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Validation of the index for the core competence of nurses leading discharge planning for older patients in China†

Original Article

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Abstract: **Objective:** With the continuous advancement of aging in China, the number of older inpatients has increased sharply. Older patients have a high demand for planning their discharge services. Nurses serve as the leader of discharge planning for patients; there is a lack of reliable evaluation tool to evaluate the core competitiveness of nurses who implement discharge planning for older patients in China. The purpose of this study was to validate the index for the core competence of nurses who lead discharge planning for older patients developed by a project team through the Delphi method in the early stage.
Methods: A cross-sectional questionnaire survey with 3-stage stratified sampling was used to select 1075 nurses from 17 public general hospitals in Ningxia, China.
Results: The index consists of 4 first-level indicators, 13 second-level indicators, and 57 third-level indicators. The results show that 57 third-level indicators had good discrimination. With exploratory factor analysis (EFA), 4 common factors that explained 72.79% of the total variance were extracted. The Cronbach's α was 0.98, and the retest reliability within a 14-d interval was 0.86. The confirmatory factor analysis (CFA) results show that the fit of the index structure was good. The criterion validity was 0.73.
Conclusions: The index presented excellent psychometric properties and can be used to measure the core competence of nurses in implementing discharge planning for older patients in China.

Keywords: *core competence • discharge planning • instrument • nurse • older patient • reliability • validation • validity*

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1. Introduction

The World Health Organization (WHO) estimated that, in 2018, there were 125 million people aged ≥80 years worldwide. By 2050, it is estimated that approximately many people aged ≥80 years (120 million) will be living in China alone and that there will be 434 million people in this age group worldwide.[1] The growth of the aging population not only increases the burden of the country's pension system but also increases the need for medical resources, and these consequences are becoming more severe in China. The China Multi-Center Report

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on Geriatric Diseases showed that the number of older hospitalized patients in China has increased rapidly in the past decade. It has been reported that there were 4.68 diseases, especially chronic diseases and comorbidities, per capita in older people and that the proportion of comorbidities exceeds 90%.[2] Due to the physiological, psychological, and cognitive changes caused by diseases, older patients in China still require long-term care after discharge.

Driven by the reform of China's medical and health system and the grading diagnosis and treatment system, the treatment model that 2-way referral, rapid division and treatment, and the up-and-down linkage diagnosis makes shortening average hospitalization days become the main measures to improve medical efficiency and make effective use of medical resources in most tertiary hospitals. This led to older patients facing discharge only after passing through the acute stage of the disease. They were transferred from the hospital with professional care to the hospital without professional and standardized care.[3] In the process of adapting to the life outside the hospital, they were prone to aggravate their illness and even re-hospitalize. At the same time, it also grew the burden of medical expenses for older patients.[4,5]

In response to the aging of China's population and provide integrated health care services for the elderly, the Health Planning Commission stated in the National Care Development Plan (2016–2020) that medical institutions should provide various forms of continuing care for older patients after discharge, extending care to communities and families.[6] Discharge planning is an important model of continuous care, and it has received increasing attention from nursing researchers and clinical practitioners in China. It has been promoted as a basic medical service in the United States, UK, and Japan and has been commonly used in older patients with a high demand for continued care.[7–10]

Discharge planning has been defined as the process of developing a series of events that occur shortly after a person is admitted to a healthcare setting to facilitate continuity of care, reduce the length of hospital stay, reduce the risk of unplanned readmission to a hospital, ensure the optimal use of hospital beds, and improve the coordination of services following hospital discharge.[10,11] Several studies have shown that discharge planning can reduce the number of patients needing to be readmitted, reduce medical costs, and improve clinical outcomes.[5,12] The results of a meta-analysis showed that the implementation of a discharge planning model could reduce the risk of readmission by 28% and shorten the length of hospitalization by an average of 2 d.[5]

The core competence of a nurse comprises the professional knowledge, skills, judgment, and personal qualities required to provide safe and competent nursing services.[13] Nurses play a leading role in discharge planning.[14,15] According to Naylor et al.,[12] the nurses who implement discharge planning directly affect the quality of discharge planning. In the United States, advanced practice nurses with extensive expertise and professional skills implement discharge planning. They often have graduate degrees and have a wealth of theoretical knowledge, proficiency, and clinical experience.[16] In addition, a study showed that advanced practice nurse (APNs) with master's degrees have more professional knowledge and skills than registered nurses and can better complete discharge planning.[17] To evaluate and improve the core competence of nurses leading discharge planning, Japanese scholars developed an evaluation index and a self-rating scale that measure nurses' abilities to implement discharge planning.[18,19]

In 2015, according to Doris et al.,[20] the nurse-led discharge planning model that was introduced into the Chinese culture and the medical environment in Hong Kong was beneficial. Some domestic researchers have suggested that specialist nurses or senior nurses with a rich working experience should implement discharge planning.[21] However, there is no relevant evaluation tool available in China for evaluating the core abilities of nurses leading discharge planning for older patients. The aim of this study was to provide an operable evaluation tool for evaluating the core competence of nurses in implementing discharge planning for older patients in China.

In the early stage, our research group interpreted China's pension policy, considered the physiological, psychological, and social characteristics of older patients and used the 4 stages of discharge planning as a theoretical framework to establish an index for the core competence of nurses leading discharge planning for older patients (ICCNLDPOP). A literature review, existing scale analysis, group review, and Delphi method were used in the construction stage. The ICCNLDPOP consists of 4 first-level indicators, 13 second-level capacity characteristic indicators, and 57 third-level behavior indicators. The purpose of this study was to conduct an item analysis and validate the reliability and validity of the ICCNLDPOP that was developed earlier.

2. Methods

2.1. Study design and population

According to Kendall,[22] the sample size should be 5–20 times larger than the number of variables assessed. Considering the cross validation of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), the sample size must be 16 times the number of

variables, and considering an inefficiency rate of 15% in the process of sample recovery, the sample size was determined to be approximately 1075.

In this study, a cross-sectional questionnaire survey with 3-stage stratified sampling was used. The details of the 3-stage stratified sampling procedure were as follows. In the first stage, the survey hospitals were selected. According to the inclusion and exclusion criteria of the hospitals (inclusion criteria: Grade II and above public comprehensive hospitals in Ningxia; exclusion criteria: nongraded hospitals and military hospitals), the 46 eligible hospitals were divided into 4 categories according to the level of the hospital: Grade III-A, Grade III-B, Grade II-A, and Grade II-B. One-third of the hospitals were selected from each layer for investigation, and the list of hospitals was determined by the random number table method.

In the second stage, the departments to be investigated were selected. According to the "Report on Nutrition and Chronic Diseases of Chinese Residents 2015," the disease spectrum of older patients, and related literature, the diseases that commonly occur in older patients include cardiovascular diseases, chronic respiratory diseases, diabetes, kidney diseases, and neurological diseases. Based on these diseases which are common in older patients, the research group identified 9 departments: departments of cardiology, respiratory medicine, endocrinology, renal medicine, urology, gastroenterology, neurology, and neurosurgery. The order of the departments investigated was determined by the random number table method. According to the order of the departments, the investigations were carried out in turn until the sample size was satisfied and the investigation was stopped.

In the third stage, the nurses to be investigated were selected. The nurses who met the inclusion and exclusion criteria were investigated after the investigators obtained participant consent. The inclusion criteria were as follows: nurses who (1) had a registered nurse certification; (2) engaged in clinically responsible nursing work in the Department of Geriatric Patients; and (3) provided informed consent to voluntarily participate in this study. The exclusion criteria were as follows: (1) nurses not in an investigative hospital (refresher nurses) and (2) nurses not working in a hospital during the survey period.

2.2. Data collection

From July to September 2018, the research team carried out a survey. During the actual investigation, 1 of the Grade III-A hospitals did not complete the sampling plan. A Grade III-A hospital with the same nature as the investigation site was additionally included in the study. Finally, 17 hospitals were investigated, including 3 Grade III-A hospitals, 2 Grade III-B hospitals, 11 Grade II-A hospitals, and 1 Grade II-B hospital. Seventeen hospitals were located in Yinchuan city, Shizuishan city, Zhongwei city, Wuzhong city, and Guyuan city in Ningxia province.

In order to ensure the quality of the questionnaire, this study selected 5 graduate students of the Ningxia Medical University who were familiar with the customs and languages of the survey area and had a certain epidemiological theoretical basis as investigators in order to ensure good verbal communication with the respondents during the investigation. Before the investigation, a master of epidemiological statistics and the person in charge of this study conducted strict training for the investigators, including the filling and recovery of questionnaires. In addition, in the questionnaire collection stage, in order to ensure the overall survey quality and the authenticity of the data, 5 investigators checked the collected questionnaires on the spot. The questionnaires with problems or missing items were verified and supplemented on the spot and then submitted to the person in charge of re-verification to ensure the quality of the questionnaires.

During the survey period, the right to informed consent and privacy of the respondents were fully respected. The respondents voluntarily decided whether to participate in the survey. A total of 1075 questionnaires were distributed in the formal survey. Among them, 14 questionnaires were lost, 40 were invalid questionnaires (>10% had incomplete content), and 1021 were valid questionnaires. The effective recovery rate was 94.98%. The research process is detailed in Figure 1.

To test the retest reliability, 110 nurses in a Grade III-A hospital in the formal survey were investigated again 2 weeks after the formal survey. A total of 110 questionnaires were issued, and 101 valid questionnaires were recovered, with an effective recovery rate of 91.82%.

2.3. Instrument

2.3.1. ICCNLDPOP

The ICCNLDPOP was used to measure the core competence of nurses in implementing discharge planning for older patients. Lu et al. developed a Chinese version of the ICCNLDPOP index.[23] The 4 stages of discharge planning were used as the theoretical framework for the index.[24] It was developed by conducting 2 rounds of the Delphi method. It contains 4 first-level indicators, 13 second-level competence characteristic indicators, and 57 third-level behavioral indicators. The index was completed by the self-evaluation of the nurses.

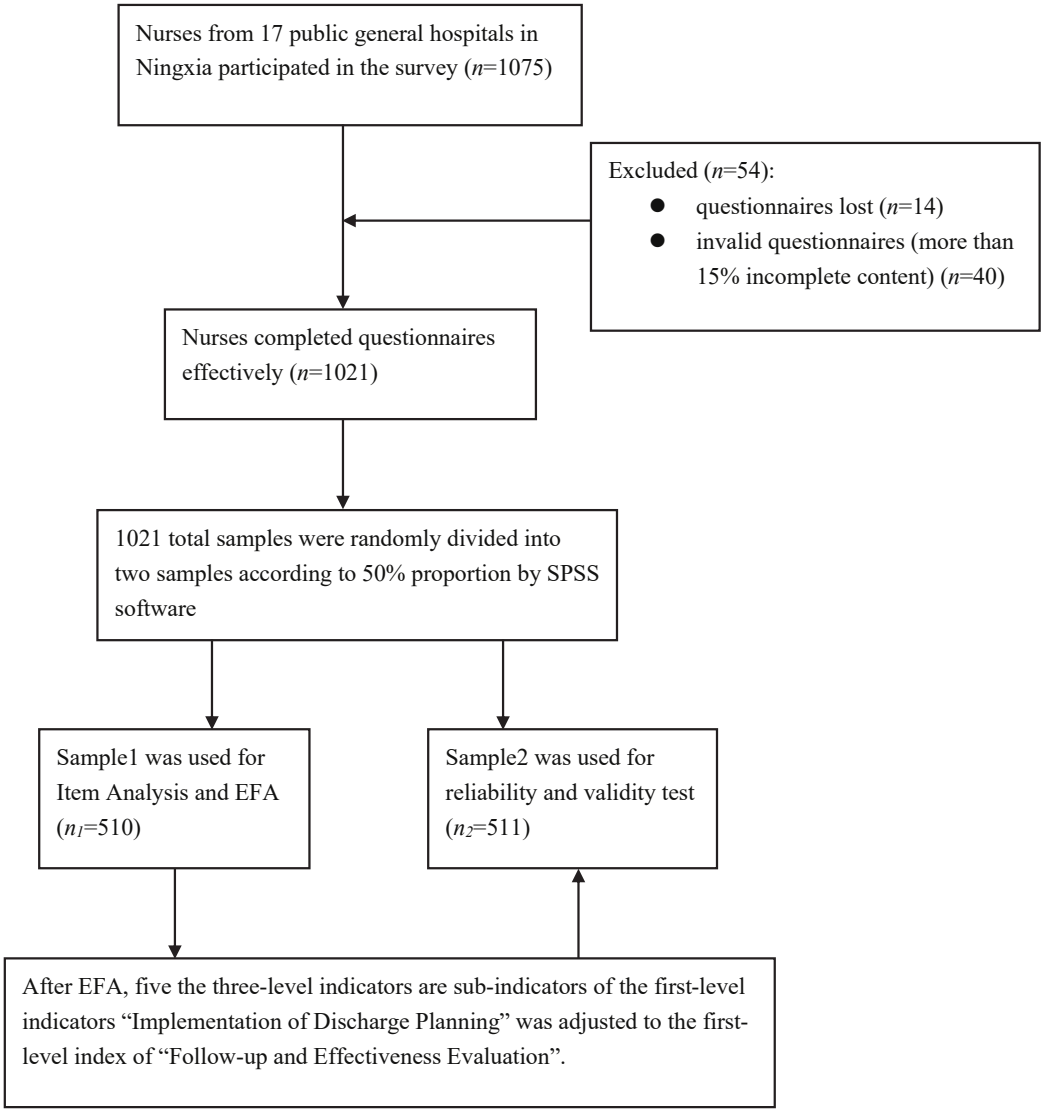

Figure 1. Research flow chart.

The following 5-point Likert-type rating system was provided as the response options and used to evaluate the level of the nurses' abilities: completely unavailable (1), mostly unavailable (2), basically available (3), mostly available (4), and fully available (5). The total score ranged from 57 to 285. The second-level indicator score was the sum of the subordinate three-level indicator scores, and the first-level indicator score was the sum of all the third-level indicator scores.

2.3.2. Other scale

The Competency Inventory for Registered Nurses (CIRN) was used as an indicator scale for the ICCNLD-POP to test the criterion validity. Liu et al.[25] compiled the scale based on qualitative research results on the core competence of registered nurses in China. The scale has good reliability and validity. The Cronbach's α coefficient of the scale was 0.89, and the retest reliability was 0.83 at 2-week intervals.[25] The presurvey results showed that the Cronbach's α coefficient of the scale used in this study was 0.99.

2.4. Ethical considerations

The investigation conforms to the principles outlined in the Declaration of Helsinki and was approved by the Ethics Committee of General Hospital of Ningxia Medical University (approval no. 2019-474) prior to the data being collected. All procedures in the studies involving human participants were performed in accordance with the ethical standards of the institutional

research committee. Moreover, informed consent forms were signed to ensure the legitimate rights and interests of the research subjects.

2.5. Data analysis

Eipdata 3.1 was used for data double entry, and SPSS version 22.0 and AMOS version 22.0 were used for statistical analysis. To ensure the comprehensiveness and scientificity of the content and theoretical framework of the index system, the total 1021 participants were randomly and evenly divided into 2 databases by SPSS software. Database 1 contained the data of 510 participants, which were used for item analysis and EFA to survey and adjust the content and structure of the index system. Database 2 contained the data of 511 participants and were used for the reliability and validity tests. The normality test was conducted for the variables involved in statistical analysis in database 1 and database 2, for which $P > 0.10$. The original hypothesis was accepted, and it was considered that the 2 databases of variables were subject to normal distribution.

(1) *General data description*: The measurement data such as working years were described by means and standard deviations. Gender, nationality, marital status, and other counting data were described by frequency and composition ratio.
(2) *Item analysis*: The items were analyzed in this study according to the critical ratio (CR). Items scoring in the top and bottom 27% of the distribution scores on the ICCNLDPOP were divided into the high score group and low score groups. When there was a significant difference between the high score group and low score group, it was considered that this index can be used to identify the degrees of responses of different subjects and that the degree of differentiation was good. Indicators that did not reach the significance level ($P > 0.05$) or had a CR value of <3 were excluded.
(3) *Reliability test*: Internal consistency reliability and retest reliability were calculated, and internal consistency reliability was expressed by Cronbach's α coefficient
(4) *Validity test*: Structural validity and criterion validity were used to evaluate the validity. The structural validity was tested by EFA and CFA.

The database 1 was used for EFA. Firstly, Kaise-Meyer-Olkin and Bartlett test of sphericity were conducted to determine that database 1 was suitable for EFA. Then, the principal component analysis and the maximum variance orthogonal rotation method were used to extract the common factor whose characteristic root was >1 to form the optimal factor load matrix. Adjust the ICCNLDPOP structure according to the factor load matrix and experts' opinions to form the adjusted index.

The structure validity of the adjusted Index system was analyzed by CFA using database 2. The ICCNLDPOP includes 4 primary indicators, 13 secondary indicators, and 57 tertiary indicators; so, the second-order CFA structural model was drawn. The structural fitness of the drawn structural model was analyzed, and the analysis indicators included the description of absolute fitness index, value-added fitness index, and simple fitness index to verify the final ICCNLDPOP structure.

(5) *Criterion validity*: The core competence scale for registered nurses developed by Liu and others was selected as the efficacy scalar scale,[25] and the correlation of the total score between ICCNLDPOP and efficacy scalar scale was analyzed by linear correlation. $P < 0.05$ was defined that the difference was statistically significant.

3. Results

3.1. Sociodemographic and health profiles of the study participants

The age of the nurses included in the total study population was 19–57 years, the average age of the nurses was 31.47 ± 6.54 years, and the average years of work experience was 8.70 ± 6.83 years, ranging from 1 year to 36 years. The average age of the nurses in database 1 was 31.41 ± 6.52 years, with age ranging from 20 years to 56 years, and the average years of work experience was 8.63 ± 6.90 years, with a range from 1 year to 36 years. The average age of the nurses included in database 2 was 31.54 ± 6.57 years, with age ranging from 19 years to 57 years, and the average years of work experience was 8.78 ± 6.75 years, ranging from 1 year to 33 years. Other general information is detailed in Table 1.

3.2. Item analysis

Item analysis refers to the analysis of each item in the scale according to the results of the survey, and this analysis is conducted to evaluate the quality of the items and screen the items.[27] The CR values of 57 Indicators were 14.89–27.01, and all reach the significance level

Characteristics	Database 1 (n_1 = 510)	Database 2 (n_2 = 511)	Total sample (n = 1021)
Sex			
Female	498 (97.65)	501 (98.04)	999 (97.85)
Male	12 (2.35)	10 (1.96)	22 (2.15)
Nationality			
Han nationality	396 (77.65)	404 (79.06)	800 (78.35)
Ethnic minority	114 (22.35)	107 (21.94)	221 (21.64)
Marital status			
Married	374 (73.33)	370 (72.42)	744 (72.87)
Other	136 (26.67)	141 (27.58)	277 (27.13)
Education level			
Polytechnic school	24 (4.71)	19 (3.72)	43 (4.21)
Junior college	260 (50.98)	255 (49.90)	515 (50.44)
Undergraduate	226 (44.31)	237 (46.38)	463 (45.35)
Hospital level			
Grade III-A	172 (33.73)	184 (36.01)	356 (34.87)
Grade III-B	102 (20.00)	85 (16.63)	187 (18.31)
Grade II-A	218 (42.75)	224 (43.84)	442 (43.29)
Grade II-B	18 (3.53)	18 (3.52)	36 (3.53)
Department			
Internal medicine	326 (63.92)	346 (67.71)	672 (65.82)
Surgery	184 (36.08)	165 (32.29)	349 (34.18)
Technical title			
Nurse	232 (45.49)	236 (46.19)	468 (45.84)
Primary nurse	193 (37.84)	174 (34.05)	367 (35.95)
Nurse in charge	57 (11.18)	81 (15.85)	138 (13.52)
Post			
Deputy director nurse and above	28 (5.49)	20 (3.91)	48 (4.70)
No job	403 (79.02)	404 (79.06)	807 (79.04)
Head of responsible section	64 (12.55)	70 (13.70)	134 (13.12)
Head nurse	43 (8.43)	37 (7.24)	80 (7.84)
Instructor for nursing students?			
Yes	258 (50.59)	252 (49.32)	510 (50.00)
No	252 (49.41)	259 (50.68)	511 (50.00)

Table 1. General characteristics of nurses, *n (%)*.

($P < 0.01$). All items conformed to the principles of inclusion.

3.3. EFA

This study conducted EFA on database 1 ($n = 510$). First, the KMO test and Bartlett's test of sphericity were performed.[28] The results showed that the Kaise-Meyer-Olkin (KMO) value was 0.981, and the result of Bartlett's test of sphericity (chi-square = 34586.135, $P < 0.001$) was adequate, suggesting that the data were appropriate for an EFA.[29,30] Principal component analysis and Varimax rotation were used to extract the common factor of the eigenvalue (value ≥1) from the 57 three-level indicators of the ICCNLDPOP. The scree plot and eigenvalues were indicative of a 4-factor solution with 57 items, accounting for 72.79% of the total variance (Table 2, Figure 2).

The common factor load coefficients of each 3-level index were between 0.417 and 0.808, which were >0.40. The 4 common factors corresponded to the 4 first-level indicators of the index system. Common factor 1 corresponded to the first-level indicator "follow-up and effectiveness evaluation," common factor 2 corresponded to the first-level indicator "assessment of discharge planning," common factor 3 corresponded to the first-level indicator "implementation of discharge planning," and common factor 4 corresponded to the first-level indicator "formulation of discharge planning" (Table 3).

After the varimax rotation, we tried to keep the items in the domain in which they had higher loadings. The three-level indicators 3.3.1, 3.3.2, 3.3.3, 3.3.4, and 3.3.5 were sub-indicators of the second-level indicator "coordination of health services," which originally belonged to the first-level indicator "implementation of discharge planning." It was adjusted to the first-level index of "follow-up and effectiveness evaluation" after EFA. In addition, the loads of three-level indicators 3.1.2, 3.1.4, 3.1.6, 2.2.4, and 3.1.1 on the original version were <0.40. The research group did not adjust the 5 three-level indicators due to the recommendation of experts. In the subsequent stage, the reliability and validity tests were conducted, and CFA was conducted to verify the index system structure again.

Component	Eigenvalue	Variance (%)	Cumulative variance (%)
Factor 1 (Follow-up and effectiveness evaluation)	34.89	23.59	23.59
Factor 2 (Assessment of discharge planning)	3.40	18.18	41.77
Factor 3 (Implementation of discharge planning)	1.65	18.16	59.93
Factor 4 (Formulation of discharge planning)	1.55	12.87	72.79

Table 2. Eigenvalue and variance contribution rate of each component of the index.

3.4. Reliability

The internal consistency reliability of the index system was adequate. Cronbach's α coefficient was 0.98. The 2-week test-retest reliability was 0.86. More details are presented in Table 4.

3.5. The structure validity

Cross-validation was implemented, that is, after EFA, database 2 (n = 511) was used to verify its structural validity by CFA.[31] Because the ICCNLDPOP consists of 3 levels of indicators, a second-order CFA structure model was drawn, as shown in Figure 3.

The results of CFA show that the absolute fitness index, value-added fitness index, and simplified fitness index indicate a good fit, and more details are presented in Table 5.

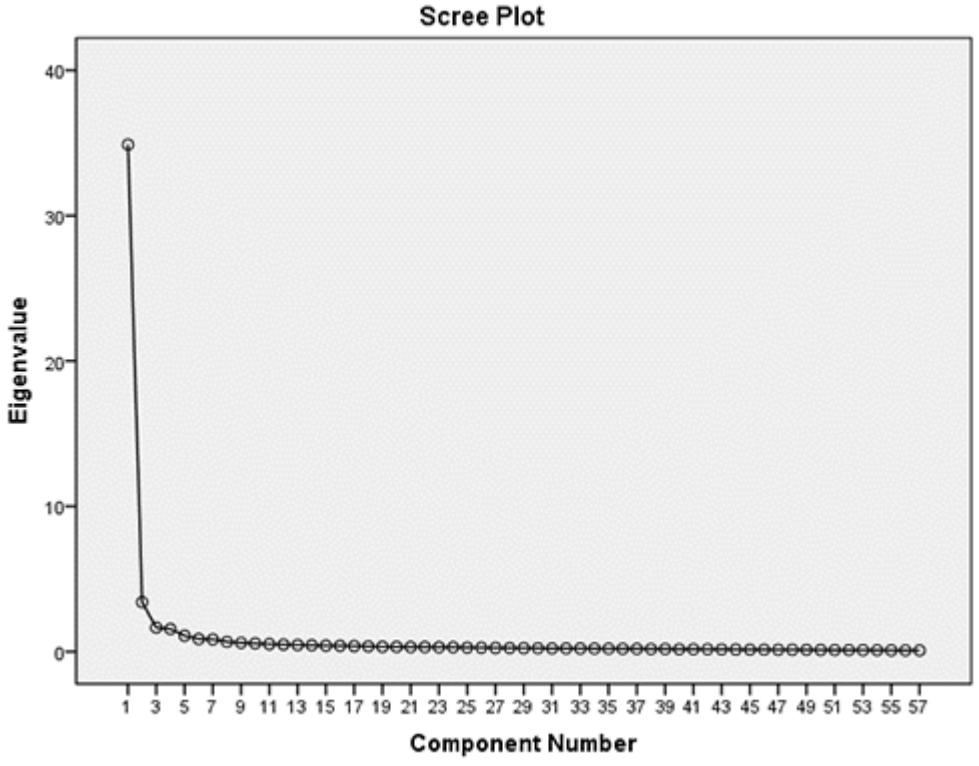

Figure 2. Scree plot for the EFA. EFA, exploratory factor analysis.

Three-level indicator		Factor 1	Factor 2	Factor 3	Factor 4
4.1.2	Assesses the rehabilitation of older patients at each home visit.	0.808	0.228	0.142	0.296
3.3.4	Coordinates beds and other resources for older patients when referring to lower medical institutions.	0.772	0.225	0.184	0.264
4.1.6	Judges whether to end the discharge planning according to the results of family visits.	0.769	0.242	0.188	0.279
4.2.1	Tracks and evaluates the rehabilitation and living conditions of older patients after discharge from hospital.	0.767	0.225	0.217	0.308
4.2.4	Evaluates and analyzes the whole process after the discharge planning is completed.	0.760	0.273	0.307	0.178
3.3.5	Provides technical guidance and training for lower medical service centers.	0.758	0.309	0.207	0.140
4.1.1	Provides multiple forms of follow-up for older patients.	0.749	0.251	0.275	0.212
4.1.5	Records the follow-up progress of older patients in a timely and accurate manner.	0.749	0.221	0.339	0.228
3.3.3	Coordinates nursing clinics to provide follow-up services and nursing specialist guidance for older patients.	0.745	0.183	0.268	0.262
4.2.2	Assesses the psychological status of older patients before and after discharge.	0.728	0.286	0.364	0.119
4.2.3	Investigates older patients' satisfaction with discharge planning and analyze results.	0.722	0.278	0.343	0.146
4.1.4	Coordinates or resolve issues raised by older patients and their families at the time of follow-up.	0.685	0.309	0.445	0.089
4.1.3	Adjusts the discharge planning in a timely manner based on the rehabilitation of older patients.	0.656	0.364	0.368	0.197
3.3.2	Coordinates the implementation of discharge planning between community health service centers and other medical institutions.	0.648	0.208	0.165	0.495
3.3.1	collaborates with community health service centers and other medical institutions to ensure the smooth referral of older patients.	0.647	0.254	0.211	0.446
3.1.6	Works with community health care professionals to ensure the smooth discharge of older patients.	0.603	0.138	0.250	0.530
3.1.2	Assists rehabilitation teachers in providing rehabilitation guidance to older patients with low self-esteem and their families.	0.562	0.218	0.366	0.439
3.1.4	Assists nutritionists to implement individualized dietary guidance according to the nutritional status of older patients.	0.524	0.230	0.292	0.493
1.3.1	Makes a preliminary judgment on whether older patients need discharge planning services.	0.202	0.750	0.330	0.220
1.4.1	Understands and records the concerns and expectations of older patients and their families about disease treatment and out-of-hospital life.	0.307	0.715	0.253	0.277
1.3.2	Discusses with the attending physician the necessity of improving discharge planning for older patients.	0.325	0.704	0.284	0.271
1.4.2	Understands and documents the thoughts of older patients and their families about dying problems and home care.	0.401	0.691	0.182	0.330
1.2.5	Assesses the self-care ability of older patients and the care capacity of primary caregivers.	0.190	0.688	0.476	0.148
1.2.2	Assesses the physical function, cognition, and mental psychology of older patients.	0.241	0.680	0.426	0.142
1.2.4	Assesses the understanding of disease treatment and knowledge of disease in older patients.	0.209	0.677	0.474	0.140
1.2.1	Assesses disease status, progression and prognosis in older patients.	0.291	0.662	0.440	0.175
1.2.3	Assesses the nursing problems of older patients, such as falls, falling into bed, skin integrity, etc.	0.126	0.655	0.556	0.037
1.1.2	Collects family composition of older patients and relevant information of primary caregivers such as relationship with patients, contact information, etc.	0.314	0.627	0.188	0.302
1.1.3	Assesses the safety of older patients' living environment, including indoor lighting, toilet layout, skid-proof facilities, etc.	0.282	0.612	0.436	0.182
1.1.1	Collects sociodemographic data of older patients.	0.348	0.574	-0.023	0.390
2.1.1	Maximizes the self-care ability of older patients as the goal of the discharge planning.	0.310	0.536	0.357	0.439
1.4.4	Uses linguistic and nonverbal communication strategies in the assessment process to address potential sensory and cognitive impairments in older patients.	0.348	0.524	0.352	0.452
1.4.3	Uses interviews to assess the discharge needs of older patients and their families.	0.407	0.500	0.305	0.412
2.2.1	Coordinates or resolve issues of concern to older patients and their families.	0.362	0.488	0.403	0.425
2.1.2	Develops a discharge planning centered on the needs of older patients and their families.	0.360	0.485	0.326	0.483
2.2.2	Discusses emergency plans for developing aggravated or critical moments in older patients.	0.366	0.451	0.425	0.440

(*Continued*)

Three-level indicator		Factor 1	Factor 2	Factor 3	Factor 4
3.2.7	Provides guidance on care methods for older patients at risk of falls, pipe falls and pressure sores.	0.286	0.375	0.741	0.032
3.2.8	Provides psychologically care for older patients and their families to alleviate their anxiety and anxiety about off-campus life.	0.384	0.351	0.666	0.136
3.2.5	Provides guidance to older patients and their families on the use of relevant medical devices and articles.	0.374	0.258	0.661	0.321
3.2.2	Provides individualized health education according to the understanding of older patients.	0.373	0.380	0.659	0.199
3.2.1	Arranges health education in accordance with the priority of older people's health knowledge needs.	0.371	0.379	0.645	0.306
3.2.4	Guides the older patients and their families on disease management methods and matters needing attention in daily life.	0.411	0.362	0.636	0.244
2.4.2	Introduces to the older patients and their families what services the hospital can provide after discharge.	0.332	0.284	0.633	0.398
3.2.6	Guides the older patients and their families to identify critical symptoms and signs and emergency measures.	0.376	0.294	0.632	0.306
2.3.3	Introduces reimbursement methods and proportions of medical insurance to older patients and their families.	0.194	0.265	0.610	0.441
2.4.1	Introduces and confirm the contents of the discharge planning to older patients and their families.	0.240	0.263	0.587	0.517
3.1.5	Assists the doctor in determining the patient's discharge date and return date.	0.418	0.399	0.586	0.234
2.4.3	Maintains the rights of older patients and their families in medical decision-making, such as the informed consent form for signing the discharge planning.	0.283	0.316	0.577	0.417
2.2.4	Discussions can be used to determine the mode of delivery of older patients at discharge.	0.183	0.447	0.573	0.290
3.2.3	Gives full play to the subjective initiative of older patients and help develop programs that change their poor health behaviors.	0.423	0.385	0.544	0.312
2.3.4	Introduces relevant healthcare policies and care resources to older patients and their families.	0.292	0.259	0.494	0.490
3.1.3	Cooperates with physicians and pharmacists to guide drug management for older patients and their families.	0.460	0.222	0.492	0.448
2.3.1	Familiarizes with the social resources available near the home of older patients, such as the location, contacts, services provided by the nearby community health service institutions, etc.	0.323	0.293	0.204	0.687
2.3.2	Fully considers the social resources available in the vicinity of older patients' housing when formulating the discharge planning, and provide them to older patients and their families in time.	0.429	0.366	0.204	0.628
2.2.3	Judges the need for the use of home medical devices and items and to provide access to them.	0.375	0.329	0.365	0.588
2.1.3	Makes individualized follow-up plan (method, content, time, etc.) according to the disease status of older patients.	0.378	0.409	0.311	0.554
3.1.1	Coordinates multidisciplinary team members to complete preparations for older patients before discharge.	0.480	0.223	0.365	0.541

Note: The factor load matrix was determined by the maximum variance orthogonal rotation method.
EFA, exploratory factor analysis.

Table 3. Factor loadings after varimax rotation based on the EFA ($n = 510$).

3.6. Criterion validity

The CIRN compiled by Liu Ming was chosen as the scale of validity.[25] The results show that there was a significant positive correlation between the total scores of the ICCNDPOP and CIRN, with a correlation coefficient of 0.73 ($P < 0.01$ 2-tailed).

4. Discussion

In the past decade, the number of elderly inpatients in China has increased rapidly, and the chronic and comorbidity problems of elderly patients are prominent, which makes the elderly patients face the problem of long-term care during the transition from discharge to family. In response to China's aging population, the Chinese government has successively promulgated a number of policies that point out that medical institutions should provide various forms of continuous care for elderly patients after discharge. As an important mode of continuous care, discharge planning is widely used in the elderly patients who have high demand for continuous care. Nurses are the leaders of discharge planning, and their core competence directly affects the quality of discharge planning. In order to objectively

First-level indicator	Second-level indicator	Number of items	Cronbach's α	Retest reliability
Assessment of discharge planning		14	0.96	0.84
	Collection of general information	3	0.84	0.79
	Assessment of medical care issues	5	0.93	0.79
	Judgment of the necessity of discharge planning	2	0.88	0.74
	Assessment of discharge needs	4	0.91	0.83
Formulation of discharge planning		14	0.97	0.85
	Establishment of individualized discharge planning	3	0.90	0.75
	Predischarge preparation	4	0.88	0.78
	Rational utilization of social resources	4	0.89	0.72
	Explanation and adjustment of discharge planning	3	0.89	0.73
Implementation of discharge planning		14	0.97	0.85
	Multidisciplinary teamwork	6	0.93	0.78
	Health education before discharge	8	0.96	0.76
Follow-up and effectiveness evaluation		15	0.97	0.81
	Coordination of health services	5	0.93	0.81
	Out-of-hospital follow-up	6	0.95	0.79
	Effectiveness evaluation	4	0.94	0.77
The total index system		57	0.98	0.86

Note: The Cronbach's α was analyzed by using the data of database 2. Test-retest reliability was to select 110 nurses for formal investigation and then investigate them again 2 weeks later to obtain data.

Table 4. Reliability of the index system ($n = 511$).

measure the ability of nurses to implement discharge planning for elderly patients, the research team used the Delphi method to construct ICCNLDPOP. In order to comprehensively cover the core competence of nurses, ICCNLDPOP took the 4 stages of discharge planning as the theoretical framework and developed secondary and tertiary indicators on the basis of the 4 stages. In order to ensure the specialization and representativeness of the ICCNLDPOP, the ICCNLDPOP referred to the relevant research on Chinese elderly patients and relevant domestic pension policies to improve and refine the specific content of the three-level indicators. Therefore, the ICCNLDPOP has a reasonable theoretical framework and has good representativeness and comprehensiveness. The purpose of this study was to carry out project analysis and reliability and validity tests on the index that were developed earlier and to provide a reliable assessment tool for the core competence of nurses leading discharge planning for older patients.

The decision value of the 57 three-level indicators of ICCNLDPOP ranged from 14.89 to 27.01, and all values in this range are >3.00 ($P < 0.01$). The results show that the 57 three-level indicators have good homogeneity and discriminatory abilities and can be used to effectively identify the differences in the abilities of different subjects. Therefore, all 57 three-level indicators were retained.

The 4 common factors were extracted after EFA, which explained 72.79% of the total variance, and the factor load of each 3-level index on the corresponding common factor was >0.40.[31,32] The 4 common factors were mostly consistent with the 4 first-level indicators of the index system, namely, "assessment of discharge planning," "formulation of discharge planning," "implementation of discharge planning," and "follow-up and effectiveness evaluation." According to the results of the EFA, the 5 three-level indicators, "3.3.1 Collaborates with community health service centers and other medical institutions to ensure the smooth referral of older patients," "3.3.2 Coordinates the implementation of discharge planning between community health service centers and other medical institutions," "3.3.3 Coordinates nursing clinics to provide follow-up services and nursing specialist guidance for older patients," "3.3.4 Coordinates beds and other resources for older patients when referring to lower medical institutions," and "3.3.5 Provides technical guidance and training for lower medical service centers" were adjusted from "implementation of discharge planning" to "follow-up and effectiveness evaluation." The reasons for the adjustment were as

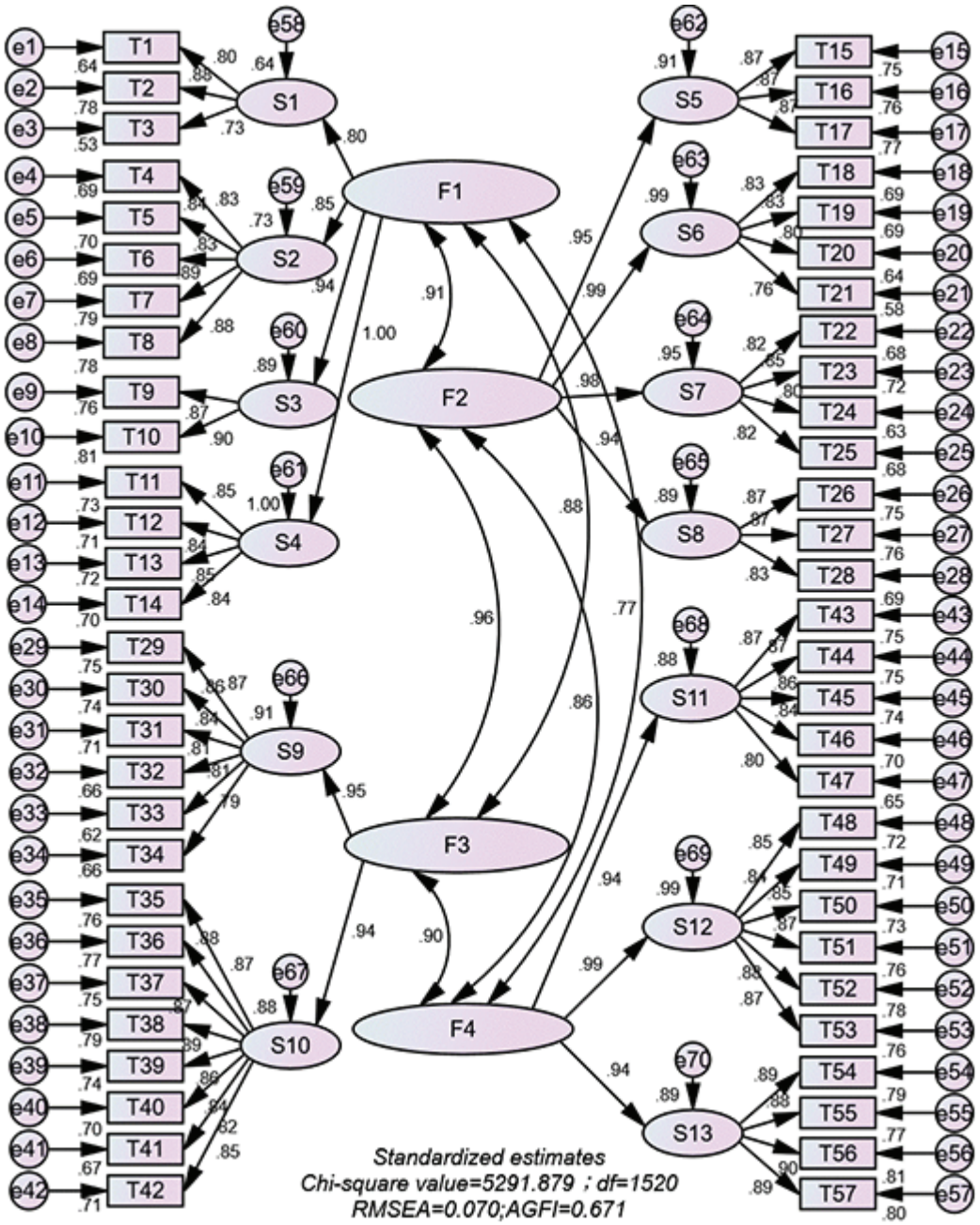

Figure 3. Second-order CFA structure model.
Note: T1–T57 were the 57 observational internal variables, that is, the 57 three-level indicators of the indicator system; S1–S13 were the 13 potential internal factors (first-order factors), which were the secondary indicators of the index system; e1–e57 were the error variables of the 57 measurement indicators; e58–e57 were the error variables of the 13 first-order factors; and F1–F4 were the 4 primary indicators (second-order construct variables). CFA, confirmatory factor analysis.

follows: (1) The three-level indicators 3.3.1–3.3.5 are all about helping patients coordinate revisit services and providing referrals to community health service centers or other medical institutions. In foreign countries, these measures should be implemented as early as possible when patients are in the hospital. In China, these measures are implemented simultaneously after a patient leaves a hospital.[33] Thus, it seemed more consistent with China's national conditions to include it in the first-level index "follow-up and effectiveness evaluation." (2) The loads of the three-level indicators 3.3.1–3.3.5 on the first-level indicators "follow-up and effectiveness

Index system	Absolute fitness index			Value-added fitness index			Simplified fitness index		
	RMR	RMSEA	AGFI	NNFI	CFI	NFI	$\chi 2/df$	PNFI	PGFI
Second-order model	0.047	0.07	0.671	0.879	0.885	0.846	3.481	0.806	0.642

Note: AGFI, adjusted goodness-of-fit index; CFA, confirmatory factor analysis; CFI, comparative fit index; NFI, normed fit index; NNFI, non-normed fit index; PGFI, parsimony goodness-of-fit index; PNFI, parsimony-adjusted fit index; RMR, root mean square residual; RMSEA, root mean square error of approximation.

Table 5. Second-order CFA structural model fitting index.

evaluation" were all >0.60, and the loads on the original first-level indicators "implementation of discharge planning" were <0.27. To ensure the structural stability of the index system, adjustments were made.

Psychometric analyses show that the Cronbach's α coefficients of the evaluation tools are >0.80 and preferably >0.85, which indicates good reliability of the evaluation tools. The total Cronbach's α coefficient of the index system developed in this study was 0.98, the Cronbach's α coefficient of the first index was 0.96–0.97, and the Cronbach's α coefficient of the second index was 0.84–0.96; all of these coefficients met the requirements of psychometrics and showed good internal consistency and reliability.[34] The total retest reliability of the index system was 0.86, the retest reliability of the 4 first-level indicators was 0.81–0.85, and the retest reliability of the 13 second-level indicators was 0.72–0.83. Generally, the retest reliability should be >0.70 so that good consistency of the index system across time is ensured.[34,35] The index system used in this study met all the standards.

Validity refers to the degree of validity of the measurement results. It refers to the degree to which the measurement tools or methods can accurately measure the variables of interest or the degree to which the measured results coincide.[36]

To ensure the structural stability of the ICCNLDPOP, EFA and CFA cross-validation were used to verify the ICCNLDPOP structure in this study. The CFA results showed that the root mean square residual (RMR), root mean square error of approximation (RMSEA), adjusted goodness-of-fit index (AGFI) values for the absolute fitness index were 0.047, 0.07, and 0.671, respectively, indicating that the fitness of the index system architecture was acceptable.[37] The non-normed fit index (NNFI) value, normed fit index (NFI) value, and comparative fit index (CFI) value for the value-added fitness index were 0.879, 0.846, and 0.885, respectively, which were close to 1, indicating that the index structure model was well adapted. The $\chi 2/df$ value for the contracted fitness index was 3.481, indicating that the model structure was acceptable. The parsimony-adjusted fit index (PNFI) value was 0.806, and the parsimony goodness-of-fit index (PGFI) value was 0.642, which were both >0.500, indicating that the model had good adaptability and that the second-order CFA model of the index system developed in this study had a fair degree of fitness and stability. Thus, the ICCNDPOP index had good structural validity.[31]

The CIRN was used to assess the validity of the index. Previous research has shown that the correlation between the total scores of the 2 scales is between 0.40 and 0.80, while the 2 scales are considered to have an ideal degree of correlation. The results of this study showed that the total score of the ICCNLDPOP is positively related to the CIRN, as the correlation coefficient was 0.73 ($P < 0.01$), which met the psychometric requirements.[38,39] Therefore, the ICCNLDPOP has good validity.

The number of older patients has increased dramatically in the past 10 years in China. At present, the State encourages medical institutions to carry out discharge planning. Nurses lead discharge planning; so, they play a key role, and their core competence largely affects the quality of discharge planning. The ICCNLDPOP has good reliability and validity, and it can consistently measure the core competence levels of nurses leading discharge planning for older patients. In summary, the index can serve as a comprehensive, reliable, and operable evaluation tool for evaluating and training nurses leading discharge planning for older patients to improve their core competence level and promote discharge planning in clinical practice.

5. Conclusions

The ICCNLDPOP is a simple self-evaluation tool that is developed for nurses. This study shows that the ICCNLDPOP has enough psychometric characteristics to effectively evaluate the core competence of nurses who implement the discharge planning for older patients. Therefore, the ICCNLDPOP can be used as an effective tool to evaluate the core competence of nurses in China. In addition, the theoretical framework of the ICCNLDPOP is based on the whole process of discharge planning, which can provide reference for other countries in developing assessment tools suitable for their national conditions.

Limitations

The present study has no limitations. First, to fully verify the reliability and validity of the index, 1021 nurses from 17 public general hospitals were included. However, the 17 hospitals were all located in the Ningxia Hui Autonomous Region, with regional limitations. In the future, a multicenter survey will be carried out in other provinces of China to expand the scope of application of the index. In addition, as the next step, the research group plans to set up nurse training programs according to the index to improve the core competence levels of nurses implementing discharge planning for older patients.

Author contributions

All authors developed the index, interpreted the result, and read and approved the final manuscript. L.L. and L.H.Y. developed the project idea. L.L., D.L., L.X.N., and W.Z.Z. collected the data and performed the statistical analyses. Z.R., L.X.N., and W.Z.Z. provided input data and set up database. L.L. and L.H.Y. contributed to modify the paper.

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Ethical approval

The investigation conforms to the principles outlined in the Declaration of Helsinki and was approved by the Ethics Committee of General Hospital of Ningxia Medical University (approval no. 2019-474) prior to the data being collected. All procedures in the studies involving human participants were performed in accordance with the ethical standards of the institutional research committee. Moreover, informed consent forms were signed to ensure the legitimate rights and interests of the research subjects.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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