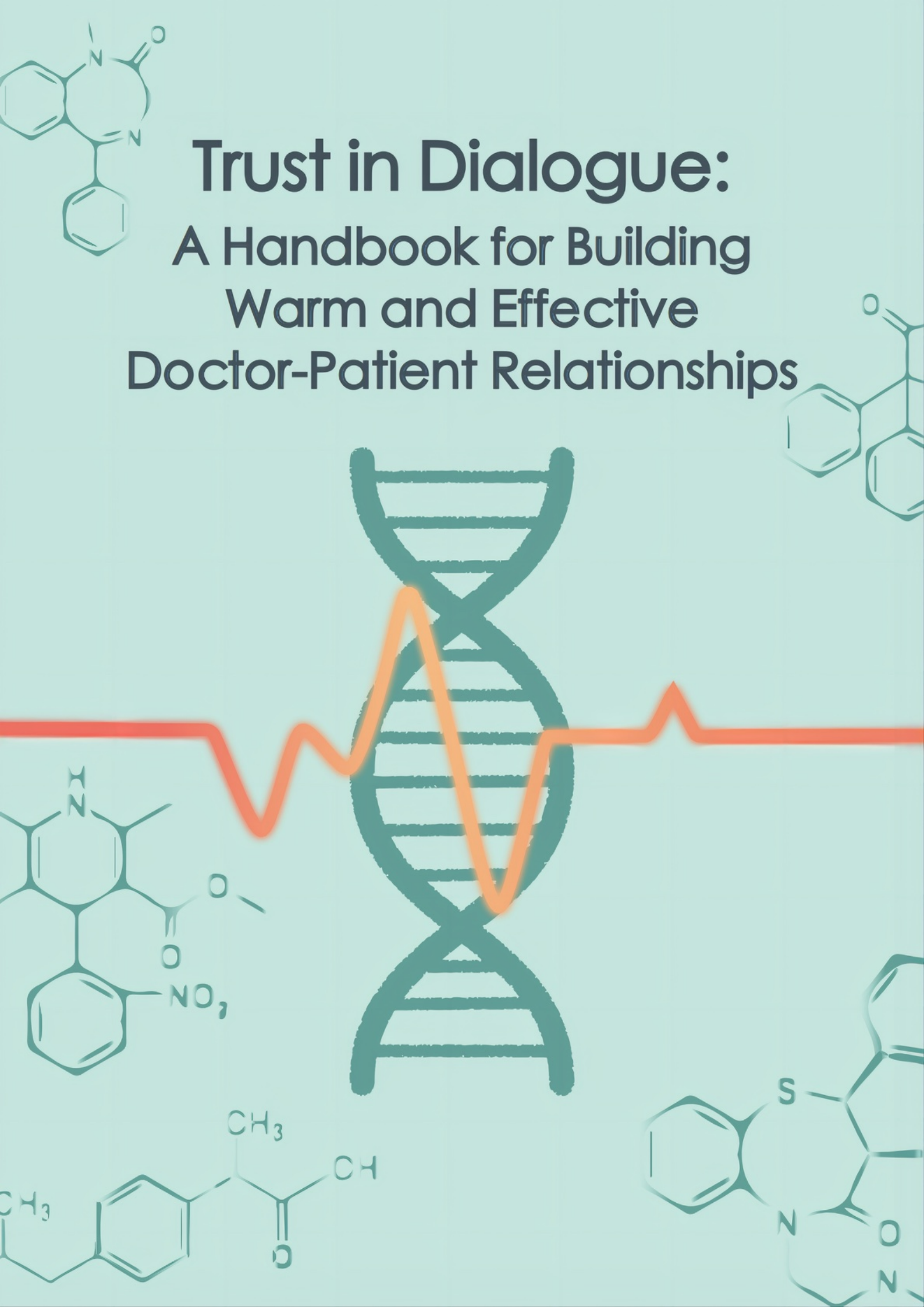


Trust in Dialogue: A Handbook for Building Warm and Effective Doctor-Patient Relationships



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1. Introduction

The doctor-patient relationship has become one of the most sensitive and contested issues in contemporary healthcare. While medicine has achieved extraordinary progress in technology and therapeutic options, the social fabric between physicians and patients often remains strained. Reports of mistrust, communication breakdowns, and even violent incidents reveal that many interactions are marked not by cooperation but by tension (Tucker et al., 2015; Ma et al., 2022; Nie et al., 2018). Doctors are overburdened by clinical responsibilities and administrative tasks, while patients often feel that their voices and emotional needs are ignored. This imbalance undermines not only the quality of care but also the public's confidence in the healthcare system (Hvistendahl, 2013).

Surveys and empirical studies highlight the scale of the problem. In national and regional investigations, more than half of physicians (50.7%) describe the doctor-patient relationship as “unharmonious,” while only 13.1% consider it harmonious (Wang et al., 2024). Patients, by contrast, tend to view the situation more positively, with nearly 70% reporting that the relationship is “not tense” (Wang et al., 2023). Trust scores reflect this divergence as well: physicians rated their trust in patients at $M = 3.87$, while patients rated their trust in doctors at $M = 4.05$ on a five-point scale (Han et al., 2022). Time constraints worsen the gap. During a typical 15-minute consultation, only 4 minutes are spent in direct communication, while the remainder is consumed by electronic medical records and administrative duties (Zhu et al., 2022). Such structural pressures make meaningful dialogue, empathy, and shared decision-making exceedingly difficult.

Our own work within the iGEM framework confirmed these challenges. In conducting Integrated Human Practices for health-related projects, such as our team's focus on colorectal cancer diagnostics and partner teams' efforts in influenza prevention, we repeatedly observed how communication barriers impeded trust.

Cancer patients expressed anxiety about treatment side effects but lacked opportunities for open discussion with their physicians. At vaccination clinics, elderly patients often misunderstood the difference between influenza and the common cold, hesitating to accept vaccines when doctors lacked time for explanation. These experiences convinced us that the success of synthetic biology in healthcare depends not only on laboratory innovation but equally on building effective, trust-based communication with the people it aims to serve.

Case Box: Patient perspective from colorectal cancer interviews

“On busy clinic days I see more than 70 patients. Each has unique concerns, but I only have a few minutes for each consultation. I want to explain side effects and treatment options carefully, but the pressure to keep moving often forces me to focus only on immediate clinical decisions.”

— Oncologist, tertiary hospital interview (2025)

Key Insight: Physicians recognize the importance of communication, yet systemic time constraints and overwhelming workloads prevent them from providing the level of dialogue patients need.

This handbook is our attempt to address that gap: to analyze systemic weaknesses in doctor–patient communication and propose principles that can guide both healthcare practice and the responsible translation of iGEM projects into society.

2. Situation Analysis: The Main Challenges and Barriers in Doctor-Patient Relationship

2.1 Lack of communication time

Medicine is not merely about treating diseases, but also about “to cure sometimes, to relieve often, to comfort always.” Patients need not only medical treatment, but also conversations that can ease their minds and provide emotional reassurance.

However, in daily clinical work, doctor–patient communication is often limited to biomedical issues, while emotional needs and private conversations are overlooked. This is not because doctors are unwilling to care for their patients, but because they simply lack the time for deeper dialogue. Doctors’ schedules are tightly packed with outpatient consultations, ward rounds, operations, meetings, teaching, and endless paperwork. For example, a typical hospital physician’s daily routine may look like in **table 1**.

Table 1. A schedule for a doctor in China (2025)

Time	Event
7:30-8:30	Conference speech / remarks
8:30-12:30	Outpatient clinic consultations
12:30-13:30	Meeting with pharmaceutical representatives
13:30-14:00	Lunch, online preparatory meeting for academic conference
14:00-15:30	Outpatient clinic consultations
15:30-16:30	Community health lecture
16:30-17:30	Hospital administrative ward round
17:30-18:30	Graduate student group meeting
18:30-19:30	Lesson preparation for next day’s lecture

19:30-20:30	Dinner
21:00-22:00	Online training for competition judging
22:00-23:00	Lesson preparation for next day's lecture

Within such a compressed schedule, the actual time spent in one-to-one conversations with patients is drastically limited. According to Becker et al., observational studies in a university hospital showed that doctors were able to spend only about 4 minutes and 17 seconds with each inpatient, while communication with relatives averaged merely 20 seconds (Becker et al., 2010). Inevitably, in this narrow time window, discussions are highly centered on the disease itself, leaving little room for empathy, emotional support, or private communication.

2.2 Information asymmetry and cognitive gap

In contemporary Chinese doctor-patient interaction scenarios, information asymmetry and cognitive divide have become structural challenges that impede effective communication. Information asymmetry refers to the significant gap in information between doctors and patients regarding medical knowledge, understanding of illness, and treatment options. The cognitive divide further manifests as comprehension biases between the two parties in terms of values, risk perception, and decision-making logic. Such asymmetry and divide not only affect communication efficiency but may also exacerbate patients' anxiety and distrust, potentially leading to medical decision-making errors.

The inherent medical knowledge barrier forms the basis of the information gap between doctors and patients. Doctors, having undergone long-term systematic training, possess professional medical language and clinical thinking skills. In contrast, patients often lack basic medical knowledge and find it difficult to understand diagnostic bases, treatment plans, and their potential risks. This includes asymmetry in the understanding of illness, information related to medical services, legal

awareness between doctors and patients, and media propaganda information. The "China National Health Literacy Monitoring Report (2022)" shows that the health literacy level of Chinese residents in 2022 was 27.78%. Moreover, the levels of health literacy in specialized areas such as chronic disease prevention and control (28.85%), infectious disease prevention and control (28.16%), and basic medical services (27.68%) were significantly lower than other areas of literacy (such as safety and first aid).

Additionally, patients may have unrealistic high expectations for medical outcomes while lacking medical knowledge. Some patients and their families, due to insufficient understanding of the particularities of medicine and a lack of medical knowledge, hold high expectations for medical outcomes. They believe that as long as they are admitted to the hospital and undergo a series of scientific examinations and treatments, their diseases will be cured. However, this expectation exceeds the current capabilities of the medical field.

The information asymmetry places patients in a disadvantaged position. In the evolution of the media market, the dual role of the media as both public opinion leaders and economic revenue generators may directly lead to biased social public opinion. This, in turn, further deepens the public's dissatisfaction with hospitals and medical staff, widening the trust gap between doctors and patients.

2.3 Emotional Support and Empathy Deficiency

Burnout is a work-related syndrome characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment. It leaves physicians feeling "drained" at work and emotionally unable to provide meaningful support to patients. In a study conducted by West et al., 2018, nearly or over 50% of physicians-in-training and practicing physicians in the United States reported burnout symptoms. According to a 2021 Chinese Physician Survey published by Tsinghua University, physicians spend an average of approximately 7.77 hours on outpatient

services and 1.47 hours on research daily, working about 5.77 days per week—an extremely high workload. Under such intensity, physicians are highly prone to mental and physical exhaustion, with only 11.86% of survey participants feeling they were not "completely drained." Such demanding work conditions, compounded by performance evaluation pressures, contribute significantly to widespread fatigue among doctors.

Additionally, due to the highly specialized nature of medical practice, physicians generally view patient-proposed remedies-based on relatives' experiences, folk prescriptions, or unverified alternative treatments as untrustworthy.

According to Hou et al. (2025), although empathy and communication skills are core components of medical humanities, related education remains marginalized in most medical school curricula. Currently, medical education in China primarily focuses on biomedical knowledge and clinical skills training. Emotional support and empathy training are mostly delivered through elective courses, special lectures, or sporadic humanities modules, lacking systematic and mandatory integration. While textbooks such as Medical Ethics and Doctor-Patient Communication have been gradually promoted, their content remains theoretically oriented, with insufficient practical training in emotional skills. Furthermore, the cultivation of emotional support in medical education heavily relies on the "apprenticeship model" and experiential learning during clinical internships rather than standardized coursework. Young doctors often only realize the importance of emotional support when facing patients directly, yet they lack systematic training in relevant methods. Although some institutions have attempted to implement activities such as "narrative medicine" workshops, their reach and depth remain considerably limited.

At the same time, patients also face many emotional barriers that affect the emotional support and empathy between doctor and patient. When suffering from a disease, especially a serious one, the patient suffers physically and is psychologically trapped in a whirlpool of negative emotions such as anxiety, fear and helplessness. The patient

is worried and hopeful, who is searching for relief, help and trust (Kaba & Sooriakumaran, 2007).

Patients with acute and serious illnesses suddenly lose the ability to take care of themselves and rely on others to help them with their basic needs, which makes them feel helpless and hapless, and full of fear in their hearts. Patients in the intensive care unit, due to the denial of visits, closed environment, easy to produce loneliness and a sense of abandonment, witnessing the death of the patients in the same room or the scene of death, will aggravate the negative emotions. Patients with chronic diseases suffer from long-term pain and suffering, their quality of life declines, and they feel anxious about the development of their illnesses and the uncertainty of treatment effects, and they may also be plunged into despair and frustration due to the financial pressure brought about by long-term treatment.

From the social survey, many patients indicated that during the medical process, doctors tended to focus more on disease diagnosis and treatment programmes and paid little attention to their psychological state and emotional needs. Factors have been shown to limit patient participation in healthcare decision making but little research attention has focused however on how emotions experienced by both the patient and the healthcare provider may affect the ability of the patient to participate (Bogaert, 2020). Patients long for doctors to listen patiently to their feelings and concerns about their condition and the impact of the disease on all aspects of their lives, but such expectations are often disappointed. Patients do not feel understood, they are frequently non-adherent with treatment, and many have poor outcomes (McCabe & Healey, 2018). Some patients, due to the long-term accumulation of psychological burdens, and then appear sleep disorders, loss of appetite and other somatisation symptoms, and these psychological problems will in turn affect the physical recovery process, forming a "psychological - physiological" vicious circle.

It is worth noting that there are relevant journals focusing on patient education. 20,376 articles were from 2012 to 2022 met the inclusion criteria of being recognized

by the search phrase "physician-patient communication." Additionally, the Patient Education and Counseling Journal was the journal with the most publications regarding the topic (Konda et al., 2023).

However, such resources have not yet received sufficient attention from both doctors and patients, and have not been able to give full play to their roles in patients' psychological counselling and the popularisation of emotional support, which further exacerbates the plight of patients in obtaining emotional support.

2.4 Inadequate hospital system support and institutional safeguards in the doctor-patient relationship

In the current healthcare system, the harmony and stability of doctor-patient relationship has a direct impact on the quality of medical services and patient experience, and the system support and institutional guarantee of hospitals are the key support to maintain a good doctor-patient relationship. However, from the point of view of actual operation, there are still many deficiencies in the system support and institutional guarantee of existing hospitals, which not only restrict the efficiency and quality of doctor-patient communication, but also may aggravate the conflicts between doctors and patients, and need to be paid great attention to.

Existing communication platforms and systems in hospitals: At present, hospitals have set up a variety of platforms and formulated corresponding systems to promote doctor-patient communication. Some hospitals have set up doctor-patient communication offices, which are specifically responsible for handling patients' complaints and suggestions and coordinating doctor-patient conflicts. In the outpatient hall set up a guide desk to provide patients with medical guidance and answer questions. Some hospitals have also opened online service platforms, where patients can enquire about test and examination results, book appointments, and engage in simple online communication with doctors through the hospital's official website,

WeChat public number, and so on. In terms of systems, there is the First Consultation Responsibility System, which requires the first doctor to be responsible for the entirety of the patient's treatment to ensure that the patient receives consistent medical services, and the three-tier check-up system, through which the higher-level doctors guide and supervise the treatment plans of the lower-level doctors, and also communicate further with the patient about his or her condition.

These communication platforms and systems promote doctor-patient communication to a certain extent. The guide desk helps patients quickly understand the medical process and reduces their anxiety due to unfamiliarity with the hospital environment and process. The online service platform facilitates patients' access to medical information, saves time and improves the efficiency of medical treatment. The Office of Doctor-Patient Communication provides a special channel for patients to make complaints, which helps to solve doctor-patient disputes in a timely manner and maintain the normal order of the hospital. The first-visit responsibility system and the three-tier check-up system guarantee the consistency and professionalism of medical services, which is conducive to doctors' comprehensive understanding of patients' conditions and the formulation of more reasonable treatment plans.

However, there are still many deficiencies in the existing communication platforms and systems. In terms of communication platforms, most doctor-patient communication offices intervene in mediation only after conflicts have already arisen, and lack a forward-looking communication promotion mechanism, making it difficult to prevent conflicts from occurring at the source. The limited number of staff at the medical guide desk makes it difficult to serve every patient during the peak period, resulting in some patients' needs not being met in a timely manner. The function of the online service platform is not yet perfect, the online communication time of doctors is short, so they can't discuss their conditions in depth, and due to the unfamiliarity of elderly patients with the operation, the utilisation rate of the online service is low, so they can't fully enjoy the convenience it brings.

Problems at the level of system implementation and assessment are equally prominent. Some doctors, due to their busy schedules, do not strictly implement the communication requirements of the first consultation system and the three-stage check-up system, and simply ask about their conditions and give medical instructions, neglecting to communicate with patients emotionally and explain their conditions, which makes it difficult for patients to fully understand the diagnosis and treatment plan, and makes them susceptible to misunderstandings. More critically, hospitals lack an effective mechanism to assess the effectiveness of doctor-patient communication, and are unable to identify and improve problems in the communication platform and system in a timely manner, making it difficult to continuously optimise the existing system and adapt to the ever-changing needs of doctor-patient communication.

In addition, there is an obvious imbalance in the distribution of medical resources in China. People's Weekly pointed out that there is a relative shortage of health resources in China and an extreme imbalance in their distribution, with the quantity and quality of healthcare resources in economically developed regions in the east being much higher than those in economically backward regions in the west. This imbalance has led to a large influx of patients into developed regions and urban medical institutions, resulting in increased pressure on physicians, and at the same time making it easy for "patient discrimination" to occur, further worsening the doctor-patient relationship.

These deficiencies have had a negative impact on the doctor-patient relationship in many ways. Inadequate communication leads to a lack of trust in diagnosis and treatment programmes, which increases the chances of doctor-patient disputes; ineffective implementation of the system reduces the quality of medical services and affects the patient's experience of medical treatment; and the lack of an assessment mechanism leads to the accumulation of problems over time, which are difficult to be solved effectively and gradually erode the foundation of trust between doctors and patients.

In summary, the current hospital in the system support and institutional safeguards in

the lack of serious impact on the harmonious development of doctor-patient relationship. Whether it is the imperfection of the communication platform, the lack of system implementation and evaluation, or the irrationality of medical resources allocation and system design, they all need to be solved urgently. Only by improving the systematic support and institutional safeguards of hospitals can a solid foundation be laid for the construction of a harmonious doctor-patient relationship.

2.5 Trust Deficiency and Defensive Medicine: A Vicious Cycle in Doctor-Patient Relationships

In contemporary medical practice, the trust between doctors and patients is facing unprecedented challenges. Multiple social surveys indicate that patients' trust in medical institutions and medical staff is on the decline, while doctors generally feel that their professional risks are increasing and their social recognition is decreasing (Park et al., 2023). This mutual distrust has given rise to a phenomenon known as "defensive medicine" - that is, doctors, in order to avoid legal disputes or patient complaints, adopt examinations, treatments or conservative strategies that exceed clinical necessity.

For instance, in a survey conducted in some top-tier hospitals in China by SMU-Union-China, one of the co-authors of this handbook, it was found that doctors admitted to ordering additional imaging tests out of fear of medical disputes, even when the clinical indications were not strong. Some doctors even chose to refer patients or refuse to perform surgeries when dealing with complex cases to avoid potential liability. Although this behavior protected individual doctors in the short term, it led to a series of negative consequences, including waste of public resources, increased economic burden on patients, and deterioration of the medical experience, further intensifying public doubts about "excessive medical treatment" and creating a vicious cycle of "trust collapse".

Behind this phenomenon lies a complex interplay of multiple factors:

1.Information asymmetry makes it difficult for patients to judge the rationality of diagnosis and treatment;

2.Insufficient communication time prevents doctors from fully explaining the basis of their decisions;

3.An imperfect medical dispute resolution mechanism leads doctors to prioritize self-protection;

4.The public's lack of awareness of the limitations of medicine causes them to mistakenly attribute the natural progression of diseases to medical negligence.

3. The Four Core Principles: The Cornerstones of Effective Doctor-Patient Communication

3. Core Principles: The Foundation of Efficient Doctor-Patient Communication

3.1 Respect

Mutual respect is the fundamental prerequisite for establishing a good doctor-patient relationship. In this context, respect from doctors toward patients is particularly important. This moral obligation to respect should not depend on personal feelings but rather on the universal recognition of human dignity. Respecting patients means acknowledging their inherent worth as human beings—a value that is unconditional and independent of the patient's personal characteristics, behavior, or capacity for autonomy. Respect should be reflected in concrete actions, such as using honorifics, actively protecting privacy, adopting non-intrusive communication methods, maintaining a humble attitude, and respecting patients' decision-making rights, etc.

3.2 Empathy

Empathy is the core of the doctor-patient relationship, which helps improve diagnostic accuracy, patient satisfaction, treatment compliance, and reduces doctors' occupational burnout. In the medical field, the Jefferson Scale of Empathy (JSE) is commonly used to measure healthcare workers' level of empathy toward patients. It is divided into three dimensions: cognitive empathy, emotional empathy, and perspective-taking. Cognitive empathy refers to the ability to understand others' emotional states, perspectives, and motivations. It is a thinking and recognition process. It requires healthcare workers to fully comprehend patients' suffering while maintaining a certain degree of professional distance and rational judgment, avoiding being overwhelmed by emotions. In contrast, emotional empathy is the spontaneous ability to feel and share others' emotional states. Perspective-taking emphasizes a more active and conscious imaginative process, attempting to simulate and experience others' situations to gain new insights.

3.3 Information Disclosure

Information disclosure is an effective means to enhance transparency in the medical service process. It refers to the proactive release of information by an organization to the public or specific individuals or groups through specific forms and procedures. In the context of doctor-patient communication, information disclosure often takes the form of healthcare providers offering informed consent forms to patients and their families, providing detailed explanations of medical conditions, treatment plans, potential risks, as well as channels for accessing fee details and medical records. These practices not only strictly fulfill statutory disclosure obligations but also represent the core requirements of respecting patients' autonomy and the principle of informed consent. Information disclosure safeguards patients' right to know, enhances patient trust, and reduces risk perception. Moreover, information disclosure must be implemented in strict accordance with local laws and regulations, adhering to medical ethics. Measures such as de-identification and tiered access controls should be adopted during the process to ensure full protection of patient privacy and prevent improper disclosure or misuse of information.

3.4 Cooperation

Cooperation is a crucial foundation for building an equal, mutually trusting, and caring doctor-patient relationship. Its core lies in moving away from the traditional "order-compliance" model and shifting toward a patient-centered partnership where both doctors and patients jointly participate in decision-making and management. Cooperation emphasizes not only collaboration between doctors and patients but also the support and coordination of multiple stakeholders, including medical institutions, families, and communities.

At the theoretical level, cooperation originates from the "Shared Decision-Making (SDM)" model in medical ethics. This model posits that medical decisions should

integrate the professional expertise of doctors with the personal preferences, values, and life circumstances of patients. Through adequate information exchange and dialogue, the most suitable treatment plan for the individual patient is jointly developed. Cooperation not only enhances treatment adherence and outcomes but also strengthens patient autonomy and responsibility.

Cooperation in the doctor-patient relationship is not only ethical but can also be legal. Gillick suggests that doctors and patients sign a formal, detailed, and negotiable written contract before establishing their relationship, clearly defining the rights, obligations, and goals of both parties. The contract should include detailed arrangements for medical visits, emergency handling, methods for notifying test results, end-of-life care preferences, and dispute resolution mechanisms. The contract should be periodically renegotiated to adapt to changing circumstances . This offers a new perspective for doctor-patient cooperation. Although it has not yet been implemented, it provides insightful ideas for clarifying rights and obligations in doctor-patient cooperation.

4. Implementation Pathways: A Systemic Approach to Building Efficient Doctor-Patient Communication

4.1 Medical Institution and System Level

The current medical training system has structural biases, overemphasizing the cultivation of clinical skills and operational abilities while somewhat neglecting the systematic development of empathy and humanistic care in medical students. Against this background, strengthening Communication Skills Training (CST) has become a key direction for medical education reform. However, the effectiveness of CST is not permanent and often diminishes over time and under clinical pressure. Therefore, continuous reinforcement mechanisms must be embedded within the training system—such as through simulated exercises, supervised feedback in real clinical scenarios, and reflective practice—to achieve long-term internalization and enhancement of communication skills. The ultimate goal is to promote a shift in medical education from pure skill transmission to holistic cultivation, encouraging doctors to recognize, respect, and respond to the patient's unique illness experience and narrative.

At the systematic level, the heavy workload of doctors is one of the primary obstacles to effective communication. Overtime and high-intensity tasks compress the time allocated to each patient, leading to superficial consultations, incomplete information exchange, and difficulties in establishing trust. Therefore, efforts should be made to optimize human resource allocation and workflow management, reasonably controlling the workload of medical staff to ensure they have sufficient time for in-depth and meaningful communication with patients. This is not only crucial for improving service quality but also essential for the professional well-being and sustainable medical practice capacity of medical workers.

Meanwhile, the feedback and evaluation mechanisms for doctor-patient

communication also require scientific and systematic adjustments. Most current assessment tools rely on cross-sectional designs, which can only capture isolated or short-term interaction segments and fail to reflect the dynamic, long-term evolution of communication quality in doctor-patient relationships . Therefore, it is essential to promote the implementation of longitudinal tracking mechanisms, integrating authentic medical consultation recordings and videos, periodic patient feedback, and third-party evaluations to construct a multidimensional and continuous evaluation system.

Furthermore, any feedback mechanism must operate within a rigorous ethical and quality oversight framework. It is crucial to remain vigilant against the potential negative effects of "indicator-driven" approaches: if communication satisfaction is excessively tied to performance evaluations, some doctors may resort to leading questions or obliging communication. In extreme cases, the pursuit of harmonious relationships might compromise the objectivity of clinical decisions—such as excessive reassurance or avoidance of risk disclosure. Therefore, the evaluation should emphasize authentic, in-depth communication with clinical relevance, rather than a simplistic focus on achieving high scores. Anti-manipulation measures must be integrated into the mechanism design, including auditing consultation content, conducting random follow-up interviews, and adopting mixed methods to comprehensively assess the consistency between communication quality and clinical outcomes.

4.2 Medical Workers Level

A study by Liang et al. categorized physicians into Doctors with Higher patient satisfaction (DH) and Doctors with Lower patient satisfaction (DL), analyzing their language strategies from the perspective of Systemic Functional Linguistics (SFL). The study found that DH were more likely to inquire about patients' daily behaviors, such as sleep and diet, reflecting their concern for the patients' quality of life and

subjective feelings. They also meticulously asked about the duration of the illness, demonstrating an intention for precise diagnosis. In contrast, DL more frequently emphasized their authority and gave one-way instructions, directly informing patients about treatment methods, reasons, and conditions, while highlighting the authority and non-negotiability of the treatment approaches .

Based on these findings, with the goal of improving doctor-patient communication effectiveness, enhancing patient satisfaction, and elevating the quality of treatment, medical staff should proactively adopt the language strategies used by doctors in the DH group during clinical communication, while avoiding the unidirectional authoritative language patterns typical of the DL group. In practical terms, medical staff can optimize their language choices in the following two aspects: First, strengthen the focus on patients' quality of life and subjective feelings by incorporating caring inquiries such as "Are you sleeping well at night?" or "Have you experienced any discomfort in your diet recently?" into the communication process. This approach conveys humanistic care through language and helps build a trusting doctor-patient relationship. Second, use precise and logically complete expressions within the patient's capacity for understanding. For example, when informing patients about health indicator standards, use clear and simple statements such as, "There's no need to worry too much about your blood pressure. Only when your systolic blood pressure (the higher number) exceeds 150 mmHg should it become a focus of attention." This helps patients accurately comprehend their condition. Avoid using rigid, absolute, and directive language such as "Don't ask too many questions—this is a necessary procedure" or "Let me tell you, this is the only way." Such language not only fails to help patients fully understand the treatment but may also come across as unfriendly due to its harsh tone, undermining the atmosphere of doctor-patient communication.

4.3 Patient and Public Level

The mindset of contemporary patients is shaped by multiple factors, and we can no longer understand patients through traditional perspectives. Patients' understanding of disease is not solely based on the biomedical model but also integrates personal experiences, cultural beliefs, and social values. This often creates a cognitive gap with the purely biomedical model adopted by physicians. For instance, patients may place greater trust in traditional remedies or harbor distrust toward modern healthcare systems. They actively resist medical authority, reinterpret the information provided by doctors based on their own worldview, and make their own decisions. This may manifest as non-adherence to treatment. The influence of emotions should not be overlooked either. Anxiety and fear, which are common among patients during medical visits, as well as concerns regarding privacy, can hinder their ability to effectively receive information and clearly express their needs, thereby compromising the quality of communication .

The public from diverse cultural and class backgrounds require informative guidance to enhance their acceptance of the modern healthcare system while respecting their diversity. This may encounter some resistance, as relevant practitioners often hold preconceived expectations, assuming that learners are readily receptive to the knowledge they impart. However, not everyone is interested in such information. Therefore, science communicators must fully consider the backgrounds of their audiences and promptly adjust their approaches based on feedback. Similarly, it is essential to guide patients in overcoming their fear of doctor-patient communication and to adopt reasonable methods to safeguard their rights. For instance, when doctors ask questions that patients are unwilling to answer, patients should truthfully express their wishes rather than provide false answers.

4.4 Technological Empowerment Level

Technological empowerment serves as the core support for enabling efficient operation of doctor-patient communication platforms and balancing medical service

quality with the experience of both medical workers and patients. Especially in the current context of strained medical resources and growing patient communication demands, technological innovation plays an increasingly critical role in optimizing the doctor-patient communication process. Among various technologies, artificial intelligence (AI), by leveraging its advantages in information processing, content generation, and process assistance, has become a key choice for hospitals upgrading their doctor-patient communication platforms in recent years. However, its application effectiveness and potential risks need to be comprehensively examined from three dimensions: practical value, existing challenges, and optimization directions.

From the perspectives of practical application and positive value, AI technology has demonstrated clear potential in alleviating doctors' communication pressure and enhancing their perception of work efficiency. For instance, a prospective quality improvement study conducted by Garcia et al. (2024) provided strong empirical evidence: the study implemented a five-week single-group intervention trial involving 162 clinicians in a real academic medical center setting. The core intervention involved embedding an AI draft generation tool into the patient message reply module of the electronic health record system. The results showed that 20% of the doctors actively chose to use the AI tool to assist in replying to patient messages. This utilization rate indicates that the AI tool has gained preliminary acceptance among clinical practitioners and possesses a certain foundation for broader adoption. More importantly, based on subjective experience data from doctors, the application of the AI tool significantly alleviated their workload—the average task load score reported by doctors decreased by 13.87 points, and the average burnout score decreased by 0.33 points. This change holds significant importance for addressing the long-standing issue of "physician burnout" in the healthcare industry: against the backdrop of a 157% increase in patient inquiries via electronic platforms since the pandemic, the AI tool can help reduce "repetitive low-value labor" in message replies (such as drafting standardized content like medication reminders and appointment confirmations). This allows doctors to focus more on critical medical decision-making aspects, such as

diagnosing conditions and developing treatment plans, thereby indirectly enhancing the depth and quality of doctor-patient communication .

However, the application of AI technology in doctor-patient communication platforms is not without risks. Its shortcomings in value diversity and interpretability may impact the "humanistic core" of doctor-patient relationships and even give rise to new medical ethical issues. On one hand, the construction of AI databases and the sources of training data are often dominated by technology developers, making it difficult for doctors and patients to participate in the screening and labeling of core data. This means that AI-generated responses may rely excessively on standardized medical guidelines while neglecting the individual differences and needs of patients, resulting in replies that lack human warmth and fail to reflect the "patient-centered" value orientation in doctor-patient communication. On the other hand, the reasoning and decision-making processes of most current generative AI systems operate as a "black box," making it impossible for doctors to clearly trace the logical chain behind AI-generated responses. This may lead to doctors distrusting AI content and could even foster "algorithmic paternalism": if doctors over-rely on AI-generated responses or if hospitals mandate the use of AI tools, it may undermine the "primary responsibility" of doctors in doctor-patient communication. Patients may feel as though they are communicating with a machine rather than a doctor, thereby damaging the trust between them—and trust is precisely the indispensable emotional foundation of doctor-patient communication .

To avoid the risks above and ensure that AI technology consistently serves the core objective of optimizing doctor-patient communication, a comprehensive framework of application guidelines must be established from two perspectives: clear positioning and capability alignment. First, the supporting role of AI in doctor-patient communication must be strictly defined: its core functions should be limited to auxiliary tasks such as "generating response templates" "providing standard reference information" and "filtering urgent messages". The final response must always be

reviewed, modified, and confirmed by doctors based on the patient's individual circumstances. This ensures that physicians remain responsible for the accuracy and humanistic care of communication, preventing AI from replacing doctors as the primary communicator. Second, medical education reform should be implemented to strengthen doctors' core competencies in the data era. On one hand, medical education should include courses on AI ethics and application to help doctors understand the technical boundaries and risks of AI, enhancing their ability to critically evaluate AI-generated content. On the other hand, there should be a greater emphasis on cultivating empathy among doctors—as AI takes over some textual tasks, doctors must learn to identify patients' emotional needs within limited time, using tone or non-verbal signals to convey care and compensate for AI's shortcomings in humanistic interaction. Additionally, a user feedback-driven technical optimization mechanism should be established: hospitals ought to regularly collect feedback from both doctors and patients regarding their experiences with AI tools. This feedback should be used to refine AI algorithm models, ensuring that the technology gradually aligns with the actual needs of both medical professionals and patients, rather than following a self-reinforcing technological loop.

In summary, AI technology provides a new pathway for the technological empowerment of doctor-patient communication platforms, but the realization of its value hinges on a delicate balance between leveraging positive effects and mitigating potential risks. Only by integrating the "technical rationality" of AI with the "humanistic rationality" of doctor-patient communication can technology truly become a tool that bridges the gap between doctors and patients and enhances the quality of medical services, rather than a barrier that hinders their interaction.

5. Outlook

As an iGEM team, we recognize that synthetic biology is not only about technological breakthroughs but also about its social acceptance and ethical responsibilities. If the public lacks basic trust in science and the medical system, even the most advanced gene therapies or intelligent diagnostic tools will be difficult to implement. Therefore, rebuilding trust between doctors and patients is not only a medical humanities issue but also a social prerequisite for promoting the application of scientific and technological innovations.

Our project is attempting to break the "black box" impression through the design principles of "technological transparency, public participatory design and explainable biological systems", enabling patients to understand, participate in and trust the diagnosis and treatment plans based on synthetic biology. Only in this way can we prevent new technologies from becoming tools of the next round of defensive medicine, but instead become a bridge to rebuild trust.

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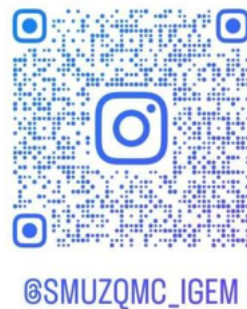
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