

## Guest Editorial

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# Introduction to the special section on enabling technologies for Healthcare 5.0

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The rapid evolution of digital health is shaping a new era in healthcare, making it accessible to individuals of all ages. As technology advances, digital healthcare has become an integral part of daily life, seamlessly integrating wireless technologies into traditional medical practices, including diagnosis, monitoring, and treatment. This integration is transforming healthcare services, significantly enhancing the quality of care, improving patient access, and ultimately elevating the quality of life. The emergence of Healthcare 5.0 signals the start of a new healthcare paradigm, shifting the focus toward a more user-centric, personalized model of care.

Despite the numerous benefits of integrating artificial intelligence (AI) and Internet of Things (IoT) into healthcare, the journey toward Healthcare 5.0 demands ongoing innovation and research. Seamless data transmission and advanced communication technologies are essential for the safe and efficient management of high-risk medical services. Achieving these goals requires significant research and development in areas such as real-time health record processing, clinical data analysis, enhanced medication safety, and reliable connectivity.

In this special section, we invited researchers and practitioners to share their novel ideas and innovations on enabling technologies for Healthcare 5.0. The papers submitted to this special section underwent a rigorous review process, culminating in the selection of twenty-five high-quality papers for inclusion in this special section. These papers offer in-depth studies that address key challenges and present practical solutions for the development and implementation of enabling technologies for Healthcare 5.0. They highlight cutting-edge research and explore innovative approaches shaping the future of healthcare, with a focus on AI, IoT, data communication, and patient-centered care.

In the paper titled “**Enhancing security in wireless body area networks (WBANs) with ECC-based Diffie-Hellman key exchange algorithm (ECDH)**,” the authors use the Elliptic Curve Cryptography (ECC)-based Diffie-Hellman Key Exchange (ECDH) technique to enhance security in WBANs. The research focuses on the sensitive nature of medical data transmission in WBANs and evaluates the suitability and performance of ECDH for secure key exchange. The results revealed that the ECDH

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algorithm provides a robust and computationally efficient solution, addressing key vulnerabilities in WBANs. In addition, the adoption of ECC-based ECDH can significantly improve data confidentiality and integrity, fostering trust in WBAN systems. This instrument is anticipated to enhance the security framework of healthcare applications utilizing WBANs, contributing to the growing body of knowledge on security in medical data transmission.

In the paper titled **“Evaluation of severe ultrasound and gene diagnosis in cardiac index and shock patient index of shock patients,”** the authors investigate the application of severe ultrasound as a noninvasive method to evaluate renal blood flow in patients with septic shock. The research highlights the vulnerability of the kidney in severe patients, where the fatality rate of acute kidney injury can reach 30% to 60%. The study focuses on the Resistance Index (RI), which reflects renal artery blood flow, and examines its relationship with hemodynamic regulation in septic shock patients. The findings reveal that the P values before and after resuscitation in the two groups with and without elevated Cardiac Output (CO) were 0.41 and 0.12, respectively, both greater than 0.05. This indicates that RI has no significant relationship with CO and suggests that RI should not be used as an evaluation index for patients experiencing early septic shock.

In the paper titled **“Systematic quantitative evaluation of gene polymorphism and therapeutic effect of xingnaojing injection in patients with brain injury,”** the authors investigate the rising incidence of brain injuries caused primarily by falls and traffic accidents. The study systematically evaluates the therapeutic role of Xingnaojing injection by comparing Glasgow Coma Scale (GCS) scores, intracranial pressure changes, and post-injury complications. It also explores the impact of gene polymorphism, focusing on APOE2,  $\epsilon$ 3, and  $\epsilon$ 4 alleles. All patients underwent thorough neurological assessments and received Xingnaojing injection along with sodium chloride post-surgery. The findings reveal a 27% incidence of epilepsy after brain injury, providing insights into the severity and prognosis of brain injuries.

In the paper titled **“Effect of double swing jump rope training on lower limb muscle strength of badminton players,”** the authors investigate a ten-week intervention to assess how double swing jump rope training affects lower limb muscle strength in badminton players. The study measures heart rate and muscle strength before and after training. Results show that this training method enhances anaerobic and aerobic capacity, improves recovery, and positively impacts lower limb muscle strength. The findings suggest that incorporating double swing jump rope training into badminton programs can effectively strengthen lower limbs and enrich training approaches in sports colleges.

In the paper titled **“Analysis of nursing effect of five tone therapy combined with acupoint massage on chemotherapy of lung cancer,”** the authors study 80 lung cancer patients undergoing chemotherapy, randomly assigned to treatment and control groups of 40 each. The treatment group received chemotherapy combined with a 5-HT3 blocker (granisetron) and acupoint massage with pentatone therapy to alleviate nausea and vomiting. The control group received only the 5-HT3 blocker with chemotherapy. Results showed a total effective rate of 92.5% in the treatment group (13 controlled, 15 markedly effective, 9 effective) compared to 85.0% in the control group (6 controlled, 16 markedly effective, 12 effective). This suggests that the combined approach is more effective in managing chemotherapy-related symptoms.

In the paper titled **“Observations of the effectiveness, dosage, and prognosis of intensity-modulated radiation therapy under ultrasonic guidance for cervical cancer patients,”** the authors analyze the effectiveness of volumetric modulated arc therapy (VMAT) guided by ultrasound in 128 cervical cancer patients. The observation group receiving VMAT showed a higher effectiveness rate (80.30% vs. 64.52%) and better one-year survival (90.48% vs. 73.33%) compared to the control group on conventional radiotherapy. Additionally, the observation group had lower radiation dosages and improved serum marker levels (CEA, SCC-Ag, CA724). These results suggest that ultrasound-guided VMAT is effective and may enhance treatment outcomes in cervical cancer patients.

In the paper titled **“Research on prediction and evaluation algorithm of sports athletes performance based on neural network,”** the authors focus on enhancing athlete performance prediction in UFC events using a recurrent neural network model based on BiLSTM. By constructing athlete profiles and analyzing their characteristics, the study experimentally evaluates the model’s effectiveness. Results indicate that the proposed prediction model achieves an overall accuracy of 0.7524, outperforming classical models like Linear Regression and MLP. This research contributes to improving athlete training and performance evaluation in professional sports.

In the paper titled **“Application of detailed nursing management intervention in neurosurgical nursing,”** the authors aim to enhance postoperative recovery in neurosurgical patients through detailed nursing management. A study involving 100 patients, divided into a detailed nursing management group (50 patients) and a traditional nursing management group (50 patients), was conducted from March 2021 to March 2022. Results indicated that patients receiving detailed nursing management experienced better overall treatment outcomes, reduced complications, and higher satisfaction compared to the traditional group. This research supports the effectiveness of detailed nursing interventions in improving the quality of care and recovery for neurosurgical patients.

In the paper titled **“Correlation between serum uric acid level and atrial fibrillation in patients with hyperthyroidism on medical data analysis context of IOT,”** the authors investigate the relationship between blood uric acid levels and atrial fibrillation in hyperthyroid patients. The study compares physiological indices of patients with and without atrial fibrillation symptoms, utilizing clinical and demographic data, along with blood tests. Hyperthyroid patients were grouped for analysis, and factors such as renal function, blood lipid levels, and thyroid function were examined through regression analysis. The findings indicate that elevated uric acid levels are associated with atrial fibrillation, highlighting the potential impact of hyperthyroidism on cardiovascular health.

In the paper titled **“Impact of continuous care on quality life of patients with inflammatory bowel disease based on multi-disciplinary cooperation on WeChat platform,”** the authors explore the effects of continuous empowerment education based on Roy’s adaptation theory on disease uncertainty and self-management abilities in patients with inflammatory bowel disease (IBD). The study involved sixty hospitalized IBD patients, divided into an intervention group receiving multidisciplinary care via WeChat and a control group receiving standard care. The results indicated that the intervention group exhibited lower levels of disease uncertainty and higher self-care competence, health awareness, and patient satisfaction, demonstrating that continuous empowerment education significantly enhances the quality of life for IBD patients.

In the paper titled **“Circulating long noncoding RNA, Zfp2-As1 and Xist based on medical data analysis are potential plasma biomarkers for gastric cancer diagnosis,”** the authors investigate the potential of circulating long noncoding RNAs (lncRNAs) ZFPM2-AS1 and XIST as biomarkers for diagnosing gastric cancer (GC). The study analyzed plasma samples from 20 early GC cases, 100 GC cases, and 90 normal subjects, revealing that both lncRNAs were significantly elevated in GC patients compared to normal subjects. ROC analysis showed AUC values of 0.62 for ZFPM2-AS1 and 0.68 for XIST, with a combined AUC of 0.751 when including CA-724. The findings suggest that ZFPM2-AS1 and XIST are promising plasma biomarkers for the diagnosis of gastric cancer.

In the paper titled **“Study on preparation technology of Qiyu constitution Yangsheng Granules,”** the authors develop a formula for “Qi Yu” granules to address liver stagnation and spleen deficiency linked to individual constitution and diet. The study focuses on preserving active ingredients from selected medicinal plants using network pharmacology and modern preparation techniques. It aims to create a factory-compatible manufacturing process for a portable health product, including herb selection, granule formulation, clinical trials, quality control, and data compilation for publication.

In the paper titled “**Visual analysis and interactive interface design of students’ abnormal behavior introducing clustering algorithm,**” the authors propose a visualization tool to address the shortcomings of traditional methods in analyzing students’ abnormal behaviors. Utilizing the K-means clustering algorithm, they identify abnormal patterns from a large dataset and create an interactive interface for visualizing results and conducting analysis. Experimental findings demonstrate the method’s effectiveness in detecting and visualizing these behaviors, offering a new approach for student management in education. Future research will aim to refine the method for more complex data.

In the paper titled “**CNN-based glioma detection in MRI: A deep learning approach,**” the authors develop an automated glioma segmentation algorithm using Convolutional Neural Networks (CNNs) to enhance tumor identification in MRI scans. Analyzing 285 MRI scans of high-grade and low-grade gliomas, they employed a U-Net network for segmentation, achieving DICE coefficients of 0.7331 for tumor core with contrast, 0.8624 for total tumor, and 0.7267 for tumor nucleus without contrast. The results indicate that the CNN-based system matches the accuracy of experienced radiologists, offering a significant improvement in diagnostic precision for brain tumors and suggesting future advancements in medical imaging.

In the paper titled “**A meta-analysis of the effect of mindfulness therapy on infertile female patients,**” the authors conduct a systematic review and meta-analysis of randomized controlled trials (RCTs) to evaluate the efficacy of mindfulness-based interventions for infertility-related issues. Analyzing 14 RCTs with 1,784 participants, the results indicate that mindfulness therapy significantly alleviates anxiety (SMD =  $-2.25$ ), depression (SMD =  $-2.25$ ), and perceived stress (SMD =  $-0.99$ ), while improving quality of life and physiological function. The study concludes that mindfulness therapy effectively enhances mental well-being in infertile women, though it calls for larger, multi-center RCTs to strengthen the evidence base.

In the paper titled “**Study on correlation between the level of insulin resistance and changes in the degree of cerebral atherosclerosis in non-diabetic patients,**” the authors investigate the relationship between insulin resistance (IR) and cerebral atherosclerosis (AS) in non-diabetic patients suffering from cerebral infarction. The study analyzed 134 patients who underwent MRA/CTA imaging, dividing them into mild and severe AS groups based on findings. Results revealed a significant difference in IR levels, measured by HOMA-IR, between the groups ( $P < 0.05$ ), with a strong positive correlation between HOMA-IR and AS severity ( $r = 0.850$ ,  $P < 0.05$ ). The study concludes that higher IR levels are associated with more severe cerebral AS in non-diabetic patients with cerebral infarction.

In the paper titled “**Nano-lamellar H-ZSM-5 molecular sieves for enhanced indoor air purification: Synthesis and adsorption characterization,**” the authors present the synthesis of novel bola-type surfactant-templated H-ZSM-5 molecular sieves with a nanosheet structure. Using a hydrothermal method, they achieved successful preparation and characterized the materials through various techniques, including X-ray diffraction and electron microscopy. The study found that traditional microporous ZSM-5 had lower formaldehyde adsorption, while the nano-lamellar H-ZSM-5 effectively adsorbed larger molecular volatile organic compounds (VOCs) such as toluene. The results suggest that these molecular sieves are promising for improving indoor air quality by effectively removing larger VOCs.

In the paper titled “**An automated ECG-based deep learning for the early-stage identification and classification of cardiovascular disease,**” the author explores enhancing cardiovascular disease (CVD) diagnosis through Electrocardiograms (ECGs) and deep learning. It introduces a novel method using a Feed Forward Neural Network (FFNN) that combines symptom-based detection with ECG analysis, employing chaos theory and the constant-Q non-stationary Gabor transform (CQNGT) to convert one-dimensional ECG data into two-dimensional images. Experimental results indicate that

the FFNN-CQNGT model achieves a precision of 94.89%, accuracy of 95.55%, specificity of 93.77%, sensitivity of 93.99%, and a mean squared error (MSE) of 40.32%, outperforming existing diagnostic methods and offering a promising solution for improving CVD diagnosis.

In the paper titled **“Establishment and analysis of quality index system for pediatric tumor nursing,”** the authors aim to create a rigorous evaluation framework for pediatric tumor nursing quality. Utilizing the “structure-process-result” model, they conducted a Delphi method-based survey among experts in pediatrics and pediatric oncology. Two rounds of consultation yielded a high response rate and indicated strong agreement among experts regarding the importance of various quality indicators. The final quality index system consists of 3 Level-1 indicators, 12 Level-2 indicators, and 54 Level-3 indicators, with over 94.7% scoring above the threshold of 3.50. This comprehensive system seeks to standardize pediatric tumor nursing practices and support the ongoing development of specialized care in this field.

In the paper titled **“The intervention effect of psychological care combined with ondansetron, dexamethasone, and promethazine hydrochloride on chemotherapy in breast cancer surgical patients,”** the author assesses the impact of combining psychological care with antiemetic medications on chemotherapy-induced nausea and vomiting in breast cancer patients. Involving 64 patients, the study found that the intervention group receiving ondansetron, dexamethasone, promethazine hydrochloride, and psychological support experienced significantly better control of nausea and vomiting, reduced anxiety, and improved nursing satisfaction compared to the control group, although quality of life scores showed no significant difference. The findings suggest that this combined approach enhances patient care during chemotherapy.

In the paper titled **“Correlation between choroidal thickness and the degree of myopia,”** the authors investigate the relationship between choroidal thickness (CT) and myopia severity among 95 myopic patients aged 18 to 50. Using measurements of CT at the macular center and other ocular parameters, the results indicate that CT is thickest at the macular center and correlates significantly with axial length (AL) and spherical equivalent (SE). Specifically, a negative relationship was found between AL and CT ( $SC = -0.596$ ,  $P < 0.000$ ) and a positive correlation between SE and CT ( $SC = 0.205$ ,  $P = 0.013$ ). These findings enhance the understanding of myopia’s pathogenesis and support early screening and personalized management strategies to slow myopia progression and prevent complications.

In the paper titled **“Secure data communication in WSHN using EXP-MD5 and DHSK-ECC,”** the authors present a framework for secure data communication in Wireless Sensor Health Networks (WSHN) utilizing EXP-MD5 and DHSK-ECC techniques. The study enhances data security through multi-level authentication for patient registration, ensuring that only authorized personnel can access health information. Patient data is encrypted post-consultation to prevent unauthorized access. The process involves generating public and private keys, using QR codes for authentication, and employing the DHSK-ECC algorithm for secure data transmission. This approach facilitates continuous health monitoring while protecting sensitive medical records.

In the paper titled **“Enhancing security in digitized healthcare system using blockchain technology,”** the authors propose a solution to improve the security and integrity of patient data collected by medical devices like ECGs and thermometers. Recognizing that traditional centralized databases are vulnerable to hacking and data tampering, the study advocates for utilizing blockchain technology to store patient information in a decentralized manner. This approach not only enhances data security and transparency but also employs Provable Data Possession to allow users to verify the integrity of their information. The integration of these technologies aims to benefit both the medical field and patients by ensuring secure, scalable, and trustworthy healthcare data management.

In the paper titled **“The effectiveness of deep learning model in differentiating benign and malignant pulmonary nodules on spiral CT,”** the authors evaluate a deep learning (DL) model’s ability to classify lung nodules in 120 patients. The DL model achieved an area under the curve (AUC) of 0.81, with accuracy, sensitivity, and specificity rates of 73.33%, 78.75%, and 62.50%, respectively, outperforming radiologists’ diagnostic metrics. However, the differences were not statistically significant, indicating that the DL model is a promising tool for pulmonary nodule differentiation.

In the paper titled **“Immunotherapy and liver cancer research trends and the 100 most cited articles: A bibliometric analysis,”** the authors conduct a bibliometric analysis of liver cancer research focused on immunotherapy, revealing significant insights into the field. Analyzing the Scopus database, they identified 2,349 papers, with the top 100 articles cited between 127 and 4,959 times; the most cited article discussed tumor microenvironmental regulation. Key journals contributing to this research include the *Journal of Hepatology* and *Hepatology*. The findings highlight the importance of understanding molecular mechanisms and prognostic indicators to advance combination therapies in liver cancer treatment.

We believe that all papers included in this special section will make a valuable and significant scientific contribution to the field. We extend our sincere gratitude to all authors for their exemplary efforts in writing these articles and for their dedication in revising them based on the reviewers’ feedback. Additionally, we would like to express our deep appreciation to the Editor-in-Chief of the *Journal* for providing us with the opportunity to publish this special section and for offering unwavering support throughout the entire publication process.

We hope this special section serves as a unique platform that brings together novel and innovative research in the areas of enabling technologies for Healthcare 5.0, fostering advancements and discussions that will shape the future of healthcare.