, workflows, and preventive measures. These efforts will contribute to the continuous improvement of patient safety culture within the organization, ultimately ensuring patient safety.

(2) Adequate human resource reserves and reasonable workload allocation to prevent fatigue

A shortage of permanent personnel in departments and units can lead to excessively long working hours, increasing the likelihood of fatigue-related errors and adverse medical events. Therefore, hospitals' human resource management should assess each department's workload and determine the necessary staffing levels accordingly. A well-balanced workforce, with a reasonable mix of experience and expertise, should be established. Staff scheduling and rest

periods should be appropriately arranged to alleviate workload pressure and prevent fatigue, thereby ensuring patient safety.

(3) Regular report on patient safety incidents and cultivation of a just and non-punitive culture

Reporting patient safety incidents and responding to errors remain weak aspects of patient safety culture in many healthcare institutions worldwide, particularly in East Asia. The primary reason is that employees fear punitive consequences after reporting safety incidents or medical errors. A just culture is a fundamental aspect of patient safety culture. Healthcare institutions should establish a blame-free environment that encourages employees to report adverse events without fear of punishment, thereby improving patient safety incident reporting and error responses.

To achieve this, healthcare institutions are advised to hold regular patient safety incident review meetings, focusing on three key aspects:

1) Analyzing the causes of reported adverse medical events and identifying subsequent corrective actions;

2) Encouraging all employees to participate in discussions, share their perspectives, and learn from mistakes;

3) Addressing adverse events by improving processes and management systems rather than blaming individuals involved.

Regularly holding such meetings will ensure that all members are aware of the adverse events within the organization, enabling them to learn from past mistakes and prevent similar errors. It will also help them understand how the organization handles reported patient safety events, particularly the measures taken regarding those directly involved.

Promoting a non-punitive culture within the organization will help physicians feel like valued team members who can rely on team support when facing challenges. This, in turn, will encourage proactive feedback in case of medical errors, without fear of being personally blamed. Eventually, more effective communication and increased error reporting can help prevent severe medical errors and adverse events. These measures not only improve the reporting rate of patient safety events and the responsiveness to errors but also enhance physicians' sense of identification with the organization's patient safety culture.

6.3.2 Strengthening professional and interprofessional training to enhance physicians' patient-centeredness self-efficacy

This study found that physicians in Eastern China scored significantly higher in the "exploring the patient perspective" dimension of patient-centeredness self-efficacy compared to those in other regions. The cultural and economic levels in Eastern China are notably higher than those in central and western regions. A stronger ability to identify patient needs suggests that physicians possess greater empathy, communication skills, and humanistic qualities.

Additionally, we observed that clinical physicians with longer tenure, older age, and higher professional titles tend to have higher patient-centeredness self-efficacy scores. Direct personal experience is the most crucial factor in developing self-efficacy. Since medicine is an experience-based discipline, an older age generally corresponds to more work experience and accumulation of direct experience, which, in turn, lead to stronger self-efficacy. Beyond direct experience, vicarious experience—gained by observing others' behaviors and their outcomes—also plays a significant role in shaping self-efficacy. Furthermore, encouragement, advice, guidance, and implicit cues from others can contribute to enhancing an individual's self-efficacy. Given these findings, strengthening both professional and interprofessional training is essential for improving physicians' patient-centeredness self-efficacy. Encouraging active participation in training programs, particularly those focusing on empathy, communication, and interdisciplinary collaboration, can help physicians develop a deeper understanding of patient needs and enhance their confidence in patient-centered care. Based on our findings and the analysis of relevant factors, we propose the following specific management measures to improve physicians' patient-centeredness self-efficacy:

(1) Improving humanistic education and physician-patient communication skills

A strong foundation in humanistic literacy fosters greater empathy. Hospital management can implement training programs for physicians focused on humanistic education and physician-patient communication skills, covering areas such as active listening, empathetic expression, and non-verbal communication. Additionally, simulated patient scenarios can be incorporated into training to allow physicians to practice communication techniques in real-life situations while receiving professional feedback and guidance.

(2) Providing more opportunities for young physicians to gain vicarious experience

Hospitals and departments can regularly organize discussions on complex cases within their specialties and encourage senior physicians to share their diagnostic and treatment experiences. Additionally, young physicians should be given more opportunities to attend academic

conferences, receive training at higher-level hospitals, and participate in professional exchanges. These experiences can serve as valuable sources of vicarious learning, ultimately enhancing their patient-centeredness self-efficacy.

(3) Offering up-to-date training on digital and AI-driven medical technologies

With the rapid advancement of artificial intelligence and digital healthcare, it is crucial to provide medical professionals with sufficient training in digital medical technologies. By mastering these technologies, physicians can gain broader access to the latest medical knowledge, cutting-edge treatments, and advanced healthcare concepts. This exposure not only enhances physicians' vicarious experience but also allows them to directly engage with AI-assisted diagnostics, further strengthening their self-efficacy. Moreover, proficiency in digital health tools enables physicians and patients to effectively use electronic health management applications, which can improve their communication and enhance physician-patient relationships, ultimately leading to better disease outcomes. Positive feedback from patients, in turn, further reinforces physicians' patient-centeredness self-efficacy.

(4) Encouraging and rewarding patient-centered medical practices

Hospital and department management should actively recognize, encourage, and reward physicians who demonstrate patient-centered medical practices in their clinical work. Establishing role models who exemplify patient-centered care can further reinforce positive behaviors within the organization. By fostering a culture that values patient-centered care, medical institutions can inspire healthcare professionals to adopt these practices, thereby enhancing their overall patient-centeredness self-efficacy.

Generally speaking, providing healthcare professionals with diverse opportunities for professional and interprofessional training not only enhances their technical skills but also improves patient outcomes and safety behaviors. By increasing direct and vicarious experiences, these initiatives can significantly strengthen physicians' patient-centeredness self-efficacy, contributing to a more robust patient safety culture. In turn, these efforts will lead to a higher quality, safer, and more patient-centered healthcare experience, driving the sustainable development of the medical industry.

6.3.3 Enhancing patient safety in regions with limited economic and healthcare resources

Multiple studies have confirmed that in regions with disadvantaged economic conditions and inadequate healthcare resource allocation, patient safety issues require greater attention and support compared to areas with better economic conditions and more abundant social and healthcare resources. Medical institutions in economically underdeveloped regions often face

challenges such as insufficient medical equipment, unstable drug supplies, and shortages of healthcare professionals. The lack of these resources directly impacts the quality and safety of medical services. Additionally, weak infrastructure and the absence of modern medical facilities and digital management systems lead to unstandardized medical procedures and inefficient information transmission, increasing the risk of human-induced medical errors. Lastly, limited financial resources restrict training opportunities for healthcare professionals, resulting in insufficient awareness and practice of patient safety culture, making it difficult to effectively implement patient safety management measures.

This study also found that the respondents from Western China, an economically underdeveloped region, reported significantly lower overall patient safety scores, particularly in five dimensions: teamwork, response to error, supervisor or clinical leader support for patient safety, communication openness, and reporting patient safety events. Based on these findings, we propose the following management recommendations:

(1) Improving healthcare workforce allocation in underdeveloped regions

A well-trained healthcare workforce is one of the core elements of ensuring patient safety. Optimizing healthcare workforce distribution and enhancing professional competence can effectively reduce adverse medical events and improve patient safety levels. Additionally, encouraging the redistribution of high-quality medical resources is a crucial strategy for strengthening patient safety in resource-limited areas. Measures such as establishing medical alliances, developing expert medical teams for long-term stationing, and providing standardized clinical training for grassroots physicians can help elevate local medical standards and improve patient safety.

(2) Providing advanced medical equipment and digital healthcare systems

Investing in medical equipment and healthcare information systems can significantly enhance service safety and efficiency. For instance, implementing data-sharing management platforms for medical devices enables real-time data collection and digital management. These measures can reduce errors caused by manual data entry, lower human-induced risks, and improve internal communication and data security within medical institutions, ultimately enhancing patient safety. Additionally, digital tools can facilitate telemedicine consultations and remote surgical guidance with higher-level hospitals, thereby improving diagnostic and treatment quality, enhancing physician-patient relationships, and ensuring better clinical outcomes.

In summary, improving human resources, upgrading medical equipment and digital systems, and redistributing high-quality resources could significantly enhance patient safety in

underdeveloped regions. We recommend that healthcare authorities introduce targeted policies to address patient safety challenges in economically disadvantaged areas.

6.3.4 Tailoring support strategies for healthcare professionals based on demographic and occupational characteristics

Our study, based on a systematic empirical analysis, revealed significant differences in physicians' perceptions of patient safety culture, patient-centeredness self-efficacy, and patient safety behavior, across different demographic and occupational groups. This suggests that management should carefully consider the specific needs of different groups when formulating policies and support measures.

Specifically, younger healthcare professionals may be more receptive to new patient safety concepts but may struggle with implementation due to limited experience. In contrast, senior professionals, despite their extensive experience, may be less open to adopting new technologies and approaches. Additionally, healthcare professionals from different departments exhibit varied patient safety behaviors due to variations in job nature and professional background. For instance, healthcare professionals of emergency department may prioritize rapid response and crisis management, whereas those from internal medicine department may focus more on long-term care and detailed oversight.

Therefore, we recommend that hospital management tailors patient safety policies and support measures to the specific needs of different healthcare professional groups. Based on our findings, we propose the following management recommendations:

(1) Implement differentiated training strategies for healthcare professionals of different age groups

For younger professionals, training should emphasize practical skills (e.g., empathy, doctor-patient communication) and professional experience sharing to help them quickly enhance their patient safety competencies. For senior professional, training should focus on updating their knowledge on new technologies, such as the use of electronic medical information systems and AI-assisted diagnostic tools, encouraging them to adopt and integrate modern medical and communication methods.

(2) Develop personalized workflows, patient safety standards, and support strategies

Tailoring work processes and safety protocols to different medical roles can help prevent adverse medical events more effectively. For nurses, training and supervision should focus on ensuring adherence to safe nursing practices. For physicians, emphasis should be placed on optimizing the use of clinical decision support systems. Additionally, different specialties

require varied patient safety strategies. For example, in obstetrics, pediatrics, and emergency medicine, ensuring adequate staffing is crucial to prevent excessively long work hours. These departments also require specialized training in managing acute illnesses and medical emergencies. For internal medicine and surgery, however, efforts should focus on improving shift handovers, standardizing information transfer, and enhancing professional training in critical care, advanced treatment concepts, and latest surgical techniques.

(3) Promote interdisciplinary medical collaboration, referral systems, and consultations within the same region or organization

Interdisciplinary collaboration and resource sharing not only provide patients with more accessible medical services and reduce disease burdens but also enhance the overall medical capabilities and patient safety standards within a region or healthcare institution.

By adopting differentiated strategies and targeted support measures, healthcare professionals can develop a stronger sense of patient-centeredness self-efficacy and improve patient safety behaviors. At the same time, these strategies and measures contribute to fostering a stronger patient safety culture within the medical institution and region, ultimately improving healthcare quality and patient safety.

6.3.5 Implementation challenges

Based on our research findings, we have proposed management recommendations as detailed above. However, their implementation may encounter several challenges. 1) Fostering a just and non-punitive culture presents difficulties. Global studies on patient safety culture, particularly in Southeast Asia, have indicated that non-punitive practices require further improvement. This challenge may stem from the close connection between patient safety culture and regional cultural norms. In many cultures, errors are traditionally met with punishment, making it difficult for healthcare institutions to promote a non-punitive approach. 2) Providing targeted professional and interdisciplinary training for healthcare professionals requires substantial financial support and dedicated work hours from them. In regions where medical funding and human resources are already limited, implementation of these strategies may be challenging without additional support from health authorities. 3) Interdisciplinary and inter-organizational collaboration, as well as the equitable distribution of high-quality medical resources to underserved areas, requires coordination at the regional and even national levels. Effective implementation of these measures depends on the involvement of health authorities in policymaking and resource allocation.

6.4 Limitations of the research

This study aims to explore the influence of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behavior by employing a quantitative research approach to reveal statistical relationships between them. However, certain limitations are inherent in the design and execution of the study, primarily in the following three aspects.

First, regarding the source of sample data, this study relied on self-reported survey questionnaires, which might have introduced subjective biases into the data.

Second, regarding the mediating effect in the relationship between patient safety culture and patient safety behavior, this study only considered patient-centeredness self-efficacy as a mediator. However, other factors may also mediate the relationship between patient safety culture and patient safety behavior. Future research is recommended to explore patients' behaviors or other organizational factors to uncover the mechanisms driving patient safety behavior.

Third, the study population is limited to physicians from large tertiary hospitals in China, with a limited scope of research. This may restrict the generalizability of the findings, as the results might not fully represent the situation in all Chinese hospitals, particularly in secondary or primary healthcare settings. Future research could expand the research scope by including a broader range of healthcare institutions, encompassing hospitals of varying levels and sizes, as well as healthcare professionals with diverse professional backgrounds. Moreover, a larger sample size would improve the universality and generalizability of the findings.

Finally, there are methodological limitations related to the cross-sectional nature of the survey. Causal relationships between variables should be examined through longitudinal studies. While this study revealed correlations through cross-sectional quantitative analysis, it did not delve deeply into the behaviors, attitudes, and perspectives of the participants, nor did it reveal the essence and underlying mechanisms of the issues. Providing health management administrators with a more comprehensive perspective to understand these problems remains an area for further exploration.

6.5 Future outlook

Building on the limitations identified in this study, we plan to further explore the following three areas in future research to enhance the breadth and depth of the findings: First, the diversity of samples is critical for the generalizability of research results. Future studies could

thus extend to a broader range of healthcare institutions, particularly facilities at various levels, including primary healthcare institutions, to ensure that findings are applicable to organizations of all types and sizes. Moreover, future research can include healthcare institutions with different cultural contexts to investigate the impact of patient safety culture and patient-centeredness self-efficacy on patient safety in both public and private hospitals in China. This will improve the transferability of the research findings.

Second, prospective interventional longitudinal studies can be utilized in future research. With programs implemented to improve the organizational safety culture and support the self-efficacy of healthcare professionals, longitudinal study designs will allow for multiple rounds of data collection. These will track changes in the measurements of patient safety culture, patient-centeredness self-efficacy, and patient safety behavior among healthcare professionals before and after interventions. This approach will provide more comprehensive data, improve data stability and reliability, enhance the accuracy of trend analyses, and increase sensitivity to changes. It will also strengthen statistical inference and enable a more precise understanding of the dynamic processes underlying the phenomena studied, leading to more reliable conclusions and theoretical frameworks.

Third, to gain deeper insights into healthcare professionals' genuine feelings and responses to organizational patient safety culture, future research could incorporate qualitative approaches, such as in-depth interviews and focus group discussions. These approaches would complement the limitations of quantitative data and offer richer, more nuanced information, contributing to a more comprehensive analytic framework. Additionally, future studies could further explore the specific needs of different demographic groups in patient safety culture practices, providing a more scientific basis for healthcare institutions' management decision-making.

By pursuing these three directions, future research can deliver more profound and comprehensive insights and offer effective strategies for healthcare institutions to enhance patient safety, improve patient satisfaction, and reduce the occurrence of adverse medical events. We hope that these efforts will contribute to advancing academic research in the field of patient safety and provide valuable theoretical guidance for clinical practice aimed at safeguarding patients.

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Annex A: Questionnaire

Questionnaire on the Effect of Patient Safety Culture and Patient-Centeredness Self-Efficacy of Physicians' Patient Safety Behavior

Dear Mr/Mrs,

Thank you very much for participating in the questionnaire survey on the effect of patient safety culture and patient-centeredness self-efficacy on physicians' patient safety behavior. The data collected will be kept strictly confidential and used only for academic research. Please feel free to answer all questions based on your experience and true feelings. There are no right or wrong answers to the questions in this questionnaire. Please choose the options that best represent your views. Thank you for your support and cooperation!

Part 1 Basic information

1.Gender: ①Male ②Female

2. Age: _____ (year)

3.Marital status: ① Married ② Unmarried ③ Divorced ④ Widowhood

4.Education level: ① College or below ② Bachelor ③ Master ④ Doctorate

5.Professional title: ① Junior ② Intermediate ③ Associate senior ④ Senior

6.Position: ① Middle-level manager or above ② General professional

7. Average daily working hours：① < 8 hours ② 8 ~ < 10 hours ③ 10 ~ < 12 hours ④ > 12 hours

8.The level of your hospital：① Level 3A hospital ② Level 3B hospital ③ Level 3 unclassified hospital ④ Level 2A hospital ⑤ Level 2B hospital ⑥ Level 2 unclassified hospital ⑦ Level 1 hospital ⑧Other levels or unrated

9. Tenure: _____ (year)

Part 2 Hospital Survey on Patient Safety (HSOPSC)

Instructions:

1. This survey asks for your opinions about patient safety issues, medical error, and event reporting in your hospital

2. If you do not wish to answer a question, or if a question does not apply to you, you may leave your answer blank.

3. An "event" is defined as any type of error, mistake, incident, accident, or deviation, regardless of whether or not it results in patient harm.

4. "Patient safety" is defined as the avoidance and prevention of patient injuries or adverse events resulting from the processes of health care delivery.

In this survey, think of your "unit" as the work area, department, or clinical area of the hospital where you spend most of your work time or provide most of your clinical services.

What is your primary work area or unit in this hospital? Select ONE answer.

☐ a. Many different hospital units/No specific unit

☐ b. Medicine (non-surgical) ☐ h. Psychiatry/mental health ☐ n. Other, please specify:

☐ c. Surgery ☐ i. Rehabilitation

☐ d. Obstetrics ☐ j. Pharmacy

☐ e. Pediatrics ☐ k. Laboratory

☐ f. Emergency department ☐ l. Radiology

☐ g. Intensive care unit (any type) ☐ m. Anesthesiology

1.Teamwork

Please indicate your agreement or disagreement with the following statements about your work area/unit.

Think about your teamwork

	Item	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree	Does Not Apply or Don not Know
1	In this unit, we work together as an effective team.	1	2	3	4	5	9
2	During busy times, staff in this unit help each other.	1	2	3	4	5	9
3	There is a problem with disrespectful behavior by those working in this unit. (reversed)	1	2	3	4	5	9

2.Staffing and Work Pace

Please indicate your agreement or disagreement with the following statements about your work area/unit.

	Item	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree	Does Not Apply or Do Not Know
1	In this unit, we have enough staff to handle the workload.	1	2	3	4	5	9
2	Staff in this unit work longer hours than is best for patient care. (reversed)	1	2	3	4	5	9
3	This unit relies too much on temporary, float, or PRN staff. (reversed)	1	2	3	4	5	9
4	The work pace in this unit is so rushed that it negatively affects patient safety. (reversed)	1	2	3	4	5	9

3.Organizational Learning—Continuous Improvement

Please indicate your agreement or disagreement with the following statements about your work area/unit.

	Item	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree	Does Not Apply or Do Not Know
1	This unit regularly reviews work processes to determine if changes are needed to improve patient safety.	1	2	3	4	5	9
2	In this unit, changes to improve patient safety are evaluated to see how well they worked.	1	2	3	4	5	9
3	This unit lets the same patient safety problems keep happening. (reversed)	1	2	3	4	5	9

4. Response to Error

Please indicate your agreement or disagreement with the following statements about your work area/unit.

	Item	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree	Does Not Apply or Do Not Know

1	In this unit, staff feel like their mistakes are held against them. (reversed)	1	2	3	4	5	9
2	When an event is reported in this unit, it feels like the person is being written up, not the problem. (reversed)	1	2	3	4	5	9
3	When staff make errors, this unit focuses on learning rather than blaming individuals.	1	2	3	4	5	9
4	In this unit, there is a lack of support for staff involved in patient safety errors. (reversed)	1	2	3	4	5	9

5. Supervisor or Clinical Leader Support for Patient Safety

Please indicate your agreement or disagreement with the following statements about your immediate supervisor/manager or person to whom you directly report.

	Item	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree	Does Not Apply or Do Not Know
1	My supervisor or clinical leader seriously considers staff suggestions for improving patient safety.	1	2	3	4	5	9
2	My supervisor or clinical leader wants us to work faster during busy times, even if it means taking shortcuts. (reversed)	1	2	3	4	5	9
3	My supervisor or clinical leader takes action to address patient safety concerns that are brought to their attention.	1	2	3	4	5	9

6. Communication About Error

Please indicate your agreement or disagreement with the following statements about your work area/unit.

	Item	Never	Rarely	Sometimes	Most of the time	Always	Does Not Apply or Do Not Know

1	We are informed about errors that happen in this unit.	1	2	3	4	5	9
2	When errors happen in this unit, we discuss ways to prevent them from happening again.	1	2	3	4	5	9
3	In this unit, we are informed about changes that are made based on event reports.	1	2	3	4	5	9

7. Communication Openness

Please indicate your agreement or disagreement with the following statements about your work area/unit.

	Item	Never	Rarely	Sometimes	Most of the time	Always	Does Not Apply or Do Not Know
1	In this unit, staff speak up if they see something that may negatively affect patient care.	1	2	3	4	5	9
2	When staff in this unit see someone with more authority doing something unsafe for patients, they speak up.	1	2	3	4	5	9
3	When staff in this unit speak up, those with more authority are open to their patient safety concerns.	1	2	3	4	5	9
4	In this unit, staff are afraid to ask questions when something does not seem right. (reversed)	1	2	3	4	5	9

8. Reporting Patient Safety Events

Please indicate your agreement or disagreement with the following statements about your work area/unit.

	Item	Never	Rarely	Sometimes	Most of the time	Always	Does Not Apply or Do Not Know
1	When a mistake is caught and corrected before reaching the patient, how often is this reported?	1	2	3	4	5	9

2	When a mistake reaches the patient and could have harmed the patient, but did not, how often is this reported?	1	2	3	4	5	9

9. Hospital Management Support for Patient Safety

Please indicate your agreement or disagreement with the following statements about your work area/unit.

	Item	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree	Does Not Apply or Do Not Know
1	The actions of hospital management show that patient safety is a top priority.	1	2	3	4	5	9
2	Hospital management provides adequate resources to improve patient safety.	1	2	3	4	5	9
3	Hospital management seems interested in patient safety only after an adverse event happens. (reversed)	1	2	3	4	5	9

10. Handoffs and Information Exchange

Please indicate your agreement or disagreement with the following statements about your work area/unit

	Item	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly agree	Does Not Apply or Do Not Know
1	When transferring patients from one unit to another, important information is often left out.(reversed)	1	2	3	4	5	9
2	During shift changes, important patient care information is often left out. (reversed)	1	2	3	4	5	9
3	During shift changes, there is adequate time to exchange all key patient care information.	1	2	3	4	5	9

11. Number of Events Reported

(None, 1 to 2, 3 to 5, 6 to 10, 11 or more)

In the past 12 months, how many event reports have you filled out and submitted?

☐ a. No event reports

☐ b. 1 to 2 event reports

☐ c. 3 to 5 event reports

☐ d. 6 to 10 event reports

☐ e. 11 or more

12. Patient Safety Rating

(Poor, Fair, Good, Very Good, Excellent)

How would you rate your unit/work area on patient safety?

A Excellent

B Very Good

C Good

D Fair

E Poor

Part 3：The Self-Efficacy in Patient Centeredness Questionnaire (SEPCQ-27)

Instructions:

In the following, a number of statements describing different aspects of how physicians and medical students can relate to and communicate with patients are presented.

Please read each statement carefully and judge how confident you are in your ability to relate to and communicate with patients in the manner described in the statement. Please answer all questions and provide your best assessment of how confident you are that you will be able to behave in the way described in the statement. Please answer as honestly and sincerely as possible.

Remember that each question must be answered based on how confident you are that you will be able to make the patient experience the particular behavior - not the extent to which you would like to be able to engage in the behavioral.

	Items: I am confident that I am able to...	Totally disagree	Disagree	Partially disagree	Agree	Completely Agree
1	Make the patient feel that I am genuinely interested in knowing what he/she thinks about his/her situation	0	1	2	3	4

2	Make the patient feel that I have time to listen	0	1	2	3	4
3	Recognize the patient's thoughts and feelings	0	1	2	3	4
4	Be attentive and responsive	0	1	2	3	4
5	Be aware of when the patient is scared or concerned	0	1	2	3	4
6	Treat the patient in a caring manner	0	1	2	3	4
7	Make the patient experience me as empathetic	0	1	2	3	4
8	Make the patient feel that he/she can talk with me about confidential, personal issues	0	1	2	3	4
9	Show a genuine interest in the patient and his/her situation	0	1	2	3	4
10	Focus on compassion, care and symptomatic treatment, when there is no curative treatment	0	1	2	3	4
11	Record a complete medical history	0	1	2	3	4
12	Reach agreement with the patient about the treatment plan to be implemented	0	1	2	3	4
13	Advise and support the patient in making decisions about his/her treatment	0	1	2	3	4
14	Ensure that the patient makes his/her decisions on an informed basis	0	1	2	3	4
15	Explain the diagnosis and treatment plan to the patient so that he/she understands	0	1	2	3	4
16	Explain things so that the patient feels well-informed	0	1	2	3	4
17	Inform the patient about the expected side effects, so the patient understands them	0	1	2	3	4

18	Explain how the treatment works or is expected to work	0	1	2	3	4
19	Explain how the treatment is likely to affect the patient's condition, so that the patient understands	0	1	2	3	4
20	Explain the treatment procedures, so that the patient understands them	0	1	2	3	4
21	Accept when there is no longer curative treatment for the patient	0	1	2	3	4
22	Be aware of when my own feelings affect my communication with the patient	0	1	2	3	4
23	Deal with my own emotional reactions when the situation is difficult for me	0	1	2	3	4
24	To maintain the relationship with the patient when he/she is angry	0	1	2	3	4
25	To stay focused on what is best for the patient if there is a professional disagreement about the diagnosis and treatment	0	1	2	3	4
26	Avoid letting myself be influenced by preconceptions about the patient	0	1	2	3	4
27	Separate my personal views from my approach in the professional situation	0	1	2	3	4

Part4: Patient Safety Behavior

Please select from the options reflecting of the following behaviors is more consistent with your patient safety behavior at work.

	Item	This statement does not apply at all here	This statement usually does not apply here	This statement seldom applies here	This statement occasionally applies here	This statement usually applies here	This statement always applies here
1	I pay attention to the colleague who doesn't comply with safety regulation or procedure book.	1	2	3	4	5	6
2	I strive for ensuring safety on the job.	1	2	3	4	5	6
3	I am sure to take safety into consideration when I have some doubts about judgment at work.	1	2	3	4	5	6
4	I try to be mentally and physically fit for work.	1	2	3	4	5	6
5	I look at the operation procedure book or safety regulations before work.	1	2	3	4	5	6
6	I remember the lessons learned from past contingencies which prevent accidents from reoccurring in the same operation procedures.	1	2	3	4	5	6
7	When someone's behavior does not comply with safety regulation, even if that person is an executive, I still pay attention to the colleague.	1	2	3	4	5	6
8	I am careful to observe the instructions in the safety regulations and operation procedure book.	1	2	3	4	5	6
9	I am able to keep having no record of contingency occurrence.	1	2	3	4	5	6
10	I ask my director or person in charge when there is doubt at work.	1	2	3	4	5	6

Annex B: List of Surveyed Hospitals

N	Hospital Name	Hospital Type	Province	City	Region	Number of beds
1	Xin Hua Hospital Affiliatod to Shanghai Jiao Tong University School of Medicine	Third-level A general hospital	Shanghai	Shanghai	Eastern Region	2450
2	Ruijin Hospital Affiliated to Shanghai Jiao Tong University School of Medicine	Third-level A general hospital	Shanghai	Shanghai	Eastern Region	2742
3	The Third Affiliated Hospital of Sun Yat-sen University	Third-level A general hospital	Guangdong Province	Guangzhou City	Eastern Region	3981
4	The Second Affiliated Hospital of Guangzhou Medical University	Third-level A general hospital	Guangdong Province	Guangzhou City	Eastern Region	2500
5	Affiliated Hospital of Nantong University	Third-level A general hospital	Jiangsu Province	Nantong City	Eastern Region	3300
6	Xiangya Hospital Central South University	Third-level A general hospital	Hunan Province	Changsha City	Central region	3500
7	Changsha First Hospital	Third-level A general hospital	Hunan Province	Changsha City	Central region	1800
8	The Second Affiliated Hospital of Anhui Medical University	Third-level A general hospital	Anhui Province	Hefei City	Central region	2650

9	Zhengzhou Central Hospital	Third-level A general hospital	Henan Province	Zhengzhou City	Central region	3191
10	Xijing Hospital of Air Force Military Medical University	Third-level A general hospital	Shaanxi Province	Xi'an City	Western Region	3218
11	Affiliated Hospital of Guizhou Medical University	Third-level A general hospital	Guizhou Province	Guiyang City	Western Region	3500
12	Xinqiao Hospital Affiliated to Army Medical University	Third-level A general hospital	Chongqing	Chongqing City	Western Region	2860
13	Nanchong Central Hospital Affiliated to North Sichuan Medical College	Third-level A general hospital	Sichaun Province	Nantong City	Western Region	2700