Analysis of factors and corresponding interactions influencing clinical management assistant ability using competency model in China

Xin Zheng, MD, Jia Shi, MD, Jinyi Wu, MD*

Abstract

The clinical management assistant (CMA) is an innovative and practical way to help manage a hospital, so the selection of CMA is important. This research is to find the influencing factors on the competency of CMA and help to select proper candidate of CMA.

Based on the items of competency theory using the structural equation model, the data of 600 hospital managers from Shanghai, Guangzhou and Wuhan were identified by exploratory factor analysis and confirmatory factor analysis. In further analysis, the interactions among the factors were evaluated.

A total of 20 items were identified as critical to CMA capability, which were further tested and divided into 3 factors: (1) personal characteristics; (2) competence; (3) thinking. The subsequent analysis showed that all factors had significant impact on CMA's ability, and competence contributed the most to the formation of CMA's ability, while the intermediary role of personal characteristics and thinking could not be ignored in practice. The results showed that the competency model contained these 3 factors and had the same structure as the classic competency model.

This study presented a tentative approach for assessing CMA's competency, as well as provided the criteria to find and evaluate a CMA.

Abbreviations: CFA = confirmatory factor analysis, CMA = the clinical management assistant, EFA = explanatory factor analysis, SEM = structural equation model.

Keywords: clinical management assistant, competency, hospital, structural equation model

1. Introduction

The clinical management assistant (CMA) was first explored and developed by Taiwan Chang Gung Hospital in the 1970s. Its purpose was to better manage the departments in hospital by drawing on theories and methods of business management, to help the departments improve the labor productivity, and to maximize resource efficiency, and finally achieve the overall

strategic goals of the hospital.[1–3] With the reform of China's medical system and the liberalization of the medical market, CMA was needed to help hospitals and departments improve market competitiveness, help hospitals to specialize in operation, and promote the development and growth of hospitals.[4,5]

CMA needs to contact and learn professional theoretical knowledge about human resources management, financial analysis, equipment management, asset management, process optimization management, operation management, statistics, marketing, and other aspects in practical work, at the same time, the need to be familiar with medical treatment, medical insurance, and classification.[6,7] Comprehensive knowledge such as referrals, master certain management tools and methods, and strong management practice ability are in need, and they should coordinate and communicate with personnel from multiple departments.[8,9]

Competence refers to the deep-seated characteristics of an individual who can distinguish outstanding performers from ordinary people in a job. It can be motivation, traits, self-image, attitudes, domain knowledge, cognitive and behavioral skills.[10,11] Competence can lead to higher management performance, has a significant impact on management, and is an individual characteristic that can produce significant performance and achievements.[12,13] Questionnaire survey is a method of issuing a structured questionnaire to investigate the ability required for a specific position, thereby constructing a competency model.[14,15]

In our research, we take competence theory into application to analyze the CMA competency. The factors required for CMA and the value of CMA can be evaluated through competency

model. So, how much the effects of identified factors contribute to CMA's competence is evaluated and we can find out a proper way to select candidate of CMA.

2. Methods and materials

This study includes 3 phases:

(1) questionnaire survey,
(2) factor analysis, and
(3) structural equation modeling.

The details of these sections are as follows.

2.1. Questionnaire survey

The questionnaire survey was conducted in two stages: a pilot survey and a large-scale survey. We gather potential competency factors from different sources to provide formal questionnaires, and then conduct large-scale questionnaires to gain the capabilities of CMA.

2.2. Pilot survey

During the pilot survey, possible items of competency factors were collected from the following sources.

(1) As the main source, the General Competence Dictionary was referred and improved to capture items. It is worth noting that, given the nature of the CMA, several projects were extracted.
(2) Interview results are another major resource.

A structured interview method called Behavioral Event Interview was also implemented in 10 CMAs. In this method, the interviewee was asked to describe his/her true experience in hospital management. Therefore, a main list containing all potential competency factors was generated as a basis for the subsequent formation of the questionnaire.

2.3. Large-scale survey

Before designing the questionnaire, all the items measured in the pilot survey were screened and summarized by comparing the core connotation of each item, mainly according to the definition and key behavior described in the general competency dictionary.

Then, a large-scale survey was conducted, and questionnaire was completed by 600 workers in management department of hospital, CMA, and superior management department of the hospital in several cities.

2.4. Factor analysis

After collecting the data, factor analysis was carried out to determine the key items that affected the performance of CMA. This part included explanatory factor analysis (EFA) and confirmatory factor analysis (CFA).[16]

The results of factor analysis also lay a foundation for the construction of measurement model in subsequent structural equation model (SEM) analysis.[17] The measurement model focuses on how potential problems were conceptualized and measured by explicit variables. The results showed that factor analysis provided a reliable tool for revealing the structure behind the measurement index, especially lack of prior knowledge of the factors or patterns of the measurement index.

2.5. Modeling of competency for clinical department's operations management assistant

Because of its superior performance in dealing with the complex relationship and estimating the interactions involved, structural equations are applied to the quantification of CMA. Structural equation model is composed of measurement model and structural model, whose purpose is to qualitatively describe the potential factors and quantitatively analyze the interaction between them respectively.[18]

On the basis of the measurement model, the interaction between potential factors is assumed, and the regression estimation by the structural model is tested. Finally, through the goodness-of-fit test, the key influence path between potential factors and competency is found, and the competency model of CMA is established.

At the same time, as a theory-driven method, all the research results of structural equations should be supported by theory. In other words, in addition to meeting the statistical criteria, it is also necessary to follow previous theories to explain the relationships found in the SEM process from a practical point. This issue has been considered and reflected in the model modification process described in later sections.

2.6. Survey samples

To understand the opinions on CMA in China, several important cities have carried out large-scale surveys, thus providing a sufficient source of information for our investigation. The number of CMAs in each of the four locations surveyed ranges from 50 to 150.

After 12 weeks of interview and survey, 600 employees from hospital management departments, clinical department operation management department, and superior management department participated in the survey and received a total of 600 questionnaires. Table 1 shows an overview of valid respondents. All subjects had informed consent to be included in the study before participating in the study. In addition, the personal information of the respondents in our study will be highly respected and strictly confidential.

3. Results

3.1. Identification of critical items

The results showed that the preliminary survey has obtained 51 potential projects that might affect the competency of CMAs. On

Table 1

The profile of respondents.

Category	Range	Frequency
Age	<26	19
	26–35	461
	36–45	88
	>55	32
Gender	Male	231
	Female	369
Education	Colleges	1
	Bachelor	121
	Master degree	478
Experience	5 yrs<	311
	5–10 years	158
	>10 yrs	131

Table 2

Definitions of items included in the questionnaire.

No.	Items	Definition
1	Sense of worth	It is composed of the sense of worth of life, life comforting and spiritual realm.
2	Professionalism	The expertness characteristic of a professional person
3	Affinity	The force attracting atoms to each other and binding them together in a molecule
4	Character	A characteristic property that defines the apparent individual nature of something
5	Responsibility	The social force that binds you to the courses of action demanded by that force
6	Self cognition	The consciousness of human beings to their physical and mental state and their relationship with the objective world
7	Communication	Transmit information
8	Administrative transactions	Administrative power in accordance with laws, regulations and rules
9	Diplomacy	Subtly skillful handling of a situation
10	Decision making	Make decisions about what needs to be resolved
11	Human resource management	The management of an organization's workforce, or human resources.
12	Time management	The act or process of planning and exercising conscious control over the amount of time spent on specific activities
13	Learning and innovation	The competence structure of knowledge worker involves learning and innovation skill
14	Reactive	Participating readily in reactions
15	Implementation	The act of accomplishing some aim or executing some order
16	Asset management	Asset management refers to the management of investments on behalf of others.
17	Analytical thinking	The abstract separation of a whole into its constituent parts in order to study the parts and their relations
18	Service awareness	Work done by one person or group that benefits another
19	Team-work	Cooperative work done by a team
20	Knowledge and technical expertise	Skill or knowledge in a particular area

the basis of describing the definition and key actions, 20 items related to management competence were collected from the general competency dictionary.

Then, the items with similar meaning were screened and summarized. Most of the definitions were given with reference to the general competency dictionary. For items that could not be directly attributed to a single attribute in the dictionary but were often mentioned by other resources, a new term was created to cover its core ideas.

After analyzing the results of the pilot survey, a list of 19 potentially key items was prepared for the large-scale questionnaire survey with corresponding detailed definitions (see Table 2).

Table 3

The statistical description of items.

No.	Items	Mean	SD
1	Sense of worth	2.73	0.54
2	Professionalism	2.93	0.25
3	Affinity	2.63	0.58
4	Character	2.55	0.62
5	Responsibility	2.95	0.22
6	Self cognition	2.73	0.48
7	Communication	2.95	0.22
8	Administrative transactions	2.78	0.41
9	Diplomacy	2.67	0.51
10	Decision making	2.63	0.55
11	Human resource management	2.47	0.59
12	Time management	2.82	0.43
13	Learning and innovation	2.85	0.36
14	Reactive	2.78	0.45
15	Implementation	2.83	0.41
16	Asset management	2.63	0.52
17	Analytical thinking	2.73	0.51
18	Service awareness	2.73	0.44
19	Team-work	2.87	0.34
20	Knowledge and technical expertise	2.68	0.53

3.2. Factor analysis

3.2.1. Explanatory factor analysis. Factor analysis generally began with EFA. The purpose of EFA was to sum up variables into several principal components, so as to reveal the potential structure and interrelationship (Table 3).

The suitability of factor analysis was evaluated by the KaiserMayer-Olkin sampling adequacy test (KaiserMayer-Olkin test) and Bartlett Test of Sphericity (Bartlett test).[19] The value of the KaiserMayer-Olkin test was 0.66, which met the general standard, and the Bartlett test indicated that the null hypothesis could be rejected with the value of 7057.506 ($P < .001$). As a result, it turned out that significant interactions exist (Table 4).

The principal component analysis method was used to extract the items whose initial eigenvalues and factor load values were greater than 1.0 and 0.4 respectively.

In essence, factor analysis is a method of replacing a large number of variables with several common factors to reflect the information contained in these variables to the maximum extent.[16] As a result, the concepts of factor load and explanatory variance are derived. Factor load is defined as the correlation coefficient between variables and common factors, indicating the degree of expositions of dominant variables by common factors. The sum of the square factor loads of all variables of a given factor refers to the percentage of variance of all variables explained by that factor. This means that the grouping results of projects depend on different factor loads, and the interpretability of the proposed factor structure can be measured by the proportion of variance.

Table 4

Kaiser-Mayer-Olkin (KMO) sampling adequacy and Bartlett test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.66
Bartlett Test of Sphericity	
Approx. Chi-Square	7057.506
df	190
Sig.	0.000

Table 5

Factor loading matrix after varimax rotation.

		Component		
Item	Items	1	3	2
1	Sense of worth	0.59	0.15	0
2	Professionalism	0.29	0.54	
3	Affinity	0.76	0.01	0.29
4	Character	0.72	0.09	0.16
5	Responsibility		0.63	0.13
6	Self cognition	0.5	0.35	0.17
7	Communication	0.5	0.42	0.09
8	Administrative transactions	0.42	0.23	0.29
9	Diplomacy	0.35	0.19	0.69
10	Decision making		0.21	0.57
11	Human resource management	0.29		0.73
12	Time management	0.38	0.51	0.36
13	Learning and innovation	0.16	0.05	0.37
14	Reactive	0.18	0.63	0.25
15	Implementation	0.27	0.54	0.07
16	Asset management	0.43	0.17	0.41
17	Analytical thinking	0.04	0.62	0.46
18	Service awareness	0.40	0.49	0.07
19	Team-work	0.10	0.45	0.28
20	Knowledge and technical expertise	0.10	0.23	0.53

The factor load matrix after rotation is shown in Table 5. According to the meaning of the project and the results of the grouping, these groups are identified as three factors based on the competency theory, as shown below.

3.2.2. Confirmatory factor analysis. CFA is used to test the reliability and validity of the proposed grouping. First of all, in terms of reliability, Cronbach α test is used to evaluate the internal consistency reliability of the questionnaire, which reflects the correlation among the dimensions of the questionnaire.[20] This result determines whether the proposed questionnaire can stably measure the identified factors.

According to experience, some professionals needed 0.70 or more as the ideal level of reliability, while 0.60 was generally considered to be the lowest acceptable threshold. The alpha value of Cronbach was shown in Table 6. The overall α value showed that the developed measurement scale was reliable, which mean that the grouping of extracted factors was appropriate.

In terms of validity, convergence validity and discriminant validity were introduced to ensure the strong correlation between items belonging to the same factor and the full distinction between different factors.[20] The validity was verified by standardized factor load (FL > 0.5), structural reliability (CR > 0.7), mean variance extraction (AVE > 0.5), and the square root of AVE (greater than the correlation coefficient between factors). The results shown in Tables 7–9 confirmed the effectiveness of the proposed grouping.

Table 6

Cronbach α reliability test of identified factors.

No.	Factors	Cronbach α
Factor 1	Personal traits	0.75
Factor 2	Ability	0.82
Factor 3	Thinking	0.69

Table 7

Cronbach α reliability test of identified factors.

Factor	Items	FL	CR	AVE
Personal traits	Sense of worth	0.72	0.79	0.44
	Professionalism	0.43		
	Affinity	0.55		
	Character	0.70		
	Responsibility	0.34		
	Self cognition	0.78		
Ability	Communication	0.62	0.82	0.34
	Administrative transactions	0.58		
	Diplomacy	0.69		
	Decision making	0.35		
	Human resource management	0.54		
	Time management	0.81		
	Learning and innovation	0.35		
	Reactive	0.61		
	Implementation	0.53		
	Asset management	0.62		
Thinking	Analytical thinking	0.64	0.70	0.38
	Service awareness	0.62		
	Team-work	0.65		
	Knowledge and technical expertise	0.56		

Table 8

Discriminant validity test of the identified factors.

Factors	Factor 1	Factor 2	Factor 3
Factor 1	1		
Factor 2	0.76	1	
Factor 3	0.71	0.81	1

3.3. Structural equation modeling

The results of EFA and CFA supported the reasonableness of dividing the 20 projects into three groups. According to the composition of each group and the corresponding definition of the project, a structural equation model was established, and the relationship between them was shown in Figure 1.

4. Discussion

As a bridge between the hospital and various departments, the CMA was the important liaison between the hospital and clinical departments in the efficient, and they completed implementation of strategic goals, management strategies, and information feedback. As the CMA needed scientific analysis and objective assessment of the operating conditions and resource allocation of clinical departments, professional knowledge was the prerequisite for his job competence.[2] CMA needed to report and display the objects and contents to the director of the department and the hospital manager through analysis using data, charts, and text.

Table 9

Discriminant validity test of the identified factors.

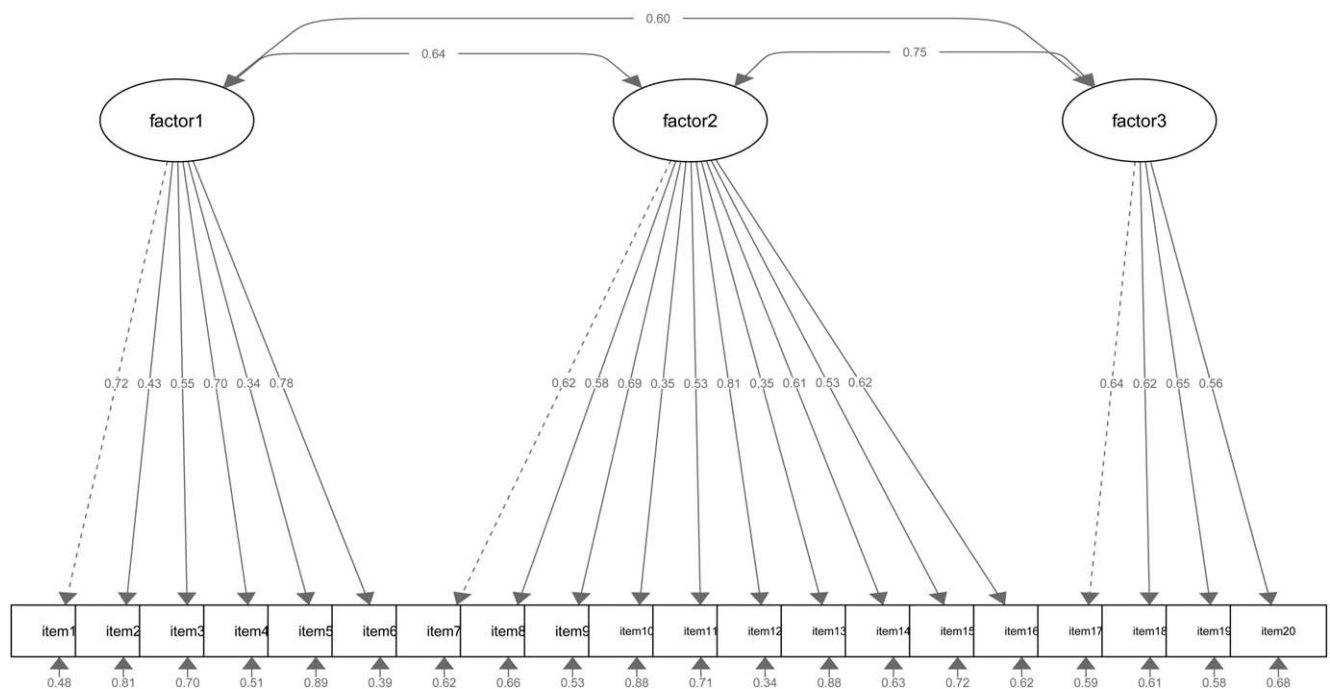| Parameter	Coefficient
χ^2	3939.530
χ^2/df	23.59
RMSEA	0.194
TLI	0.384
CFI	0.459

Figure 1. Structural equation model of the clinical management assistant competency.

In our research, 20 ability items were extracted from the ability dictionary.[21] Most projects had internal influences, and these factors were analyzed by investigating the CMA's perception of its characteristics. The proposed model focused on internal differences in the various CMAs, rather than external changes.

EFA and CFA mathematically classified the project as 3 potential factors, and then constructed these factors through SEM and competency theory. The factor 2 served as the basis for the model, as individual roles were formed based on its experience, which indicated that this function was not easily affected by the external environment.

SEM models had been validated to analyze potential structures among the factors that make up CMA's capabilities. The results showed that the proposed model meets the general goodness-of-fit values. Therefore, the main factors affecting personal capabilities and related performance could be identified through the role of communication, administrative transactions, diplomacy, decision making, human resource management, time management, learning and innovation, reactive, implementation as well as asset management. In this study, individual roles had the greatest impact on ability. With regard to other factors, it was not surprising that relatively visible factors also played a vital role in developing competence, as most current training programs and field regulations were designed to improve competence. It was worth noting that the important path between the other 2 factors also proved the effectiveness of the introduction in competency theory. In other words, the significant impact from perception and skills reminded researchers that proper perception and cooperation between CMAs was necessary to develop their capabilities.

The research results supported the existence of the influencing factor infrastructure derived from the competency theory,[22] and the model provided a reasonable overall description of the interaction between these factors. Therefore, this exploration had produced an interpretable framework to promote an understanding of the reasons behind the different responses of the CMA. The research results also had practical significance. For HR personnel, the competency model could be used as an assessment tool for recruitment, selection, and training tasks. Whether a CMA can complete its work was influenced and determined by various characteristics. A thorough understanding of these characteristics was important to improve the performance of CMA. Based on the competency theory, combined with EFA, CFA, and SEM, this paper established a model that outlined and evaluated CMA capabilities. The study found that three factors had a significant impact on CMA performance, namely cognition, skills, and personality.

To the author's knowledge, this study was the first attempt to analyzed CMA capabilities based on competency theory. The purpose of this research was to contribute to the knowledge system in the characteristics and behavior of CMA by providing a comprehensive theoretical framework based on competency theory. In practice, this study confirmed the rationality of using targeted strategies to optimize job performance and proposed a tentative method for evaluating on-site CMA. In addition, the survey results highlighted the need for managers and professionals to develop a training system to properly and smoothly integrated CMA into the crew in hospital.

Since it is the first paper about factors and corresponding interactions influencing CMA ability using competency model in China, there are inevitably some limitations. Firstly, samples are from big cities in China, and we can include more samples in middle and small cities. Secondly, the questionnaire is mainly about qualitative analysis, and we can collect some management data about CMA in the future to do quantitative analysis.

Author contributions

Conceptualization: Xin Zheng.
Data curation: Jinyi Wu.
Formal analysis: Jia Shi.

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