

ORIGINAL ARTICLE

# Development of performance indicators for innovation management in nursing units of community hospitals affiliated to the Ministry of Public Health

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## Abstract

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Performance indicators of innovation management are essential for organization development in competition situation that rapidly change. This study developed performance indicators for innovation management in nursing units at community hospitals by using quantitative methods. The development processes of the performance indicators for innovation management are presented as follows: 1) definition of operational terms; 2) creation of questions from the definition of terms, which resulted in 24 indicators of 3 components; 3) content validity testing by nine experts, with a CVI = 0.84; 4) determining the internal consistency reliability with thirty head nurses of nursing units from community hospitals, with a Cronbach's Alpha Coefficient for input to the innovation process component at 0.88, the innovation process component at 0.91, and Output at 0.78; 5) testing of the construct validity by using factor analysis to extract indicators from the implementation process, with 294 head nurses in nursing units of community hospitals.

The research instrument for measuring innovation management performance of nursing units at community hospitals affiliated with the Ministry of Public Health contain of 3 components with 23 indicators: 1) input to the innovation process is composed of 10 indicators, e.g. time and budget allotted to training; 2) the innovation process is composed of 9 indicators, e.g. sharing experience between nursing units to help learning for creating innovations at nursing units, and 3) output is composed of 4 indicators, e.g. innovations of nursing units have been created and/or there have been more innovations over the past five years. The developed instrument was congruent with empirical data ( $\chi^2 = 0$ , GFI= 1.000, RMSEA= 0.053)

The developed instrument can be used to measure nursing unit management performance and to be used to policy formulation and strategic planning to innovation management at the level of nursing units at community hospitals affiliated to the Ministry of Public Health, Thailand.

**Keywords:** Indicators, innovation management performance, community hospitals.

# การพัฒนาตัวชี้วัดผลการดำเนินงานการจัดการ นวัตกรรมของหอผู้ป่วย โรงพยาบาลชุมชน สังกัดกระทรวงสาธารณสุข

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## บทคัดย่อ

กัญญาวิณ์ โมกขาว สุจิตรา เหลืองอมรเลิศ นงลักษณ์ จินตนาดิกล และ เนตรชนก ศรีทุมมา  
การพัฒนาตัวชี้วัดผลการดำเนินงานการจัดการนวัตกรรมของหอผู้ป่วย โรงพยาบาลชุมชน  
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การวัดผลการดำเนินงานการจัดการนวัตกรรมเป็นสิ่งจำเป็นต่อการพัฒนาองค์กรให้ทันต่อการแข่งขันและการเปลี่ยนแปลงที่รวดเร็ว งานวิจัยนี้มีวัตถุประสงค์เพื่อพัฒนาตัวชี้วัดผลการดำเนินงานการจัดการนวัตกรรม โดยใช้วิธีวิจัยเชิงปริมาณ การพัฒนาตัวชี้วัดผลการดำเนินงานของการจัดการนวัตกรรมมีขั้นตอนดังนี้ 1) กำหนดค่านิยามศัพท์เชิงปฏิบัติการ, 2) สร้างข้อคำถามจากค่านิยามศัพท์ ได้ 24 ตัวชี้วัด 3 องค์ประกอบ, 3) ตรวจสอบความตรงตามเนื้อหาโดยผู้ทรงคุณวุฒิ 9 คน ได้ค่า CVI เท่ากับ 0.84, 4) หาค่าความเที่ยง โดยนำไปทดลองใช้กับหัวหน้าหอผู้ป่วย โรงพยาบาลชุมชน จำนวน 30 คน ได้ค่าความเที่ยงขององค์ประกอบสิ่งนำเข้ากระบวนการนวัตกรรมเท่ากับ 0.88, กระบวนการนวัตกรรมเท่ากับ 0.94, และผลผลิตเท่ากับ 0.78, 5) ตรวจสอบความตรงเชิงโครงสร้าง โดยใช้การวิเคราะห์องค์ประกอบ จากการนำไปใช้กับหัวหน้าหอผู้ป่วย โรงพยาบาลชุมชน จำนวน 294 คน

ผลการศึกษาได้เครื่องมือวิจัยที่ใช้วัดผลการดำเนินงานการจัดการนวัตกรรมของหอผู้ป่วย โรงพยาบาลชุมชน ประกอบด้วย 3 องค์ประกอบ จำนวน 23 ตัวชี้วัด ได้แก่ 1) สิ่งนำเข้ากระบวนการนวัตกรรม 10 ตัวชี้วัด อาทิ มีการจัดสรรเวลาและงบประมาณสำหรับการฝึกอบรม 2) กระบวนการนวัตกรรม 9 ตัวชี้วัด อาทิ มีการแลกเปลี่ยนประสบการณ์ระหว่างหอผู้ป่วย ที่ช่วยให้เกิดการเรียนรู้ในการสร้างนวัตกรรมของหอผู้ป่วย, และ 3) ผลผลิตมี 4 ตัวชี้วัด อาทิ มีนวัตกรรมของหอผู้ป่วยเกิดขึ้นและ/หรือเพิ่มขึ้น ภายใน 5 ปี ที่ผ่านมา เครื่องมือที่พัฒนาขึ้นมีความสอดคล้องกับข้อมูลเชิงประจักษ์ ( $\chi^2 = 0$ , GFI = 1.000, RMSEA = 0.053)

เครื่องมือที่พัฒนาขึ้นนี้ สามารถนำไปใช้วัดผลการดำเนินการจัดการนวัตกรรมของหอผู้ป่วย และใช้เป็นข้อมูลในการกำหนดนโยบาย และการวางแผนกลยุทธ์สำหรับการจัดการนวัตกรรมในระดับหอผู้ป่วย โรงพยาบาลชุมชน สังกัดกระทรวงสาธารณสุขต่อไป

คำสำคัญ: ตัวชี้วัด, ผลการดำเนินงานการจัดการนวัตกรรม, โรงพยาบาลชุมชน

## Introduction

With the current rapid advances in science and technology, the world's societies are becoming societies with knowledge-based economies. Each economy is being driven by new knowledge and innovations, because knowledge resources can be created infinitely<sup>1</sup>. For nursing organizations, nursing innovation management is important as it leads to enhancing the quality of nursing services, creating new knowledge, reducing unnecessary expenses<sup>2</sup>, and improving job performance<sup>3</sup>. To achieve the ultimate goals of any nursing organization such as good quality of nursing services and being a learning organization, the performance indicators for innovation management should be articulated clearly and practically.

The Bureau of Nursing has formulated the policy for nursing innovation development and supported knowledge exchange for creating new nursing knowledge or nursing innovations<sup>4</sup>, which will be good for nursing practice guidelines<sup>3</sup> for providing effective nursing services, and these will lead to nursing outcome improvements<sup>5,6</sup>, patient safety<sup>7</sup>, cost effectiveness, and the creation of competitive advantages for hospitals<sup>8</sup>. According to the Nursing Bureau policy, nursing administrators in community hospitals have to set key success indicators at the nursing unit level, to create at least one innovation per year, with the goals of improving the quality of nursing service, reducing unnecessary expenses, and enhancing patient satisfaction<sup>9</sup>. The aforementioned indicators are quantitative measurements of innovation building and neither can be used to analyze problems from nursing unit innovation management, nor can they be specified as innovation management policies of nursing units and organizations.

At present, performance indicators of innovation management have been found only in business contexts, and they have been measured using the number of innovations, introduction of innovations to the market, innovation awards, innovations resulting from intellectual property patents, and customer satisfaction<sup>10,11,12</sup>. Those indicators may not be suitable for community hospital nursing unit context, because nursing units are not focused on the number of innovations for their own sake or for commercial gain, but instead focus on improving the quality of nursing.

From a literature review of the innovation management performance concept, Tidd and Bessant's<sup>13</sup> innovation management performance concept explains innovation management performance by addressing it in terms of input to the innovation process, the innovation process, and output, thereby enabling an explanation of innovation management performance with coverage of all areas, in addition to providing for consistency with nursing unit innovation management environments, leading not only to emphasis on performance but also placing importance on supporting factors leading to nursing implications<sup>2</sup>.

For the reasons, the researcher developed and tested the quality of innovation management performance measurement of nursing units using Tidd and Bessant's innovation management performance concept. Along with Burn and Grove's method of instrument development,<sup>14</sup> the instrument development involves 8 steps as 1) Identifying the concepts of the variables, 2) Defining the concept, 3) Designing of a scale, 4) Seeking item review, 5) Conducting preliminary item tryouts, 6) Performing field tests, 7) Conducting construct validity studies, and 8) Evaluating the reliability of the scale.

This data from head nurses of nursing units were used for validity and reliability<sup>15</sup>. As a result, nursing units should be able to use the developed indicators to measure their innovation management performance for the nursing unit, and use them as effective guidelines for creating nursing innovations in nursing unit.

### **Research objectives**

The objectives of this research were:

1. To establish and develop performance indicators of innovation management for nursing units of community hospitals affiliated to the Ministry of Public Health.
2. To assess and validate the performance indicators of innovation management for the nursing unit level of community hospitals affiliated to the Ministry of Public Health.

## **Methods**

### **Conceptual framework**

Specification of performance indicators of innovation management for nursing units was developed by the researchers based on Tidd and Bessant's innovation management performance concept.<sup>13</sup> These were composed of three broad areas for the components: input to the innovation process, the innovation process itself, and output from the process. The concept was then used to create indicators for use in measurement of innovation management performance by nursing units, by applying Burn and Grove's<sup>14</sup> instrument development method to assess and validate the quality of indicators in the following four areas: 1) content validity, 2) construct validity

by using exploratory factor analysis, 3) confirmatory factor analysis, and 4) reliability.

### **Population and sample**

The population consisted of 454 head nurses from the largest community hospitals nationwide, 91 hospitals.. The sample was restricted to head nurses of community hospitals who have at least three years' experience. The sample size was determined with a ratio of 20 respondents per parameter which was considered as the most appropriate<sup>15</sup>. A stratified random sampling was used by sampling from the Health Service Network's 12 networks, and simple random sampling and sample size calculation resulted in 300 head nurses from 60 community hospitals.

### **Indicator development**

Development of the indicators involved 8 steps<sup>14</sup>:

- (1) Identifying the concepts of the variables.

Selecting innovation management performance concepts that could be used in the research and building an understanding about these concepts in use.

- (2) Defining the concept.

Defining an operational definition of innovation management performance in nursing units of community hospitals affiliated with the Ministry of Public Health.

- (3) Designing of a scale.

Designing a scale to be used to consider each indicator for measuring performance of innovation management for nursing units in community hospitals affiliated to the Thai Ministry of Public Health. The scale must correspond with the objective of the research and content of the items.

(4) Seeking item review

Seeking item review from a team of subject matter experts with knowledge and experience in innovation management of nursing units, expertise in the area of nursing innovations, and with at least three experts in the field of survey instrument development<sup>15</sup>. Content validity index (CVI) and item-Objective Congruence Index (IOC) were analyzed<sup>15</sup>.

(5) Conducting preliminary item tryouts.

Conducting a preliminary pretest of the items with 30 head nurses of nursing units who have had at least three years of innovation management experience in nursing units at community hospitals. Data were used to calculate indicators reliability by using Cronbach's Alpha Coefficient to obtain internal consistency of the overall scale, each component's reliability, item-total correlations, item-item correlations, and alpha-if-item deleted reliability coefficients.

(6) Performing field tests.

The sample group in this study was composed of 300 head nurses of nursing units with at least three years of experience in managing nursing units of community hospitals, based on the concept of DeVillis<sup>15</sup>.

(7) Conducting construct validity studies.

Having collected data from head nurses of nursing units of community hospitals affiliated to the Ministry of Public Health whose duties involving the management of innovations in nursing units, conducting statistical data analysis by performing explanatory factor analysis and confirmatory factor analysis.

(8) Evaluating the reliability of the scale.

After construct validity, the collected data should be analyzed for reliability one more time,

because there may be fewer items, and therefore the previous reliability analysis cannot be used with components consisting of a distinct set of items.

### **Data analysis**

The data were analyzed using the following computer programs: 1) descriptive statistics were used to determine means and standard deviations, 2) exploratory factor analysis was used to organize components of innovation management performance, 3) confirmatory factor analysis was performed to test for the goodness of fit of the structural model of the factors, weights were assigned to constructing the indicators and empirical data to determine the weights of the main variables used in constructing the indicators, and 4) Cronbach's Alpha Coefficient provided a measure of the internal consistency of the scale and describes the extent to which all the items in a test measure the same construct.<sup>16</sup>

### **Ethical consideration**

The ethical committee of Christian University of Thailand approved this study (registration no. N.02/2559) on September 6, 2016 and permission was obtained from the directors of community hospitals where the research data was collected. The researcher explained the research objectives and methodology to inform the participants. The researcher also asked for the participants' informed consent. The data obtained from the questionnaires were kept confidential. The findings were presented from an overall perspective, and the participants had the right to cancel participation in the study at any time without any impact on participants.

## Results

Two hundred ninety-four head nurses of nursing units at community hospitals responded by self-administered. Most of head nurses were female (98.9%) and were aged 41 – 50 years (60.2%). Most of them graduated with bachelor degrees or an equivalent level (64.3%). About one-third of head nurses had nursing unit management experience within a range of 5 – 10 years (37.1%), followed by nursing unit management experience within between 11 – 15 years (25.5%). Furthermore, most of the head nurses had experience in leading teams to create innovations within a range of 1 – 5 years (58.2%).

The results of this study are presented with the steps in the development of the indicators as follows:

The first step was identifying concepts of the variables of performance of innovation management for public health community hospital nursing units, and building an understanding about the details of Tidd and Bessant's innovation management concept<sup>13</sup>. The second step operationally defined innovation management performance in a way that could be used to measure innovation management performance from the perspective of the head nurses of nursing units. This involved creating 24 indicators of 3 components. Each of the components consisted of the following: 1) input to the innovation process (ten indicators), the innovation process (ten indicators), and 3) output (four indicators). In the third step a measurement scale was designed in the form of a 5-point Likert scales that would be used to consider each of the indicators for measuring nursing unit innovation management performance. Anchor points for the scale had labels ranging from “most real”, “real”, “not sure”, “unreal”

and “most unreal”. Item content for the scales was selected that corresponded to the objective being studied by the researcher and the indicators<sup>14</sup>.

Pursuant to the fourth step, item review was sought from nine subject matter experts. The reviewers consisted of two head nurses of nursing units in community hospitals who had knowledge and experience in innovation management in nursing units, one head nurse of a nursing unit who had innovation management knowledge and experience and had been awarded national innovation awards, one researcher with experience in conducting research on innovations, one expert in the field of instrument development, one expert in the area of nursing innovations, and three innovation developers in other fields. Item reviews obtained a content validity index (CVI) of 0.84 and item-Objective Congruence Index (IOC) with a range of 0.56- 1.00.

In the fifth step a preliminary tryout of the items was conducted with 30 head nurses of nursing units who had at least three years of innovation management experience in nursing units of community hospitals. Data were used to calculate the instrument's components reliability by using Cronbach's Alpha Coefficient. The internal consistency of the input to the innovation process component was 0.88; the innovation process component was 0.91; the output to the innovation process was 0.78; and the overall reliability was 0.91. The corrected item-total correlation was at 0.30 – 0.76. The item-item correlation matrix was at 0.30- 0.70 for more than 50% of the correlations, and the alpha if item was deleted ranged from 0.8- 0.9, showing that the scale's internal consistency value was at a satisfactory level.



In the sixth step, testing of the measure was performed at field tests with head nurses of nursing units of community hospitals affiliated to the Ministry of Public Health. The sample group was randomly selected by stratified random sampling and simple random sampling by listing each hospital's entire Health Service Network's 12 networks for a non-displacement proportionally, and the collection of data from head nurses whose duties involved the management of innovations in nursing units for at least 3 years. Researchers were able to collect data from 294 completed forms out of 300 sent out (98%), and to conduct statistical data analysis by performing explanatory factor analysis and confirmatory factor analysis.

The exploratory factor analysis of indicators for measuring innovation management performance of nursing units was conducted as follows: Data suitability was tested in line with the conditions of statistical data analysis. Factor analysis found significant Bartlett's Test of Sphericity ( $P$ -value < 0.01), the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of 0.945, meaning the variables were related. The data had high suitability for analysis using factor analysis statistics.<sup>16</sup> Construct validity was determined by performing exploratory factor analysis, extracting the components by principle component factor analysis, and using orthogonal rotation to simple structure by the Varimax method.

The relevant component selection criteria consisted of considering factors with Eigenvalues exceeding 1.00 with component explanations for three indicators and up. In addition, each indicator had a factor loading of 0.50 and up.<sup>17</sup>

According to the exploratory factor analysis, the innovation management performance indicators of nursing units had 23 indicators for the 3 components. The components of innovation management performance consisted of: 1) ten indicators in the area of input to the innovation process; 2) nine indicators in the area of the innovation process. Component 2 had one indicator that could not be organized in any component because the factor loading of the indicator was less than 0.50; and 3) four indicators in the area of output. The percentage of total variance accounted for by the factors can be explained at 71.39 percent (see Table 1). The factor loadings of the innovation management performance indicators of nursing units are organized from high to low as shown, input to the innovation process indicators were in a positive range from .50 to .99 with a statistical significance of .01 for all of them; innovation process indicators were in a positive range from 0.51- 0.94 with a statistical significance of .01 for all of them; and outputs indicators were in a positive range from 0.84- 0.91 with a statistical significance of .01 for all of them in Table 2.

**Table 1** Eigenvalues, percentage of variance, percentage of accumulated variance, and number of indicators of each component of performance indicators of innovation management

Component name	Eigen value	Percentage of variance	Percentage of accumulated variance	Number of indicators
1. Input to the Innovation Process	11.22	26.91	26.91	10
2. Innovation Process	3.22	24.98	51.89	9
3. Output	1.97	19.50	71.39	4

Confirmatory factor analysis found the innovation management performance model to be consistent with the evidence-based data as a perfect fit<sup>17</sup> by considering chi-square statistics equal to 0.000 or / df equal to 0, GFI equal to 1.000 and RMSEA equal to 0.053. This shows that the main hypothesis was

accepted. The research model fitted well to empirical data. The result of factors score was found that the most of 3 important components was administrative potential of innovation management performance followed by outputs, input to the innovation process, and innovation process respectively (Table 3).



**Table 2** Factor loadings of performance indicators of innovation management for nursing units

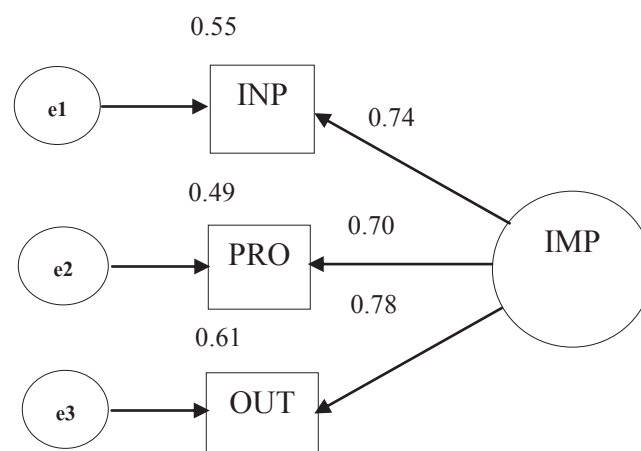
No.	Indicators	Factor loading
<b>Input to the innovation process</b>		
1	Time allotted to training and development of knowledge to create innovation for nurses at nursing units.	0.99
2	Budget allocated to training and development of knowledge to create innovation for nurses at nursing units.	0.96
3	Innovation projects conducted by nurses at nursing units with budget allocations.	0.96
4	Policy of time allocation for nurses to create innovations.	0.90
5	Time allotted for nurses in nursing units with innovation creation.	0.86
6	Provision of mentors for conducting research and creating innovations.	0.81
7	Training courses and knowledge development to create innovations for nurses in nursing units.	0.64
8	Announcement of annual budget planning to support the creation of innovation for nurses to acknowledge.	0.59
9	Systems for supporting the creation of innovations for nurses in nursing units such as modern information technology systems, statistical data analysis support systems and venues for group meetings (teams).	0.58
10	Agencies supporting the creation of innovations for nurses in nursing units.	0.50
<b>Innovation process</b>		
11	Sharing experience between nursing units and other agencies to help create learning for creating innovations at nursing units.	0.94
12	Declaration of honors for nurses successfully creating innovations.	0.87
13	Organization management without attachment to original criteria or procedures.	0.85
14	Awards motivating nurses to create innovations.	0.81
15	Provision of opportunities for nurses in nursing units to express opinions.	0.80
16	Forums for presenting successful innovations of nursing units.	0.77
17	Nurses in nursing units work closely with clients to conduct surveys and develop new concepts for creating innovations.	0.77
18	Dispersion of decision-making power allowing nurses at nursing units to participate in selecting new ideas to develop inventions, services or processes.	0.51
19	Promotion of atmospheres of belief that expressions of opinion will not create negative effects for persons who provided opinions.	0.51
<b>Output</b>		
20	Innovations of nursing units have been created and/or there have been more innovations over the past five years.	0.91
21	The innovations were created over the past five years have been implemented in nursing units.	0.91
22	New ideas from nurses and/or additional ideas over the past five years.	0.90
23	There are nursing innovators and/or more nursing innovators over the past five years.	0.84

**Table 3** Statistics from analysis of relationships between variables of innovation management performance component models of nursing units at community hospitals under the Ministry of Public Health.

Component number	Component name	Factor loading	t	R <sup>2</sup>
1	Input to the innovation process (INP)	0.74	12.25**	0.55
2	Innovation process (PRO)	0.70	10.88**	0.49
3	Output (OUT)	0.78	13.26**	0.61

P < .01\*\*

$\chi^2 = .000$ , / df= 0, GFI =1.000, RMSEA =0.053



**Figure 1** Confirmatory factor analysis of innovation management performance factor models

Future to the eight steps for evaluating the reliability of the scale. The data was tested by determining the internal consistency of 23 innovation management performance indicators of nursing units. Cronbach's Alpha Coefficient for the entire set after

construct validity analysis was at 0.951. Cronbach's Alpha Coefficient in each component was at 0.923 – 0.946 and item analysis and inter-item correlation had values of 0.310 – 0.891. Corrected item – total correlation was at 0.452 – 0.732.

## Discussion

This study found that performance indicators of innovation management, developed from Tidd and Bessant's innovation management performance concept, consists of three components that relate to input to the innovation process, the innovation process itself; and output from the innovation process. It corresponds within the context of innovation management performance in the nursing unit at community hospitals affiliated to the Ministry of Public Health. The input on the content validity of the indicators from the opinions of nine experts was that they had good value. Reliability has shown that the values obtained were all at good and acceptable levels. The construct validity test results on the performance indicators of innovation management for nursing units were found to be composed of three components and 23 indicators. All three components can explain the total variance accounted for at 71.39 percent. The findings on each component are discussed as follows:

Concerning input to the innovation process, organizations with a focus on innovation can be described as requiring necessary and sufficient input resources to influence creative thinking and innovation creation, such as having sufficient budget to create opportunities for increasing the amount of innovation products desired by organizations, time allocated for personnel to create innovations, appropriate technology for supporting innovation creation, including support leaders for changes such as support for new creations or innovations to increase clients service satisfaction by personnel who have knowledge, skills, training and development for sufficient knowledge and capabilities in creating innovations<sup>13</sup>. Therefore,

innovation-focused organizations require decision-making concerning possessing sufficient resources in the area of time, budget, and technology capable of creating high quality innovations. This will lead to improved organization performance. Organizations with numerous innovations are likely to select for developed and searched resources in addition to new technology as instruments to support innovations, including development research to support changes in the organization.<sup>18</sup> These findings concur with Chen, Tsou and Huang<sup>19</sup> who found organizations emphasizing innovations need to be supported in the area of providing necessary time, budget, and technology, including time for developing the knowledge and capabilities of personnel to create innovations.

The innovation process can be discussed as an organizational structure consistent with innovation creation, an organization with flexible structures, distributed power, teamwork supporting innovation building, and an atmosphere allowing personnel to express opinions and participate in decision-making that leads to learning and innovation creation.<sup>19</sup> This allows the personnel to feel independence in seeking new things without fear of penalties.<sup>20</sup> Motivation building and commensurate rewards based on situations with opportunities to share knowledge and learn of service clients' needs, to use as guidelines for creating innovations meeting an agenda for the service clients' needs<sup>13</sup> was consistent with the study of Gamasak.<sup>21</sup> The aforementioned study found official and inflexible organizational structures to be negatively correlated with innovation management performance, while good relationships between service providers and service clients, organizational cultures offering opportunities for personnel to express opinions, think,

and do new things were positively correlated with innovation management performance.

In the area of output, assessment of capabilities or success of organizations in creating innovations can be measured based on basic output factors by measuring to determine whether or not the organization presents new things or improves new innovations, has products/inventions and new innovation processes that are new to the firm,<sup>22</sup> including measurements of the number of new innovators and implementation of innovations in the organization.<sup>14</sup> This concurs with a study conducted by Birasnev, Albufalasa and Bader<sup>23</sup> who measured innovation management performance with the number of new products, new working processes, and the number of developed products to improve quality of the organization.

Performance indicators of innovation management reliability after construct validity was considered is based on inter-item correlations with a value of 0.31 – 0.89, corrected item-total correlations of 0.45 – 0.73, Cronbach's Alpha Coefficient for input to the innovation process component at 0.95, innovation process component at 0.92, and output component at 0.93, with an overall Cronbach's Alpha Coefficient of 0.95. These findings can be discussed as follows: Good indicators require internal consistency, meaning each question on the instrument should measure the same characteristics<sup>24</sup> by considering internal consistency based on inter-item correlations at .30 - .70, or corrected item-total correlations at more than., and a Cronbach's Alpha Coefficient for the components at .80 and above.<sup>25</sup> These results showed performance indicators of innovation management had very good internal consistency measured on the same issue.

In conclusion, the performance indicators of innovation management for nursing units of community hospitals affiliated to the Thai Ministry of Public Health are indicators with good construct validity and very good accuracy, including consistency with three main components based on Tidd and Bessant's innovation management performance concept<sup>14</sup> The components of innovation management performance consisted of: 1) input to the innovation process, 2) the innovation process, and 3) output. Moreover, these indicators can be used to measure the innovation management performance of nursing units at community hospitals in the future.

## Recommendations

The head nurses of nursing units of community hospitals affiliated to the Ministry of Public Health can implement innovation management performance programs base on the indicators developed in this study to measure the innovation management performance of their nursing units. Furthermore, the findings can to be used to policy formulation and strategic planning to innovation management at the level of nursing units at community hospitals affiliated to the Ministry of Public Health, Thailand.

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