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Original Article

Identification of psychological stressors in cancer patients based on a computer decision support nursing system

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Abstract: Objective: We aim to improve the decision-making process of nursing evaluation, and the purpose of this paper was to introduce nursing outcome classifications based on standardized nursing language, as well as build a comprehensive nursing evaluation decision-making system model based on an artificial neural network and fuzzy comprehensive evaluations. Methods: Based on the principle and method of the decision support system (DSS), this paper proposed a framework of DSS and developed an intelligent nursing decision support system which integrates expert systems, data, models and knowledge. Results: Taking cancer patients as examples, based on the analysis and comparison of cancer stressors and their frequency of occurrence, this paper found that the 5 major factors for cancer patients' stress events were lack of privacy, attitude of the medical workers, unfamiliar medical workers and uncomfortable temperature in wards. In addition, through the single factor analysis of the stressors, it was found that "the impact of hospitalization on individuals and their families", "the professional level and service attitude of medical workers", and "partial loss of free social contact in the hospital" were all positively correlated with stress level. The degree of cancer patients' participation in treatment decision-making was lower than the expectation of the patients. There was a statistically significant difference between the actual participation and the anticipated participation of cancer patients in nursing decision-making ($P < 0.0001$). In addition, the system helped patients adapt to the hospital environment as quickly as possible, so that they could feel comfortable in the hospital environment, as well as a relaxed and pleasant with the humanistic environment. Conclusion: Cancer patients have a variety of stressors, and the pressure is high. Our computer decision support nursing system assisted nurses to help patients to take positive coping measures to relieve pressure as soon as possible, so as to improve their quality of life.

Keywords: Decision support system, tumour patients, pressure source, neural algorithm

Introduction

In the present knowledge-based economy, nursing care is becoming increasingly complex, and problems such as access to professional care, fragmented care, safety, quality and cost are more prominent [1]. Effective decision-making processes can promote professionalization of health services [2]. The emergence of health information technology such as clinical decision support system and electronic medical records has promoted reform and innovation with nursing service delivery modes [3]. The latest nursing procedures are based on standardized nursing language and include scientific assessment, nursing diagnosis, intervention and patient outcome sorting [4].

Pressure in this context, refers to a need in a relationship between an individual and the environment that exceeds the individual's adaptive resources. The occurrence of stress in patients with malignant lymphoma during chemotherapy intermission is due to the challenges, threats, and injuries caused by the interaction between patients and their environment [5], which exceeds their response resources and therefore is considered to be stressful. The total stress level of cancer patients is medium to high, among which the stress sources related to

disease, disease prognosis, physical discomfort and disease diagnosis are among the top three. The second factor is chemotherapy-related stress, including chemotherapy effect, fear of chemotherapy side effects, chemotherapy regimen, health guidance and economic burden [6]. Research [7] has shown that when considering the perspectives of cancer patients, families and medical personnel, no treatment plan is perfect, and the optimal treatment decisions vary based on the individual decision maker and the type of decision. The values or preferences of the decision makers play a crucial role in treatment decisions. A shared decision-making mode is a way for clinical medical workers and patients to fully communicate with each other on disease conditions, treatment plan information and patient values, etc. to jointly make treatment decisions [8]. When patients are first admitted to hospital, their treatment ideals can be focused on doubt, denial, fear and anxiety, along with physiological manifestations of insomnia and loss of appetite [9]. After diagnosis, the feelings can be anger, need to vent, abandonment, aggressive behaviour and refusal to cooperate with treatment and care [10]. In the process of continuous treatment, patients suffer great pain and lose confidence in their care, so that they are in a pessimistic and desperate psychological state [11]. A clinical decision support system can match patient characteristics with computer coded expert knowledge by applying clinical decision software, provide relevant information for specific patients, and help nurses implement advanced nursing procedures [5]. The clinical decision support system based on artificial intelligence technology is considered as an effective tool to improve both the quality of patient care and the work efficiency of medical workers, making it a hot spot in the research field of health information [12]. The electronic medical records can lay a foundation for the clinical decision support system. Previous researchers have integrated the clinical decision support system from the information network provided by the electronic medical records to carry out warnings, prevention, diagnosis and intervention based on the decision support system [13]. Although the clinical decision support system (DSS) is of great significance in providing advice regarding diagnosis, prevention and treatment to medical workers and assisting in patient diagnosis and treatment behaviour, it still faces many technical challenges.

Firouzi et al. [14] found that intervention measures with information and social support and emotional management improved the perceptual control of cancer patients and reduced their anxiety. Chen et al. [15] conducted cognitive behavioural therapy intervention on patients after chemotherapy and found an improvement in patient perceptual control ability and many posttreatment problems. Ellington et al. [16] designed two intervention methods, internet-based cognitive behavioural therapy and problem-solving therapy, which reduced the negative emotions of cancer patients and improved their perceptual control ability. Sund et al. [17] tested the stress level of children with cancer and found that their perceptual control was improved, and their anxiety was reduced. El-Jawahri et al. [18] found that stress management for patients after chemotherapy improved their perceptual control ability and promoted their physical and mental health. Argyris [19] adopted pretreatment intervention to improve the perceptual control ability and quality of life of cancer patients after chemotherapy after discharge. Mork [20] used cognitive behavioural therapy to intervene on the stress level of cancer patients, which improved the patients' perceptual control ability and reduced their anxiety and depression. For example, scientific knowledge and patient data sets are usually located in large files ("information islands") in the database, so the current use of knowledge based "production rules" to express expert opinions, and scientific and advanced nursing procedures based on standardized nursing language are unsatisfactory [21].

With the development of health information technology and the popularization of information systems, science and nursing continue to be integrated, and the collection, integration, interaction and sharing of data and knowledge have gradually become the key components to achieve professional and personalized patient care [22]. Therefore, by introducing a comprehensive evaluation model and artificial neural network comprehensive evaluation model, we we have developed an integrated and intelligent nursing decision support system to pro-

vide reference for the implementation and application of subsequent systems, and an identification system of psychological stressors for cancer patients based on decision support nursing system.

Methods

Data collection and pre-processing

The data of 154 cancer patients admitted to a hospital from June 2019 to December 2020 were investigated. There were 55 cases of lung cancer, 29 cases of oesophageal cancer, 25 cases of gastric cancer, 17 cases of pancreatic cancer, 16 cases of colon cancer, 2 cases of lymphoma, 7 cases of breast cancer, 1 case of osteosarcoma, 1 case of pelvic carcinoma and 1 case of renal carcinoma, with an average age of 61±9 years (29, 86). Among them, 65% of the patients were covered by public medical care for expenses and overall planning for serious diseases.

This study was carried out in two steps: preliminary tests and a formal investigation. Thirty questionnaires were sent out for the pre-test, of which 18 were effective. The effective rate was 60%, which is relatively low. In the formal investigation and study, quality control was adopted for the challenges encountered in the pre-test, and the response rate and effectiveness were increased. In the formal investigation, 154 questionnaires were sent out, and 154 cancer patients filled in the questionnaires effectively, with an effective rate of 100%. The self-made measurement forms divided the stressors into four broad categories. Several choices were assigned to each category and evaluated by patients on the day before chemotherapy. The survey required respondents to choose one option in each category that posed the greatest pressure to them.

Theoretical basis

Nursing procedures (nursing evaluation→nursing diagnosis→nursing intervention→nursing evaluation) are within a systematic process of decision evaluation and problem solving. In practical clinical work, nursing problem evaluation which is a comprehensive judgment of the interaction of multiple factors involving nursing diagnosis, diagnostic definition characteristics, therapeutic nursing measures, patient characteristics and willingness, etc. The first step of comprehensive evaluation is to determine the evaluation index system according to the characteristics of the object system. According to the principle of establishing an index evaluation system, this study constructed a decision-making index system for comprehensive nursing evaluation based on standardized nursing language of nursing outcome classification.

There are different indicator types and processing methods. Therefore, before the comprehensive evaluation, the types of evaluation indexes need to be consistent, and the small, medium and interval indexes should be converted to the large indexes. Assuming that the extremely small index is x, the extremely large index is x*, and the allowable upper bound of index x is M, the consistency processing formula is:

$$x^* = M\left(1 - \frac{1}{x}\right)(x \geq 0) \tag{1}$$

Supposing that the medium index x, the extremely large index x*, the allowable lower bound of the index x is m, and the allowable upper bound of the index x is m. The consistency processing formula is:

$$\begin{aligned} x^* &= M\left(1 - \frac{1}{x}\right)(x - m), m \leq x \leq \left(\frac{M}{2} + m\right) \\ x^* &= M(1 + m)\left(x - \frac{m}{x}\right), \left(\frac{M}{2} + m\right) \leq x \leq M \end{aligned} \tag{2}$$

Assuming that the interval type index is x, the extremely large index is x*, the allowable lower bound of the index x is M, the allowable upper bound of the index x is M, the lower limit of the optimal stability interval of the index x is q_1, and the upper limit of the optimal stability interval of the index x is q_2, the consistency processing formula is:

$$\begin{aligned} x^* &= 1 + \frac{1-(q_1+x_2)^2}{min\{q_1+m, q_2-M\}}, (x < q_1) \\ x^* &= \frac{1}{M-m}, (q_1 \leq x \leq q_2) \\ x^* &= 1 + \frac{1-(q_2+x_1)^2}{min\{q_1+m, q_2-M\}}, (x > q_2) \end{aligned} \tag{3}$$

For data to be dimensionless, also known as the standardization and normalization of index data, is to eliminate the influence of dimensions and magnitude among measurement

indexes through mathematical transformation. Before the comprehensive evaluation and knowledge acquisition, the attribute values of each evaluation index should be uniformly transformed to [0, 1]. m represents the interval grade. In the corresponding index evaluation standard V (grade I means very poor, grade II means poor, grade III means general; grade IV means good, grade V means good), Vk means a fuzzy comprehensive evaluation set of care plan. Assuming that the maximum value of an index within the target range of the evaluation index is x_{max}, the minimum value of an index within the target range of the evaluation index is x_{min}, and the actual value of the index of a patient within the target range of the evaluation index is x_i, the mathematical model transformation formula of quadratic parabolic partial large distribution for extremely large data is as follows.

$$\begin{cases} f(x_i) = 0, (x < x_{min}) \\ f(x_i) = \frac{x_i + x_{min}}{x_{max} - x_{min}} - (1 - x_i)^2, (x_{min} \le x_i \le x_{max}) \\ f(x_i) = 1, (x_i > x_{max}) \end{cases} \quad (4)$$

An expert scoring method is used to quantify the indicators for qualitative evaluation of dimensionless indicators in the index system, and then a standardization processing was carried out. The processing method is similar to the mathematical model transformation formula of applying quadratic parabolic partial large-scale distribution to extremely large data. The back propagation model is a multi-layer network with one-way propagation composed of three layers: input layer, hidden layer and output layer. There may be one or more hidden layers. In this study, a 3-layer back-propagation neural network model was adopted, with x1, x2, ..., xn being the input value of the input layer. After transformation by the linear function f(x)=x, the output of neurons in the input layer is y1, y2, ..., y_c, to calculate the actual output values O_j and y_k of the neurons in the hidden layer and the neurons in the output layer, and the formula is as follows:

$$\begin{cases} Net_j = \sum_{i=1}^{n} \omega_{ij} (x_i + \theta_j)^2, j = 1, 2, ..., m \\ O_j = \frac{1}{1 - e^{Net_j}} \\ Net_k = \sum_{j=1}^{m} V_{ij} \cdot (x_i + O_j)^2, k = 1, 2, ..., c \end{cases} \quad (5)$$

Where, Net_j represents the neuron input value in the hidden layer; j is the current input sample; w_{ij} is the connection weight of the input layer neuron i to the hidden layer neuron j; θ_j is the threshold of the hidden layer neuron j; the transformation function of the hidden layer neuron is the S-type function (Formula 5); O_j is the output value of the hidden layer neuron j; Net_k is the input value of the output layer; V_{ij} is the connection weight between the output neuron k and the hidden neuron j; and Δk is the threshold of the output neuron k.

Construction of decision support system

This study took the problem of processing the system as the core part of the decision support system to build an intelligent and comprehensive decision support system for nursing evaluation. The framework of the system is composed of a man-machine interface, problem processing system, management subsystem of comprehensive nursing evaluation decision index system, comprehensive evaluation subsystem, evaluation result output subsystem, neural network learning subsystem and nursing scheme set simulation subsystem. Among them, the management subsystem of comprehensive nursing evaluation decision-making index system is composed of index system construction module, index extraction module, information query module and database module. The comprehensive evaluation subsystem is composed of an inference machine of the nursing plan evaluation & solution module, result evaluation module, knowledge base, model base, sample base, method base and evaluation result database of the comprehensive scheduling management module. The overall architecture of nursing decision support system is shown in **Figure 1**.

System function analysis

The flow chart of intelligent nursing comprehensive evaluation decision support system is shown in **Figure 2**.

The system integrates all aspects of the medical care process, and its functions are shown in **Figure 3**. The human-machine interface is a window for human-machine interaction between an “intelligent” decision support system and users. Users input problem related information into the processing system in a system-

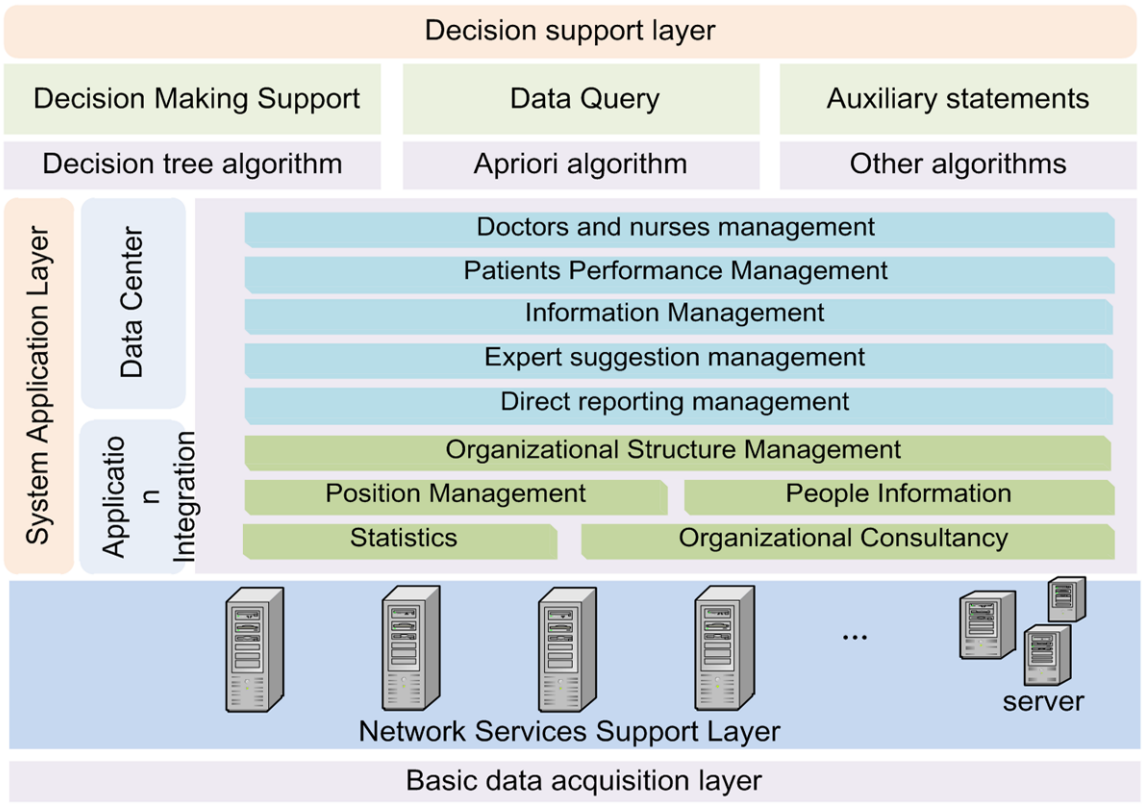

Figure 1. The overall structure of the nursing decision support system.

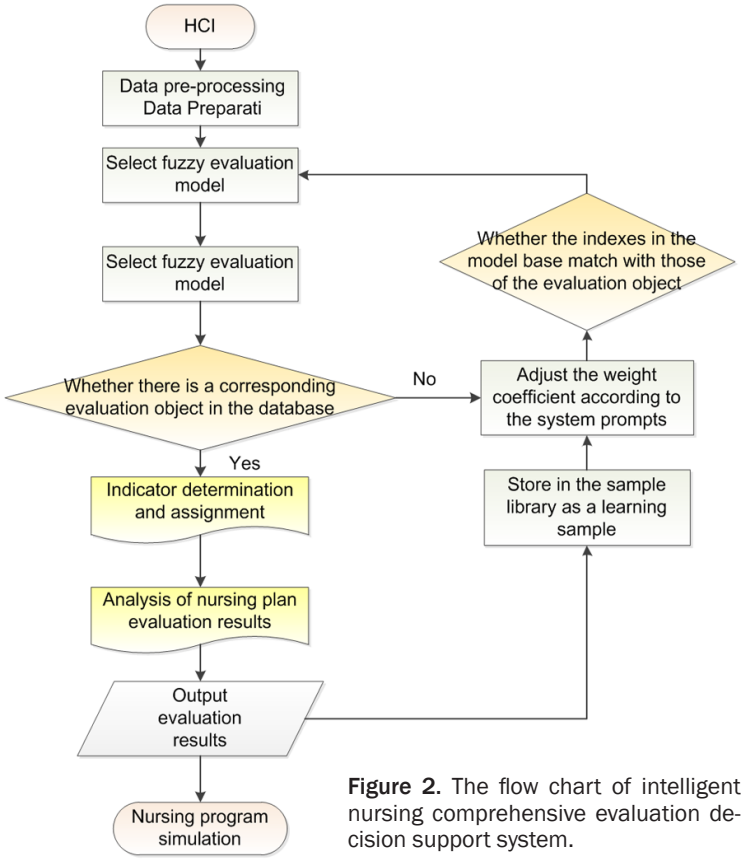

Figure 2. The flow chart of intelligent nursing comprehensive evaluation decision support system.

readable way, and the system outputs the corresponding evaluation results according to the user's established requirements. Through the menu drive, users can directly enter the required functional modules. Compared with other algorithms, mining technology builds the cancer risk prediction model for complications and metabolic control management through data integration between heterogeneous systems. The study introduced also had a risk prediction model which was brought into the clinical decision support system, the system fitting the specific requirements of medical workers, putting forward effective solutions, and providing decision support for individualized treatment and nursing.

The problem solving and analysis process in the problem solv-

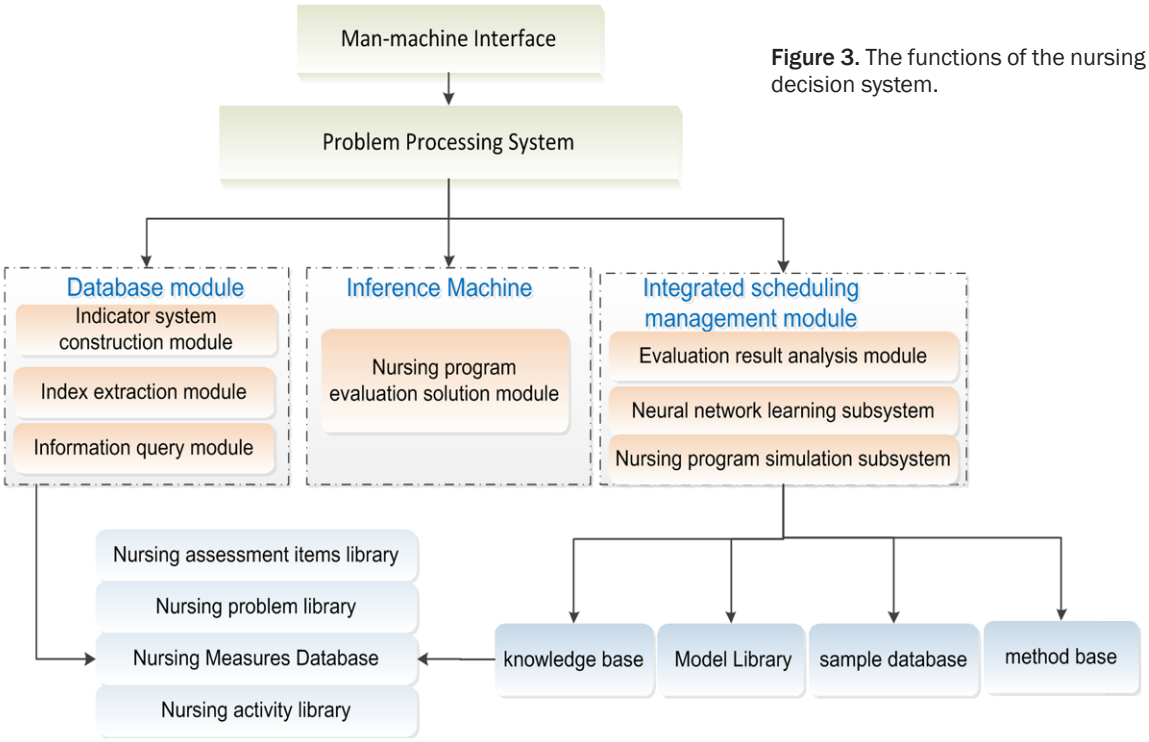

Figure 3. The functions of the nursing decision system.

ing system is as follows: 1) According to the nursing problem to be solved by the decision maker, a nursing plan (nursing evaluation→diagnosis→measures→sensitive outcome) module sequence is established for this nursing problem; 2) Following the internal structure of each module of the nursing plan, that is, nursing assessment→diagnosis→measures→target corresponding data module and matching file, the corresponding rule connection is established and run; 3) Comprehensive evaluation, analysis and ranking of the nursing plan based on the nursing problem are carried out.

The management subsystem of the decision-making index system of comprehensive nursing evaluation mainly manages the index system, the original data of the index and the data generated by the index. The comprehensive evaluation subsystem dispatches the nursing comprehensive evaluation decision model based on a fuzzy comprehensive evaluation and back propagation of the neural network comprehensive integration to complete the comprehensive evaluation of the designated nursing plan [23]. The nursing plan set simulation subsystem is based on the patient/nursing plan, which measures the influence of the change of evaluation indices on the comprehensive evaluation result of nursing plan through nonlinear mapping of outcome index variables to patient outcome, and provides decision support for the implementation of advanced nursing program.

Results

Pressure source classification and occurrence frequency

The stressors of cancer patients were mainly divided into four categories, as shown in **Table 1**. Cancer stressors and their frequency are shown in **Figure 4**.

In this study, among the stressful events of cancer patients, the most severe ones from high scores to low scores were: no privacy, medical workers' attitude, not familiar with the medical workers, uncomfortable room temperature, partial loss of social contact, and not being familiar with the hospital environment. See **Figure 5** for details.

Univariate analysis of pressure sources

The t-test showed that religious belief was not a significant factor on the total stress in the 154

Table 1. The source and frequency of stress in cancer patients

Pressure source	Forest landscape pattern index	Symbol
Sources related to the disease	Prognosis of the disease	nc
	Physical discomforts	b
	Fear of certain tests	c
Sources related to the environment	Changes in eating and sleeping habits	d
	Influenced by other people in the room	e
	Attitude of medical workers	f
	Privacy protection	g
	Maladjusted	h
	Lack of security	i
Sources related to the chemotherapy	Side effects	j
	Worried that treatment won't work	k
	Self-image change	l
Sources related to the family and society	Depend on others	m
	Worried about unemployment	n
	Fear of being unaccompanied	o

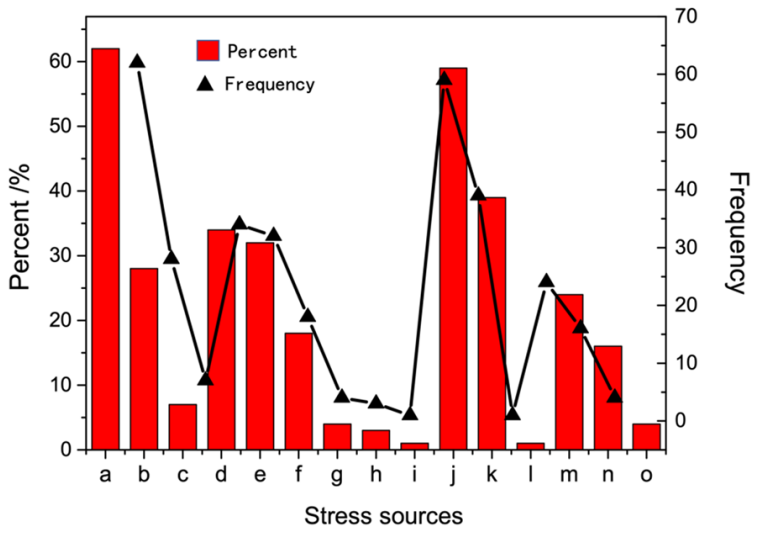

Figure 4. Pressure source classification and occurrence frequency. The triangles represent data points of pressure source frequency.

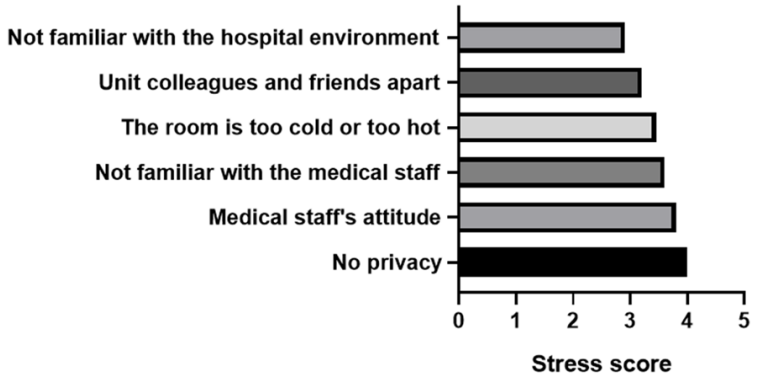

Figure 5. Stressors in cancer patients.

patients. However, there was a statistical difference in "partial loss of free social interaction in hospital" in patients with or without religious belief. For patients with religious beliefs, "partial loss of free social interaction in the hospital" brought serious stress. Univariate analysis was conducted on the influence of different occupations on total stress. There was no statistical difference in total pressure between different ethnic groups, but "economic problems" brought pressure. There was no significant difference in total stress among patients with different ages or occupations, but there were statistically significant differences in "being unfamiliar with hospital environment and environmental discomfort", "economic burdens", "impact of hospitalization on individuals and their families", "disease severity and its impact on individuals" among patients with different occupations. The results are shown in **Figure 6**.

There was a low positive correlation with health care and

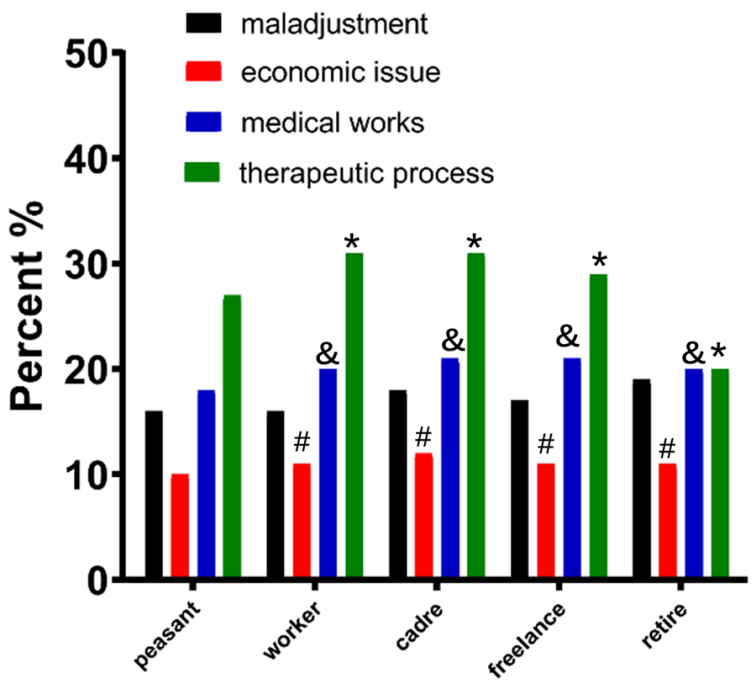

Figure 6. The main stress events of patients and their correlation among four dimensions. #: P < 0.05 compared with the economic problems of peasants; &: P < 0.05 compared with the medical works of peasants; *: P < 0.05 compared with the therapeutic process of peasants.

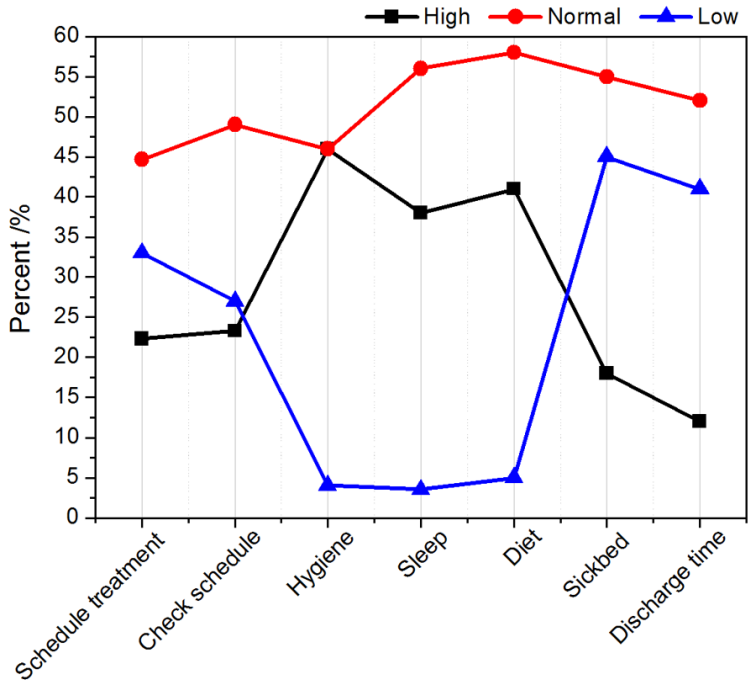

Figure 7. Degree of patient involvement in nursing decision making.

"the impact of hospitalization on individuals, their families" (r=0.156) and "skill level and service attitude of medical workers" (r=0.220). There was a low positive correlation of the occupation of patients with "partial loss of free social interaction in hospital" and "the skill level and service attitude of medical workers" (r=0.177; r=0.174, respectively). There was a low negative correlation between education level and "disease severity and its impact on individuals" (r=-0.181). There was a low negative correlation between per capita income and total stress (r=-0.192). Low positive correlation was found between health care and "partial loss of free social interaction in hospital", "financial problems", "severity of illness and its impact on the individual" and "problems caused by diagnosis and treatment".

Degree and desirability of participation in nursing decision making

There was a statistically significant difference between the actual participation and the anticipated participation in nursing decision-making in cancer patients (P < 0.0001). Patients' actual participation in nursing decision-making is lower than their expectation. See **Figure 7**.

We compared the expectation and actual participation of cancer patients in treatment and nursing decision making using paired sample rank test. The results showed that all the items involving cancer patients in treatment decision-making had statistical significance (P < 0.0001), except for when "the doctor decided my treatment plan" (P > 0.46).

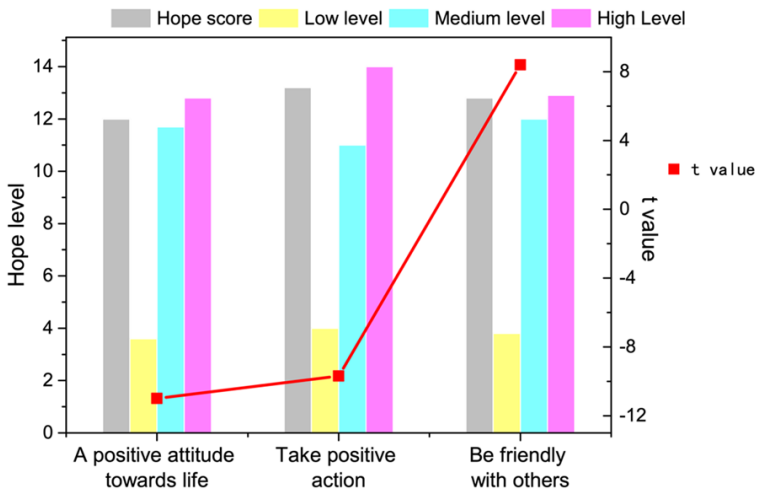

Figure 8. Group and score of hope level of cancer patients.

There were significant differences in "positive attitude towards reality and future", "taking positive actions", "maintaining close relationship with others" and "overall level of hope" between the "Take positive action" group and the "Be friendly with others" group. See **Figure 8**.

Studies have shown that patients undergoing postoperative chemotherapy for breast cancer are generally at a medium-high level of hope, and the vast majority of patients are full of confidence in overcoming the disease and hope for life. Combing with others research [24], the results (see **Figure 8**) showed that the total stress was negatively correlated with quality of life and its five dimensions. The greater the patients' total stress, the lower their quality of life.

This platform can enable patients to have a comprehensive understanding of pretreatment preparation, in treatment cooperation and posttreatment matters, which is conducive to reducing the patient anxiety as well as to life planning. A nursing decision support system can improve the effectiveness of health education for patients undergoing health care surgery by evaluating patients based on basic data and reminding nurses to carry out diversified point-by-point health education at different times. Comparisons can be extended considering the state of art algorithms.

Discussion

The solution for nursing evaluation decision-making and problem solving is a complex system process involving many factors, indexes and levels. In this study, the principle of fuzzy comprehensive evaluation and back propagation neural network comprehensive evaluation were deeply analysed. Based on the classification of nursing outcomes in standardized nursing language, a nursing comprehensive evaluation decision-making model was built based on the integration of back propagation neural network and fuzzy comprehensive evaluation. On the basis of the model, using the decision support theory, taking the problem processing system as the core, we designed an intelligent nursing comprehensive evaluation decision support system, which integrates an expert system, data, models, knowledge and methods.

Cancer patients are less involved in treatment and care decisions than they would like to be. This finding suggests that we still have a lot of work to do in this area. Medical workers play an important role in cancer patients' participation in treatment and nursing decisions. For instance, nurses should give patients more information. Medical workers need to further improve the relationship with patients, so as to improve the degree of participation, as well as the quality of life of cancer patients and to promote the development of cancer care.

As treatments for cancer patients become more diverse and complex, objective evidence and opinions from medical experts in various fields are needed to determine the most appropriate treatment. The Intelligent Nursing Decision Support System has been developed to solve this problem. An AI computer system for medical workers can improve the quality of medical care by increasing the speed and accuracy. Watson for Oncology (WfO) -- a representative AI-CDSS -- is not directly related to patient

care, but provides providers with tools to organize and track patient health and medical information, and helps facilitate access to medical information [25]. Mdt-WfO resulted in higher patient satisfaction and positive perceptions than MDT. Our analysis further verifies the superiority of the intelligent nursing decision support system. However, the advantage of this study is that we use a Nursing Comprehensive Evaluation decision-making model, and the data collected in this study on WfO are self-reported. Publication or survivor bias and recall bias may affect the information provided. The intelligent nursing decision support system is still in the initial stage in the field of nursing information in China, and this study has only made a preliminary exploration, so we will conduct further studies in the future to obtain more applications and improvements.

However, this article still has some limitations, such as small sample size, low statistical efficacy, inconsistent measurement methods and lack of diversity of participants. In addition, the description of the intervention group was often ambiguous. Treatment fidelity and adherence were also not well described in most studies. Besides, the intelligent nursing decision support system fails to take into account certain characteristics of individuals and their environment and culture. These factors include insurance coverage, medical guidelines, ethnicity and geographic area. Patient satisfaction and patient perception are also key factors that directly and indirectly affect patient outcomes through changes in patient compliance and attitudes toward care.

In conclusion, cancer patients have a variety of stressors, and the pressure on them is high. Our computer decision support nursing system assisted nurses to help patients to use positive coping methods to relieve pressure as soon as possible, so as to improve their quality of life.

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Disclosure of conflict of interest

None.

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References

[1] Boyle DA and Bush NJ. Reflections on the emotional hazards of pediatric oncology nursing: four decades of perspectives and potential. J Pediatr Nurs 2018; 40: 63-73.

[2] Chambers SK, Hyde MK, Smith DP, Hughes S, Yuill S, Egger S, O'Connell DL, Stein K, Frydenberg M, Wittert G and Dunn J. New challenges in psycho-oncology research III: a systematic review of psychological interventions for prostate cancer survivors and their partners: clinical and research implications. Psychooncology 2017; 26: 873-913.

[3] Shanafelt T, Ripp J and Trockel M. Understanding and addressing sources of anxiety among health care professionals during the COVID-19 pandemic. JAMA 2020; 323: 2133-2134.

[4] Wade DM, Mouncey PR, Richards-Belle A, Wulff J, Harrison DA, Sadique MZ, Grieve RD, Emerson LM, Mason AJ, Aaronovitch D, Als N, Brewin CR, Harvey SE, Howell DCJ, Hudson N, Mythen MG, Smyth D, Weinman J, Welch J, Whitman C and Rowan KM; POPPI Trial Investigators. Effect of a nurse-led preventive psychological intervention on symptoms of posttraumatic stress disorder among critically ill patients: a randomized clinical trial. JAMA 2019; 321: 665-675.

[5] Jadalla A, Ginex P, Coleman M, Vrabel M and Bevans M. Family caregiver strain and burden: a systematic review of evidence-based interventions when caring for patients with cancer. Clin J Oncol Nurs 2020; 24: 31-50.

[6] Devarajan M, Subramaniyaswamy V, Vijayakumar V and Ravi L. Fog-assisted personalized healthcare-support system for remote patients with diabetes. J Ambient Intell Humaniz Comput 2019; 10: 3747-3760.

[7] Chen M, Zhang Y, Qiu M, Guizani N and Hao Y. SPHA: smart personal health advisor based on deep analytics. IEEE Commun Mag 2018; 56: 164-169.

[8] Missouridou E. Secondary posttraumatic stress and nurses' emotional responses to patient's trauma. J Trauma Nurs 2017; 24: E3-E4.

[9] Punj R and Kumar R. Technological aspects of WBANs for health monitoring: a comprehensive review. Wireless Networks 2019; 25: 1125-1157.

[10] Contreras I and Vehi J. Artificial intelligence for diabetes management and decision support:

literature review. J Med Internet Res 2018; 20: e10775.
[11] Kondylakis H, Bucur A, Crico C, Dong F, Graf N, Hoffman S, Koumakis L, Manenti A, Marias K, Mazzocco K, Pravettoni G, Renzi C, Schera F, Triberti S, Tsiknakis M and Kiefer S. Patient empowerment for cancer patients through a novel ICT infrastructure. J Biomed Inform 2020; 101: 103342.
[12] Carayon P, Cassel C and Dzau VJ. Improving the system to support clinician well-being and provide better patient care. JAMA 2019; 322: 2165-2166.
[13] Rossi R, Socci V, Pacitti F, Di Lorenzo G, Di Marco A, Siracusano A and Rossi A. Mental health outcomes among frontline and second-line health care workers during the coronavirus disease 2019 (COVID-19) pandemic in Italy. JAMA Netw Open 2020; 3: e2010185.
[14] Ahmed F, Qin YJ and Martinez L. Sustainable change management through employee readiness: decision support system adoption in technology-intensive British E-businesses. Sustainability 2019; 11: 2998.
[15] Hendriksen E, Rivera A, Williams E, Lee E, Sporn N, Cases MG and Palesh O. Manifestations of anxiety and coping strategies in patients with metastatic lung cancer and their family caregivers: a qualitative study. Psychol Health 2019; 34: 886-899.
[16] Macía P, Gorbeña S, Barranco M, Iglesias N and Iraurgi I. A global health model integrating psychological variables involved in cancer through a longitudinal study. Front Psychol 2022; 13: 873849.
[17] Firouzi F, Farahani B, Ibrahim M and Chakrabarty K. Keynote paper: from EDA to IoT eHealth: promises, challenges, and solutions. IEEE Trans Comput Aid Desi Integr Circ Syst 2018; 37: 2965-2978.
[18] Chen M, Ma Y, Song J, Lai CF and Hu B. Smart clothing: connecting human with clouds and big data for sustainable health monitoring. Mobile Netw Appl 2016; 21: 825-845.
[19] Ellington L, Clayton MF, Reblin M, Donaldson G and Latimer S. Communication among cancer patients, caregivers, and hospice nurses: content, process and change over time. Patient Educ Couns 2018; 101: 414-421.
[20] Børøsund E, Mirkovic J, Clark MM, Ehlers SL, Andrykowski MA, Bergland A, Westeng M and Solberg Nes L. A stress management app intervention for cancer survivors: design, development, and usability testing. JMIR Form Res 2018; 2: e19.
[21] El-Jawahri A, LeBlanc TW, Kavanaugh A, Webb JA, Jackson VA, Campbell TC, O'Connor N, Luger SM, Gafford E, Gustin J, Bhatnagar B, Walker AR, Fathi AT, Brunner AM, Hobbs GS, Nicholson S, Davis D, Addis H, Vaughn D, Horick N, Greer JA and Temel JS. Effectiveness of integrated palliative and oncology care for patients with acute myeloid leukemia a randomized clinical trial. JAMA Oncol 2021; 7: 238-245.
[22] Argyris N and French S. Nuclear emergency decision support: a behavioural OR perspective. Eur J Oper Res 2017; 262: 180-193.
[23] Mork PJ and Bach K; selfBACK Consortium. A decision support system to enhance self-management of low back pain: protocol for the selfBACK project. JMIR Res Protoc 2018; 7: e167.
[24] Grim K, Rosenberg D, Svedberg P and Schon UK. Development and usability testing of a web-based decision support for users and health professionals in psychiatric services. Psychiatr Rehabil J 2017; 40: 293-302.
[25] Aliverti A. Wearable technology: role in respiratory health and disease. Breathe (Sheff) 2017; 13: E27-E36.