

Article

Innovating Healthcare Support Services in Clinical Settings

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Abstract: This paper explores innovative approaches to optimize healthcare support services in clinical settings, focusing on three critical domains: advanced sterilization technologies, interdisciplinary medical care models, and digital medical record systems. First, addressing the limitations of traditional sterilization, the study proposes the implementation of cutting-edge solutions, including hydrogen peroxide plasma, UV-C combined with photocatalysis, supercritical CO₂ (SC-CO₂), and nano-antibacterial coatings, to enhance sterilization efficiency, reduce equipment damage, and ensure patient safety. Second, to improve chronic disease management, the paper critically evaluates current practices and introduces the "Nutrition-Pharmacy-Dietary Integration (NPD)" collaborative model, leveraging intelligent information-sharing systems to provide personalized, cross-disciplinary patient care. Finally, to resolve inefficiencies and security risks in current electronic health records (EHR), a "Smart EHR" solution is proposed, integrating Artificial Intelligence (AI) for automated medical record entry, blockchain for data security and cross-institutional sharing, and cloud computing for real-time accessibility. Ultimately, the synergistic application of these innovations aims to significantly improve clinical operational efficiency, elevate the quality of patient care, and drive the digital transformation and sustainable development of medical institutions.

Keywords: Healthcare Support Services; Innovative Sterilization Technologies; Interdisciplinary Care Model

1. Innovative Sterilization Solutions and Strategic Implementation Plans

1.1. Background

Hospitals are the core places for medical services, and the effectiveness of sterilization work is directly related to patient safety and the level of hospital infection control. Traditional high-temperature and high-pressure sterilization (such as high-pressure steam sterilization) and chemical sterilization methods (such as ethylene oxide) have problems such as long sterilization time, great damage to equipment materials, and chemical residues in actual applications [1]. Therefore, combining advanced technology with new methods and proposing innovative sterilization solutions will help reduce medical costs, improve resource utilization, and help improve sterilization efficiency, reduce the risk of hospital infection, reduce the risk of medical device contamination, and enhance patient trust.

1.2. Innovative Sterilization Solutions

1.2.1. Plasma Sterilization Technology

Principle: Use hydrogen peroxide (H₂O₂) plasma to generate active oxygen free radicals in a low-temperature environment, destroy the cell structure of microorganisms, and achieve rapid sterilization.

Advantages: Low-temperature operation can protect heat-sensitive equipment; short sterilization time, no harmful residue, and environmentally friendly.

Scope of application: endoscopes, minimally invasive surgical instruments and other temperature-sensitive medical equipment.

1.2.2. Plasma Sterilization Case Study and Analysis

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Hainan Provincial Hospital of Traditional Chinese Medicine in China performs a large number of surgeries every day, including: laparoscopic minimally invasive surgeries, such as gastroscopy, laparoscope, etc. These instruments are usually made of optical lenses, plastics, metals, etc. The use of high-temperature sterilization methods may cause damage to instruments and materials. Therefore, high-temperature and high-pressure steam sterilization cannot be used. However, although traditional ethylene oxide (EO) sterilization is applicable, the sterilization time is relatively long, usually 12-24 hours, and incomplete sterilization will also increase the risk of medical staff. Therefore, in 2018, a hydrogen peroxide plasma sterilizer was introduced. Plasma sterilization equipment (such as a hydrogen peroxide plasma sterilizer) uses hydrogen peroxide (H_2O_2) plasma to sterilize at a low temperature of 45C-55C to ensure that the microorganisms inside and outside the laparoscope are completely killed. The sterilization effect of the hospital has been significantly improved after the introduction of plasma sterilization equipment. Shortened sterilization time: from the original 12-24 hours to 45-60 minutes, greatly improving the sterilization efficiency. No toxic residue: It avoids the harmful gases that may remain after ethylene oxide sterilization, improving patient safety. Reduce the damage rate of equipment: Compared with high-temperature steam sterilization, plasma sterilization avoids the problems of fogging of the laparoscope lens and aging of plastics (As shown in Figure 1).



Figure 1. Plasma Sterilization Equipment

1.2.3. Ultraviolet (UV-C) + Photocatalytic Composite Sterilization

Principle: High-energy UV-C ultraviolet rays can destroy microbial DNA, and at the same time combine titanium dioxide (TiO_2) to catalyze oxidation reactions to further enhance the sterilization effect.

Advantages: High efficiency, safety, can be used for air and surface sterilization, no chemical residue.

Scope of application: Air disinfection in operating rooms and wards, and surface sterilization of medical equipment.

1.2.4. Case Study

Research by Mark H. Erez of Columbia University found that photocatalytic oxidation (PCO) is produced when ultraviolet light shines on a surface coated with a photocatalyst. Inside the device, photons from the UV light interact with the oxidant, triggering an "oxidation" reaction that breaks down water vapor in the air into water ions and hydrogen ions. The process also produces ions that attract pollutants, which end up trapped in the filter substrate for subsequent removal. The anions then bind to pollutants in the air, either deactivating them or breaking them down into less harmful components such as hydrogen, oxygen, nitrogen and carbon. The effectiveness of PCO technology depends on many factors: the intensity of the light source, the UV wavelength used, the

power source, and the specific choice of mechanical filters - some PCO devices produce undesirable pollutants, so the actual benefits of PCO may be limited. UV-C exposes passing air to 254 nanometers of UV-C to inactivate or destroy microorganisms and other biological contaminants in the air. Its mechanism of action is to destroy the genetic material of microorganisms. Effectiveness depends on the dose and duration of exposure. Many systems rely on passive airflow or are designed to include low-decibel fans to circulate air in the room [2]. Therefore, the application scenarios of ultraviolet (UV-C) + photocatalytic composite sterilization can be used in operating room, ward air disinfection, and medical equipment surface sterilization, because its sterilization effect depends on the effective exposure dose and duration, as well as on passive airflow (As shown in Table 1).

Table 1. Hydrogen Peroxide (H₂O₂) with Air Disinfection Devices (Ppm)

Treatment Systems	Surface Bacteria (n-8)	Surface Virus (n-8)	Airborne Bacteria (n-8)	Airborne Virus (n-8)
UV-C	nt	nt	nt	nt
PCO	00.00/0.01	0.00/0.00	0.00/0.01	0.00/0.01
BPI - 1	<0.01	<0.01	<0.01	<0.01
BPI - 2	<0.01	<0.01	<0.01	<0.01
MDBD	0.03/0.05*	0.03/0.07*	0.04/0.06*	0.03/0.06*

The legal exposure limit for indoor H₂O₂ is 1 ppm averaged over an 8-hour day (Occupational Safety and Health Administration). P < 0.05 MDBD versus BPI-1, BPI-2, and PCO. BPI-1: Bipolar Ionization (1); BPI-2: Bipolar Ionization (2); PCO: Photocatalytic Oxidation; UV-C: Germicidal Direct Irradiation for surface testing or Germicidal Air Chamber for airborne tests; MDBD: Modulated Dielectric Barrier Discharge; <0.01 ppm = not detectable; nt = not tested. (*p < 0.05 for MDBD vs BPI-1, BPI-2, PCO, and UV-C)

1.2.5. Supercritical Carbon Dioxide (SC-CO₂) Sterilization

Principle: In the supercritical state, CO₂ has good solubility and can penetrate into microbial cells, destroy their structure and achieve sterilization.

Advantages: Non-toxic and harmless, environmentally friendly, can be used for equipment that is sensitive to heat, humidity or chemicals.

Scope of application: high-precision instruments such as surgical sutures and biological implant materials.

1.2.6. Examples of Application Scenarios

Sterile processing of biological implants (heart valves, artificial bones) Traditional high temperature and high-pressure sterilization will destroy the structure and performance of implants, such as heart valves, artificial bones, cartilage substitutes, etc. Traditional chemical sterilization will cause residues, so SC-CO₂ sterilization technology is used. Supercritical CO₂ is combined with a small amount of hydrogen peroxide (H₂O₂) or alcohol solvents to remove microorganisms and organic residues. Effectively kill pathogens such as spores, bacteria, and viruses while maintaining the structural integrity of biological implants. Complete sterilization is achieved. CO₂ will completely evaporate at room temperature and pressure, leaving no harmful chemicals and achieving non-toxic and residue-free. Compared with irradiation sterilization (gamma rays or electron beams), SC-CO₂ is gentler and reduces material damage.

Therefore, examples of the use scenarios of supercritical carbon dioxide (SC-CO₂) sterilization are mainly reflected in: high-precision instruments such as biological implant materials, sterile processing of biological implants (heart valves, artificial bones) as shown in the figure 2.

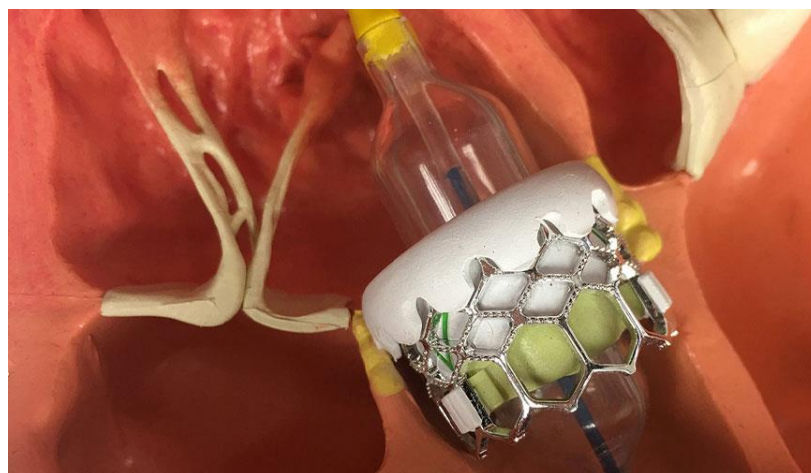


Figure 2. Cardiovascular Implants - Heart Valve Prostheses

1.2.7. Nano Antibacterial Coating Technology

Principle: Antibacterial materials such as silver nanoparticles and graphene oxide are coated on the surface of medical equipment to inhibit bacterial attachment and reproduction.

Advantages: Continuous sterilization, reducing the number of repeated disinfection of equipment and extending the service life of equipment.

Scope of application: high-frequency contact equipment such as scalpels, catheters, and nursing equipment.

1.2.8. Case Study

Biological contamination of medical devices and implants is a growing problem. Perrin Elcock, who has a deep understanding of the development of virus-inactivating surfaces, proposed a strategy based on nano-coating technology. Once applied to biomedical equipment and protective equipment for medical staff, it may help produce materials that reduce or prevent the spread of viral droplets in the air. After research, it was found that the antibacterial rate of nano-antibacterial coating technology is as high as 99.9%, which can sustainably inhibit pathogens such as *Escherichia coli*, *Staphylococcus aureus*, and methicillin-resistant *Staphylococcus aureus* (MRSA). It can reduce the risk of bacterial contamination within 24 hours [3].

Example scenarios: It can be applied in high-contact areas such as wards, operating rooms, nurse stations, bed rails, door handles, medical staff work surfaces, and other areas that are prone to become mediums for pathogen transmission. Coating high-contact surfaces in hospitals with nano-silver/titanium dioxide antibacterial coatings to achieve long-term antibacterial effects (As shown in Figure 3).

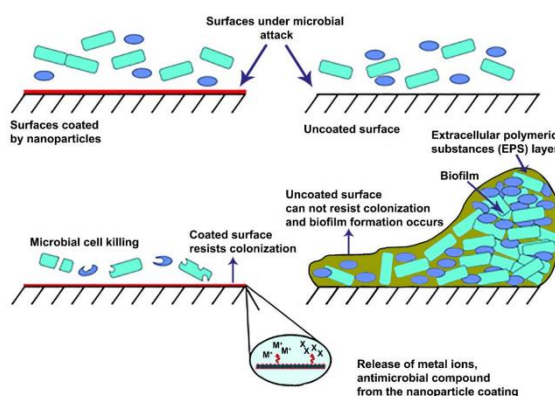


Figure 3. Coating Diagram

1.3. Strategic Implementation Plan

1.3.1. Phase 1 (0-3 Months): Pilot Program and Technical Evaluation

Select key sterilization scenarios in the hospital (such as operating rooms, ICUs, and endoscopy centers) for small-scale pilot applications. Evaluate the performance of new technologies in terms of sterilization efficiency, equipment compatibility, and safety, and compare them with traditional methods. Organize a multidisciplinary team (infection control experts, engineers, and doctors) to conduct technical feasibility analysis [4].

1.3.2. Phase 2 (3-6 Months): Technical Optimization and Process Standardization

According to the pilot results, adjust sterilization parameters, optimize sterilization processes, and improve sterilization efficiency. Develop hospital sterilization management standards, and combine with intelligent monitoring systems to track sterilization effects. Train medical staff to improve the operational standardization and safety of new sterilization technologies.

1.3.3. Phase 3 (6-12 Months): Comprehensive Promotion and Continuous Improvement

Promote innovative sterilization programs throughout the hospital and formulate performance evaluation standards. Combined with hospital infection control data, conduct long-term follow-up evaluation of the application effects of new technologies. Based on clinical feedback and emerging research, continue to optimize sterilization strategies and explore more efficient sterilization technologies.

1.4. Effectiveness of the Solution

1.4.1. Research Data Support

1. As shown in Figure 4A, the reduction in the number of *P. fragi* increased significantly with the increase in SDBD + UV treatment time in the range of 30 to 150 s ($p < 0.05$), indicating that the bactericidal effect is time-dependent. Figure 4B illustrates the effect of irradiation distance on the bactericidal effect. As the irradiation distance increased from 6 cm to 30 cm, the number of *P. fragi* increased. However, no statistically significant changes were observed in the range of 12 to 18 cm, which may be related to the device structure, suggesting that there is an optimal bactericidal irradiation distance in the range of 12 to 18 cm. These two trends are consistent with previous studies, demonstrating the effects of SDBD + UV treatment time and irradiation distance on the bactericidal effect. As shown in Figure 4C, the number of bacteria decreased sharply between 30 and 90 s, and then the decline tended to be gentle, because the plasma-active bactericidal substances dissipated with the extension of storage time [5].

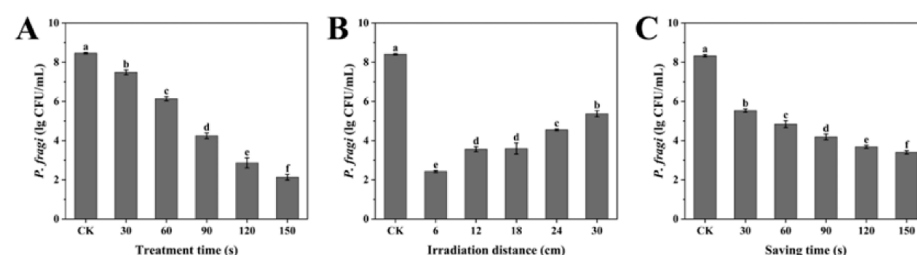


Figure 4. Single-factor Experiment Effects of Three Independent Variables on the Antibacterial Activity of SDBD + UV

Single factor experiments effects of three independent variables on the antibacterial activity of SDBD + UV: (A) treatment time (irradiation distance: 18 cm, saving time: 90 s); (B) irradiation distance (treatment time: 90 s, saving time: 90 s); (C) saving time (treatment time: 90 s, irradiation distance: 18 cm). Different letters in the figure indicate significant differences between the data ($p < 0.05$) [5].

2. UV-C radiation is the most effective method for decontaminating infectious solid waste and targeting specific bacteria. When using UV-C rays, complete elimination of *Staphylococcus aureus* up to 6 logs was observed after 60 minutes, while reductions of *Bacillus subtilis* and *Pseudomonas aeruginosa* were 2 and 3 logs, respectively. Ozone gas was able to inactivate all strains, but this process was accelerated and improved when

ozone gas and UV-C rays were used simultaneously. The total reduction in bacterial load was 8 logs [6].

3. Supercritical CO₂ sterilization technology shows good sterilization effect. Bacillus atrophies spores (10⁶ CFU) were sterilized by exposure to SCCO₂ 2. The experimental control group showed either growth or no growth of spores. No growth of Bacillus atrophies spores was shown after exposure to SCCO₂ 2 /NovaKill (As shown in Figure 5).

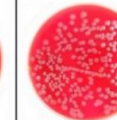
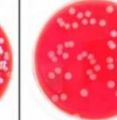
Experimental Controls				SCCO ₂ + NovaKill		
Extraction Buffer	Amniotic Membrane - No inoculation - No SCCO ₂	Spore Suspension	Inoculated Amniotic Membrane - No SCCO ₂	Sterilization Run #1	Sterilization Run #2	Sterilization Run #3
No Growth	No Growth	Growth	Growth	No growth	No growth	No growth
						

Figure 5. Developing a Sterilization Process Using Supercritical Carbon Dioxide and NovaKill

1.4.2. Real Case Analysis

These nanomaterials can not only inactivate oral bacteria, but also achieve more efficient disease treatment and prevention by improving the performance of the material itself, increasing the accuracy of drug targeted delivery, and imparting richer functions. Zinc phosphate cement (ZPC) containing Cu-doped biogases nanoparticles (Cu-BGn) exhibits sufficient mechanical and physical properties and enhanced antibacterial effects [7] (As shown in Figure 6 and Figure 7).

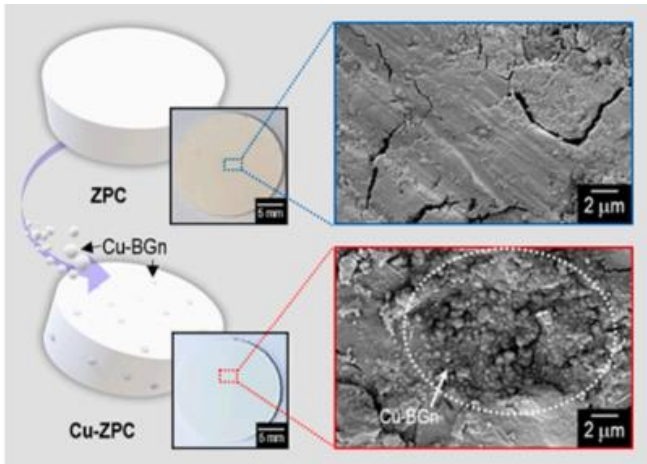


Figure 6. Antibacterial Effect

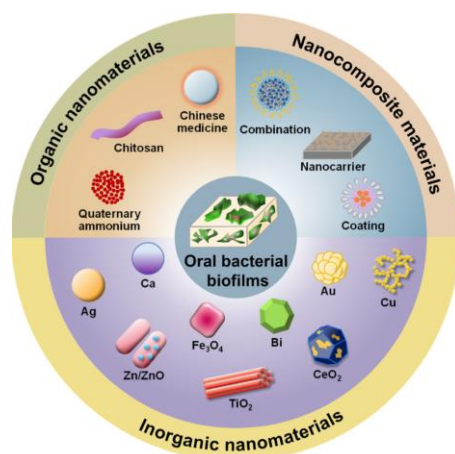


Figure 7. Different Types of Nanomaterials for Antimicrobial Therapy.

Higher safety, plasma sterilization uses hydrogen peroxide (H_2O_2) as a sterilant, which decomposes into water and oxygen after sterilization, leaving no harmful residue. Short sterilization cycle. Plasma sterilization is usually completed within 45-75 minutes, while EO sterilization requires 6-12 hours of sterilization time. Plasma sterilization does not emit toxic gases, while EO sterilization requires a special ventilation system to remove ethylene oxide gas [8].

1.4.3. Statistics and Long-Term Tracking

Combined with hospital infection data, compare the actual effects of new and old sterilization methods in reducing infection rates, reducing equipment damage and improving hospital operating efficiency [9].

Continuously monitor key indicators such as equipment sterilization cycle, cost consumption, and medical staff satisfaction to optimize strategies.

1.5. Summarize

By applying new technologies such as plasma sterilization, UV + photocatalysis, supercritical CO_2 sterilization, and nano-antibacterial coatings to hospital sterilization work, sterilization efficiency can be significantly improved, equipment loss can be reduced, and patient safety can be improved. Formulating a reasonable strategic implementation plan and combining evidence-based medical data to evaluate the effectiveness of the plan will ensure the successful implementation and long-term application of new technologies [4]. In the future, hospitals can further explore AI intelligent sterilization systems to achieve full-process monitoring and optimization and provide more advanced technical support for hospital infection prevention and control [10].

2. Critical Evaluation and Improvement Plan of Interdisciplinary Medical Service Model

2.1. Case Evaluation

Chronic Disease Management Team of Mayo Clinic in the United States: (As shown in Figure 8).



Figure 8. Mayo Clinic

Chronic diseases such as diabetes and hypertension require long-term management, but it is difficult for a single doctor to provide comprehensive care. Therefore, Mayo Clinic has established an interdisciplinary team for chronic disease management, including endocrinologists, nutritionists, sports therapists, nurses and psychologists to provide patients with comprehensive health management. Experts from different disciplines consult regularly to reduce the possibility of misdiagnosis and treatment deviation. Including drug therapy, diet adjustment, exercise plan and psychological support. However, due to the large amount of investment in the early stage, the effect cycle of Mayo Clinic was long. In 2021, Charlie Munger, vice chairman of Berkshire Hathaway, donated US\$200 million to Mayo Clinic. In 2023, Mayo Clinic's research projects received more than US\$500 million in external funding. Mayo Clinic received a lot of external funding support and was able to invest in medical research. At the same time, medical personnel of different professions have deviations in treatment concepts, and in the era of underdeveloped information, the information sharing system is imperfect.

Effects: The control rate of blood sugar and blood pressure of patients has improved, the occurrence of complications has been reduced, and the quality of life has been improved.

2.2. Evaluation of Interdisciplinary Medical Care Models

2.2.1. Advantage

The interdisciplinary medical service model can bring together the strengths of experts, improve medical quality, and increase the accuracy of diagnosis [11]. The cooperation of multidisciplinary teams is conducive to avoiding the limitations of a single discipline, optimizing treatment plans, improving efficacy, improving the cooperation ability of medical teams, and reducing medical errors. It helps to promote medical research, innovation, and development [12].

2.2.2. Disadvantages

1) Insufficient interdisciplinary collaboration: Nutritionists, pharmacists and food service staff in the medical team often work independently and lack effective communication mechanisms. For example, the diet plan formulated by the nutritionist for the patient may not match the medication management recommendations of the pharmacist, affecting the treatment effect [1].

2) Limited information sharing: The problem of data islands is serious, and different departments and departments use their own independent systems. For example: doctors rely on electronic medical records, the pharmacy department uses a drug management system, the nutrition department uses a dietary assessment software, and the nursing team relies on a nursing management system. Hospital information systems (HIS) are usually based on departments, resulting in the failure to efficiently share patients' nutritional status, drug use and dietary arrangements [4].

3) Lack of systematic evaluation and feedback: There is a lack of systematic evaluation and feedback mechanisms. Due to too many people, the feedback results are difficult to unify. The effect of team collaboration is difficult to measure, and there is a lack of feedback from patients and medical staff. The interdisciplinary team's follow-up mechanism after the patient is discharged from the hospital is imperfect, making it difficult to evaluate the long-term effects of nutritional interventions, and it is difficult to continuously optimize the patient's dietary management outside the hospital, resulting in limited chronic disease management effects [13].

2.3. Improvement Plan

Establishing the "Nutrition-Pharmacy-Dietetic Integration (NPD) Collaborative Model" In order to solve the shortcomings of the current model, the "Nutrition-Pharmacy-Dietary Integration" (NPD) collaborative model is proposed to strengthen the integration between nutritionists, pharmacists and dietary service teams, optimize patient dietary management through nutrition, pharmacy and dietary services, improve drug treatment effects, reduce adverse reactions, and achieve precision medicine and individualized care [14].

2.4. Key Strategies

2.4.1. Establish a "Nutrition-Pharmacy-Diet Collaborative Team"

A fixed team of nutritionists, pharmacists, clinicians, and hospital food service staff provides comprehensive assessment and intervention programs for patients. Establish an electronic health record (EHR) sharing platform to enable team members to access patient data in real time. Set up regular meetings (such as once a week) to discuss the diet-drug matching of inpatients and dynamically adjust the program based on the condition [15]. The composition of the team and the responsibilities of each member are summarized in Table 2.

Table 2. Composition and Responsibilities of the NPD Collaborative Team

Team members	Main Responsibilities
Clinical Nutritionist	Assess the patient's nutritional status and develop a personalized meal plan
Clinical Pharmacist	Assess the nutritional impact of medications and provide advice on drug-food interactions
Food service staff	Adjust hospital meals according to nutrition plan and provide appropriate dietary choices
doctor	Supervise and integrate interdisciplinary collaboration to ensure the scientific nature of medical plans
Data Analyst	Monitor patients' long-term health data on diet, medicine and nutrition to provide decision support

2.4.2. Develop a "nutrition-Drug-Diet Sharing System" (Intelligent Food-Drug Interaction Management System)

Establish an interdisciplinary sharing module so that nutritionists, pharmacists and food service teams can simultaneously access patients' medication status, allergy history, dietary preferences and medical records. Set up an intelligent reminder system, combined with the hospital's electronic medical record (EHR), to automatically remind doctors/pharmacists to avoid specific foods that affect the efficacy of drugs when prescribing. Combined with the nutrition guide to build a drug-food interaction database, covering high-risk foods (such as grapefruit, dairy products, etc.) [12]. Provide accurate dietary advice

2.4.3. Individualized Nutritional Intervention and Intelligent Dietary Management

Combining AI and big data analysis, we analyze patients' medication use, disease type, and dietary habits to provide patients with personalized nutrition plans that match their medication use and health needs [16]. For example, the diet plan for diabetic patients

can automatically adjust the carbohydrate intake ratio and coordinate insulin dosage with pharmacists.

2.4.4. Implementation

The NPD collaborative model is implemented in four phases, each with a defined focus and a set of specific measures, as summarized in Table 3.

Table 3. Implementation Phases of the NPD Collaborative Model

Stage	Implementation content	Specific measures
Phase 1 (0-6 months)	Request analysis and system construction	Form an interdisciplinary team, develop an information sharing platform, and formulate standardized processes
Phase 2 (6-12 months)	Pilot application and optimization	Pilot operation in specific wards (e.g. diabetes department, cardiovascular department) to collect data and optimize processes
Phase 3 (12-24 months)	Hospital-wide promotion	Promote the NPD model throughout the hospital and incorporate it into the hospital's standard nursing process
Phase 4 (24 months later)	Long-term monitoring and improvement	Evaluate long-term effects and continuously optimize the nutrition-pharmacy-dietary collaboration mechanism based on patient feedback

2.5. Potential Advantages and Challenges

Potential Advantages: Improve patient safety: Avoid drug-food interactions (such as conflicts between antihypertensive drugs and high-sodium diets) through collaboration between nutritionists and pharmacists [17].

Optimize individualized treatment: Dynamically adjust dietary plans based on the condition and drug response to improve patient recovery [4].

2. Improve medical quality and efficiency: Intelligent systems assist medical decision-making and improve the accuracy of food-drug management. Improve the efficiency of the medical team and reduce decision-making errors caused by information asymmetry of medical staff

3. Medical Record Service Evaluation and Innovative Digital Solutions

3.1. Medical Record Service Evaluation

3.1.1. Advantages

It is conducive to building a safety risk prevention system to improve the quality of outpatient, emergency and hospitalization. Standardized diagnosis and treatment, standardized implementation of diagnosis and treatment processes, is conducive to the standardization of surgical operations and improves the quality of medical records. It is also conducive to the evaluation of nursing staff's work, the implementation of norms and standards, and the management of drugs, mainly for medication issues, antibiotics/basic drugs and other rational medication matters [18].

3.1.2. Disadvantages

Data accuracy issues: Since medical record entry still relies on manual work, there are data entry errors, duplicate records or incomplete records. Paper medical records are still used in some hospitals, resulting in delayed data entry and affecting real-time performance. Limited accessibility: The sharing of medical records between different departments such as doctors, nurses, and pharmacists is inefficient, and the patient's complete medical history may not be accessible in real time in all diagnosis and treatment scenarios. It is difficult for individual patients to access or manage their own medical data, which limits the information continuity of patients when they visit hospitals across hospitals [19]. Low operational efficiency: The existing EHR system interface is complex,

and medical staff need to spend a lot of time filling out medical records, which affects clinical work efficiency. Medical data retrieval is slow, and querying medical history and treatment records may require multiple steps. Data security and privacy risks: Due to the high sensitivity of medical data, traditional EHR systems are prone to risks such as data leakage and unauthorized access. The lack of standardized data sharing agreements between hospitals makes cross-institutional data exchange difficult.

3.1.3. Efficiency

It is conducive to improving the efficiency of medical services, reducing paper medical records, preventing loss, and retrieving files at any time, which is conducive to improving efficiency and improving the evaluation standards of medical and health service quality, including medical technology level, medical safety, medical ethics, service attitude and patient satisfaction [20].

3.2. Innovative Digital Solutions

In order to improve the accuracy, accessibility and efficiency of medical records, the "Smart Medical Record (Smart EHR)" solution is proposed, combining artificial intelligence, blockchain and cloud computing technologies to achieve efficient and secure medical record management.

Key Technological Innovations: (1) Artificial intelligence (AI) assisted medical record entry Using voice recognition + natural language processing (NLP) to support doctors to automatically generate medical records through voice input, improving entry efficiency. AI automatically checks incomplete or erroneous information in medical records and provides intelligent correction suggestions.

(2) Blockchain technology ensures data security Using blockchain encrypted storage to ensure the immutability and access rights management of medical records. Allowing patients to authorize medical institutions to access their medical records to improve the interoperability of medical data across hospitals [21].

(3) Cloud EHR platform for real-time sharing Supporting access from multiple terminals (PC, mobile phones, tablets) through cloud computing, making it convenient for medical staff to query patient information at any time. Combined with 5G network, telemedicine and cross-institutional data synchronization can be achieved.

3.3. Resource Education and Staff Training Implementation Plan

Resource Allocation and Staff Training: The rollout of the Smart EHR platform is organized into four phases. Table 4 sets out the resource allocation and the training focus required at each stage.

Table 4. Resource Allocation and Staff Training Plan for the Smart EHR Implementation

stage	Implementation content	Resource Allocation	Training Focus
Phase 1 (0-6 months)	Requirements analysis and system development	Establish a cross-departmental technical team to develop AI data entry + blockchain EHR platform	Organize doctors, nurses and IT personnel to participate in demand survey
Phase 2 (6-12 months)	Pilot operation	Pilot operation in specific departments (such as emergency department, ICU) and optimize the system	Train medical staff to use AI data entry and cloud query functions
Phase 3 (12-24 months)	Hospital-wide promotion	Fully deploy in hospitals and establish data sharing mechanisms with external institutions	Establish data security training to strengthen privacy protection awareness

Phase 4 (24 months later)	Continuous Optimization	Optimize smart health record functions based on patient feedback	Remotely train patients on the use of personal health data management tools
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3.4. Potential Impact

3.4.1. Impact on Patient Care

It can improve the accuracy of diagnosis and treatment. AI-assisted medical record input reduces human errors and improves the integrity of medical records. Improve medical experience: Through smart health records, patients can view medical records, examination reports and medication records independently to improve transparency. The telemedicine function allows patients to have video consultations with doctors at home to improve the efficiency of chronic disease management [9]. It can help collect patient data, analyze patient data, record and warn patients' various physical indicators, and appropriately reduce the burden on nurses and improve the efficiency of nursing.

3.4.2. Impact on Medical Management

Improve hospital operation efficiency: Medical staff can quickly record medical records through voice or automation, reduce paperwork time, and devote more energy to clinical practice [22]. Data storage is cloud-based, reducing the cost of archiving paper medical records and improving data management efficiency. Digital medicine is not only offline electronic diagnosis and treatment, but also telemedicine, which is characterized by being free from time and space constraints. Patients can obtain doctor's diagnosis and treatment suggestions in a timely manner through online consultation and remote testing. In this way, patients can obtain self-service through digital transformation, and the quality of doctor-patient interaction will be effectively improved [7].

3.4.3. Adverse Effects

Doctors and nurses may over-rely on smart systems and reduce direct communication with patients. Smart health data monitoring can automatically identify abnormal indicators and issue early warnings, but it may lead to over-medicalization. The elderly, patients in rural areas or with low technical capabilities may not be able to effectively use smart health records or telemedicine, leading to inequality in medical services [23].

4. Summary and Reflection on Innovation of Medical Support Services

4.1. Summary of Innovative Approaches to Sterilization, Interdisciplinary Care, and Medical Record Services

1. Sterilization service innovation. Use intelligent monitoring systems to track sterilization processes to ensure compliance with standards and reduce human errors. Combine emerging technologies (such as plasma sterilization, UV-C sterilization, and nano-antimicrobial coatings) to improve sterilization effectiveness and efficiency. Improve resource utilization and reduce costs through data-driven optimization (such as AI analysis of sterilization data).

2. Interdisciplinary medical service innovation. Launch the "Nutrition-Pharmacy-Dietary Integration (NPD)" model to strengthen the collaboration of nutritionists, pharmacists, and dietary service teams to improve the quality of chronic disease management. Establish an information sharing system to ensure that patients' diets, medications, and nutrition plans match each other to reduce cross-influence. Provide personalized health management, combine AI and telemedicine technology to develop accurate nutrition and medication plans for patients.

Medical record service innovation. Use AI+voice recognition to assist in medical record entry, improve data accuracy, and reduce the burden of paperwork for doctors.

4.2. Benefits: Innovation in Medical Support Services

Real-time data sharing is provided through cloud EHR, which improves the convenience of medical teams to access medical records and reduces repeated examinations. Blockchain technology is used to ensure data security, allowing patients to authorize cross-institutional access to medical records and improve the efficiency of medical collaboration.

1) Improve patient safety and nursing quality. Precise sterilization reduces the risk of hospital infections (HAIs) and improves patient safety. Smart EHR reduces human errors and enables doctors to obtain complete medical history and related information more quickly. Interdisciplinary collaboration ensures the scientific nature of treatment plans and improves treatment effects.

2) Enhance patient experience and improve medical transparency. Through the smart medical record system, patients can view their medical history at any time and improve the autonomy of health management. Telemedicine and personalized diet management improve the long-term care effect of patients with chronic diseases.

3) Promote innovation and sustainable development of medical institutions. Data-driven intelligent decision-making improves hospital management capabilities, adopts emerging technologies to optimize service models, and enhances hospital influence.

5. Conclusion

Innovation in medical support services has a profound impact on improving patient care quality, optimizing medical operations, and promoting sustainable development of the industry. Through intelligent sterilization technology, interdisciplinary collaboration models, and digital EHR systems, the accuracy, efficiency, and safety of medical services can be effectively improved. At the same time, medical organizations need to establish a long-term innovation culture through incentive mechanisms, interdisciplinary collaboration, digital empowerment, and other strategies to ensure that innovative results can be continuously implemented and ultimately improve the quality and accessibility of the global medical system.

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