DEVELOPING AN INNOVATION CULTURE MEASUREMENT CONSTRUCT FOR HEALTHCARE ORGANIZATIONS

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ABSTRACT

OBJECTIVE

To develop an innovation culture measurement model specific to healthcare, by amending the original scale items of the Dobni innovation culture construct and model developed in 2008.

DESIGN

The project performed exploratory factor analysis from data collected on surveys, using redesigned scale items from the original Dobni innovation culture measurement.

SETTING

Managers and administrators from a Provincial Health Services Authority in Canada.

RESULTS

An exploratory factor analysis was performed on the 43 scale items used in the survey. The scale items were reduced to 31 and loaded on to new factors creating an Innovation Culture Measurement Model specific to healthcare.

CONCLUSION

Although exploratory, the new model and scale items provide a foundation for researchers to advance innovation culture measurement in healthcare. Academically, measuring innovation culture has created a rich research stream, but to date has not exclusively focused on healthcare. Pragmatically, measuring innovation culture provides healthcare leaders and policy setters a benchmark to assess internally over a period of time or towards other entities.

KEYWORDS

innovation, healthcare, culture, measurement, survey

INTRODUCTION

Innovation in healthcare is recognized by academics and healthcare practitioners as essential to reduce costs, improve the quality of services, and enable organizational success, however successful innovation execution is also known to be challenging [1,2,3,4]. The urgency for innovative healthcare solutions and speed of change are only increasing.

"We need approaches to the solutions that aren't just arithmetic and additive, but are in some sense logarithmic. This will require us to reach across historic boundaries and

unlock the potential of collaboration across the usual disciplines." Jeffrey S. Flier, MD – Dean of the Faculty of Medicine, Harvard University. [5]

Although innovation is difficult to execute, having a strong innovation culture is well established as a critical determinant of innovation [6,7]. One of the research areas that has garnered attention is the measurement of innovation culture. Pragmatically, the value of measurement is "what gets measured, gets done" and starting with a benchmark of how innovative an organization culture is, promotes a roadmap for improvement. Academically, innovation culture measurement provides an opportunity for researchers to measure innovation determinants individually and collectively in innovation culture models. As a result, significant theory and evidence in the literature has evolved developing measurement scales of innovation culture including: Aiman-Smith, Goodrich, Roberts, & Scinta [8], Anderson & West [9], Danks, Rao, & Allen [10], Dobni [11], Remneland-Wikhamn & Wikhamn [12], Tohidi, Mohsen Seyedaliakbar, & Mandegari [13], and Wang & Ahmed [14]. To date, the Dobni model is established as the most referenced innovation culture construct [15].

This study focuses on innovation culture measurement in healthcare, which addresses a primary critique of researchers and potentially offers a pragmatic tool for healthcare practitioners and policy setters. Over the past decade, our innovation culture measurement studies have utilized and extended the Dobni [16] model to research organizational innovation in a global context. We consistently find organization culture to be a linchpin of success [17,18,19,20]. Across an array of industries and countries, high (low) innovating firms have strong (weak) innovation cultures. High innovating firms also outperform low innovators on critical cultural determinants such as leadership, knowledge management, process and resources.

Although informative, one of the critiques of the innovation culture measurement research stream is that measurement constructs can be generic and lack specific industry context [21]. We agree with this critique, especially given the complexity of the healthcare industry. Our motivation for this research is to adapt the Dobni innovation culture measurement construct to consider healthcare context. By doing this, researchers will have a more relevant instrument and practitioners can interpret results from a healthcare perspective. This study uses the same research method and approach as the original Dobni innovation measurement construct research.

METHODS

Scale items developed in the Dobni model were redesigned to contextualize measuring innovation culture in the healthcare. Changes were based on secondary literature and terminology related to healthcare such as patient management, hospitals and roles. Extensive changes were not made to ensure construct validity of the Dobni model were still relevant. Consistent with the Dobni survey, a seven-point Likert scale accompanies these scale items. Incorporating a Likert scale allowed respondents to accurately indicate the degree or extent to which they agree with the described scale item. In the end 43 scale questions were used. Factor loadings are presented in the results section.

A Provincial Health Authority from a Canadian Province represented the population for data collection. The data collection process involved administering a survey questionnaire to 75 management and operational level employees within a division of the Authority. This was done to ensure that the data collected was relatively homogenous given the exploratory nature of this research. It was also important that survey respondents had common knowledge of the division's goals as it related to health care delivery. Surveys were administered digitally to mitigate travel and exposure to large gatherings amid the COVID-19 pandemic.

The survey link was electronically administered to employees, of which the response rate was 56% (42 completed surveys). Our contact point within the Authority voluntarily administered the survey to employees. Although participants did not voluntarily include information of their organizational position, multiple levels of categorical hierarchy rank were captured through ongoing communication with contact points. These categories include executive/senior management, middle level management and operational level employees. Data was collected between February and March of 2021. No responses were discarded because of significant missing values, or incomplete information. The 42 completed surveys were analyzed and interpreted using SPSS v27. The sample size is considerably smaller than other surveys we have conducted using similar techniques and survey instruments. The survey was administered during the

COVID-19 pandemic and likely contributed to the smaller sample.

An application was put forward to the University of Saskatchewan Research Ethics Office consistent with the University of Saskatchewan Policies and Procedures for Ethics in Human Research. The application contains extensive details related to the nature and scope of the research. Ethics clearance was received.

RESULTS

DOBNI MODEL OVERVIEW

The Dobni model is a survey instrument developed in 2008 that measures innovation culture. The survey was developed through extensive theoretical inquiry and has been empirically tested. The initial model was comprised of 69 constructs used to explain 12 drivers of innovation. The original model framed the 12 drivers of innovation into four perspectives: intent, infrastructure, influence and implementation. Subsequent research has reframed the survey to fit the context of the research inquiry. The survey has been beneficial for academics interested in researching innovation culture using quantitative methods and for practitioners trying to assess their innovation culture state and plan for innovation improvements. For example, practitioners have translated the Likert scale constructs to provide organizations with an innovation culture score out of 100.

SCALE ITEM DEVELOPMENT

Consistent with the method used in the Dobni model, exploratory factor analysis was used to identify the smallest number of interpretable factors that adequately explained the correlations among the scale items.[1] The forty-three scale items initially loaded onto eight definable factors with eigenvalues greater than one. However, twelve of the scale items were dropped because their Cronbach alpha values fell below 0.5. Appendix 1 illustrates factor loadings and the items that have been deleted (strikeover) in efforts to enhance the model.

EXPLORATORY MODEL DEVELOPMENT

In order to present the findings in a more meaningful pragmatic way, the model is presented in Figure 1 utilizing the framework of the Dobni model.

FIGURE 1: HEALTHCARE INNOVATION CULTURE MEASUREMENT MODEL

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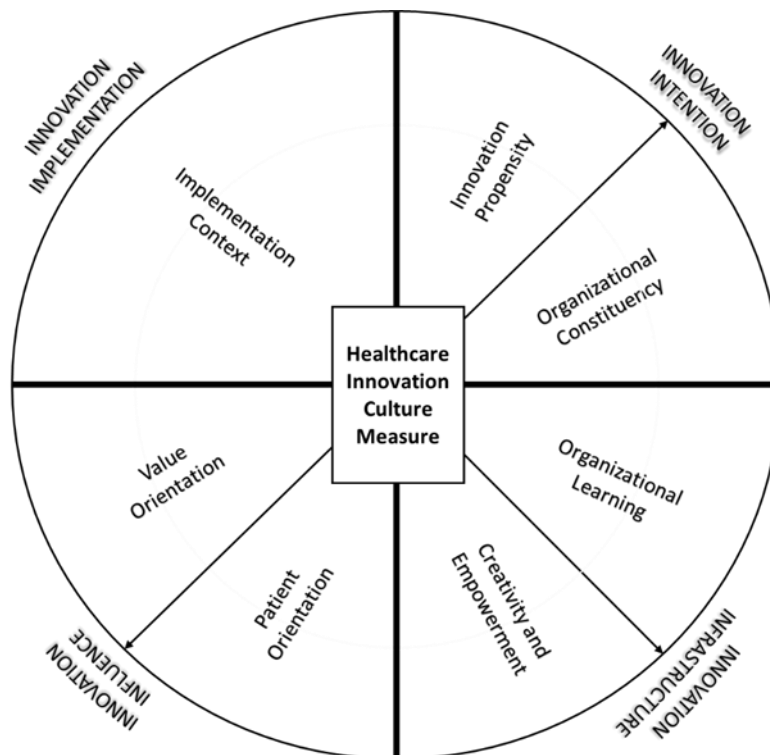
[1] This analysis was performed using the extraction method principal components and the rotation procedure used was varimax rotation

The model is created through the exploratory factor analysis and the authors' interpretive experience in innovation modeling. The model is consistent with other innovation culture measurement models we have researched [22,23,24] that are framed after the Dobni model, but differs in simplicity and healthcare focus. The model categorizes four main innovation perspectives – intention, infrastructure, influence and implementation. Each perspective is defined and impacted through the innovation drivers. For example, the more an organization demonstrates an innovation agenda (driver: innovation propensity) and the more employees are engaged in innovation activities (driver: organizational constituency), the more an organization will demonstrate an intent to innovate (perspective: innovation intention). Organizations can assess their innovation culture measure by "averaging" the scores of each innovation driver. For example, if the average score for each innovation driver was 5 out of 7 (or 71.4%), then the innovation culture measure for the organization would be 71.4%. We have often compared scores of different organizations or compared a score of an organization to an industry average. This provides a notable benchmark and platform to measure improvement.[2] These were subsequently titled, described, and are displayed in Figure 1.
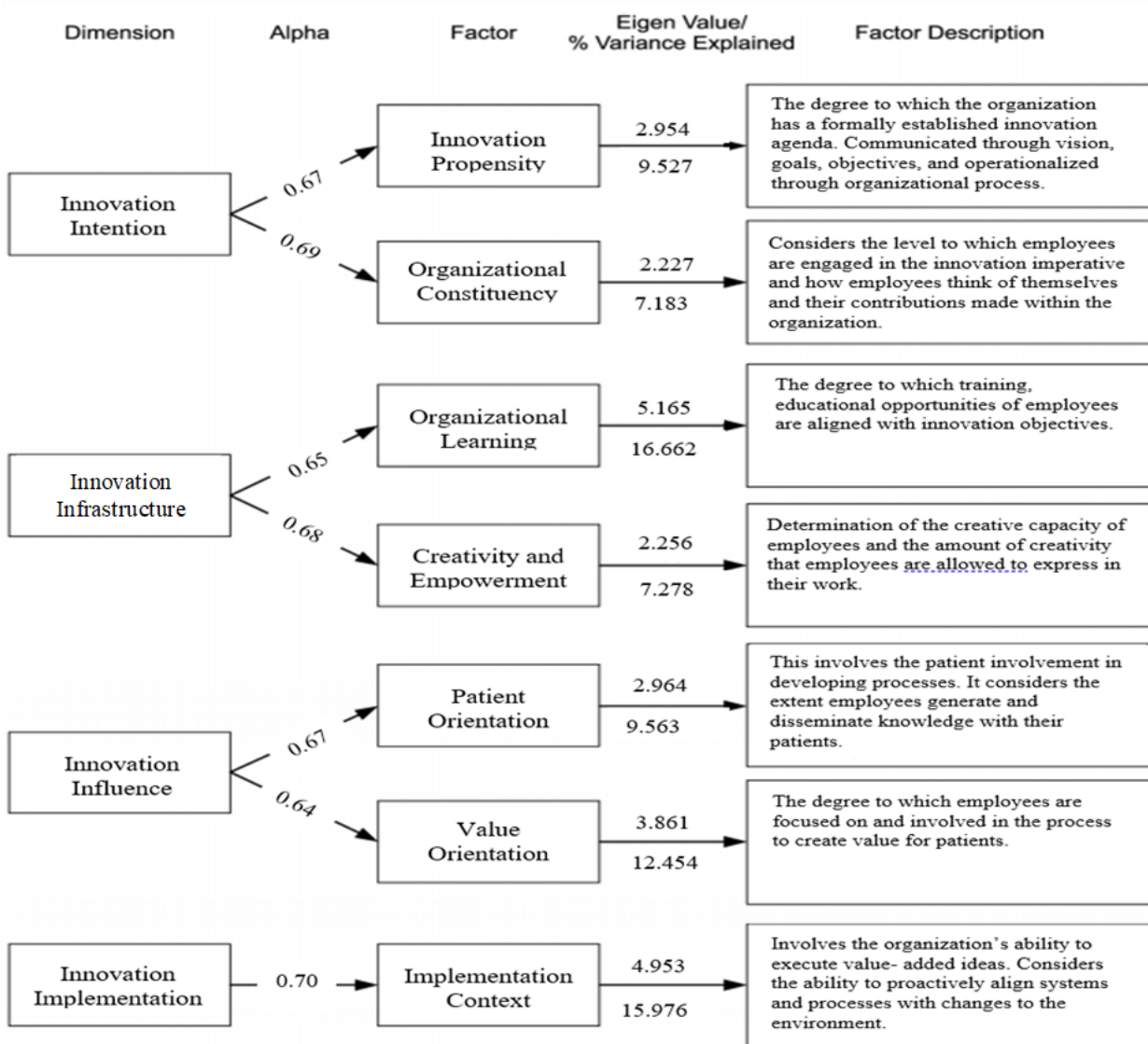
In addition to a pragmatic contribution, our motivation for this research was to advance an innovation culture measurement instrument, so that other researchers could extend the scholarly body of knowledge. Figure 2 below presents the final factor model with statistical findings and descriptions.

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[2] Consistent with exploratory research, scale items were deleted if the Cronbach coefficient alpha value were below 0.5. According to Hinton [25], an alpha value above 0.5 shows moderate reliability. In total, twelve scale items were dropped, falling below the 0.5 thresholds as outlined within the factor analysis solution. The coefficients produced were reasonably uniform and two significant ranges emerged. The lower range, 0.50-0.62, consisted of thirteen scale items, while the higher range 0.65-0.768 consisted of seventeen scale items. All of these scale items satisfy the 0.5 threshold. Further analysis was undertaken to re orientate the model around fewer, more distinctive factors. This was accomplished by forcing the remaining items on to fewer factors until the model was optimized with a 7-factor solution.

FIGURE 2: FACTOR MODEL

Dimension	Alpha	Factor	Eigen Value/ % Variance Explained	Factor Description
Innovation Intention	0.67	Innovation Propensity	2.954 / 9.527	The degree to which the organization has a formally established innovation agenda. Communicated through vision, goals, objectives, and operationalized through organizational process.
	0.69	Organizational Constituency	2.227 / 7.183	Considers the level to which employees are engaged in the innovation imperative and how employees think of themselves and their contributions made within the organization.
Innovation Infrastructure	0.65	Organizational Learning	5.165 / 16.662	The degree to which training, educational opportunities of employees are aligned with innovation objectives.
	0.68	Creativity and Empowerment	2.256 / 7.278	Determination of the creative capacity of employees and the amount of creativity that employees are allowed to express in their work.
Innovation Influence	0.67	Patient Orientation	2.964 / 9.563	This involves the patient involvement in developing processes. It considers the extent employees generate and disseminate knowledge with their patients.
	0.64	Value Orientation	3.861 / 12.454	The degree to which employees are focused on and involved in the process to create value for patients.
Innovation Implementation	0.70	Implementation Context	4.953 / 15.976	Involves the organization's ability to execute value- added ideas. Considers the ability to proactively align systems and processes with changes to the environment.

DISCUSSION

STATEMENT OF PRINCIPAL FINDINGS

The basis of this study is derived from the groundwork and initial modeling of Dobni. After testing and identifying thirty-one scale items, seven factors represented the smallest interpretable correlations for measuring innovation culture within healthcare. As seen in Figure 1, the model defines the dimensions of innovation culture as innovation intention, infrastructure, influence, and implementation. These dimensions are consistent with the Dobni model and allow for integration to other model applications. The produced factors were then assigned a label that described what scale items loaded on each factor. The explained factors contain the average alpha of the scale items, and the eigenvalues explain how much variance of the scale items explains a single factor. Eigenvalues greater than one indicate the factor items explain more than one unique variable and all factors contained more than one scale item leading to higher reliability.

The central contribution is the model in Figure 2 and the scale items in Table 1. Although exploratory, they are presented to advance researchers' ability to measure innovation culture in the context of healthcare.

TABLE 1: FINALIZED 7-FACTOR SCALE FOR DOBNI INNOVATION CULTURE MEASUREMENT (HEALTHCARE)

(presented in order of variance explained)

Organizational Learning

1. I believe that I am trusted to act in our unit's best interests with minimal supervision.

2. I am encouraged to challenge decisions and actions if I think there is a better way.

3. As an employee, I am empowered to generate ideas.

4. I feel comfortable making suggestions for enhancements to processes and services.

5. Our unit's communications are open and honest.

6. Performance management information is used for improvement rather than for control.

Implementation Context

1. Our unit/area provides employees with time and space to pursue ideas.

2. Our unit/area is prepared to redirect or leverage current resources (administrative, human and financial) to support innovation.

3. Our unit/area has put resources (administrative, human and financial) behind our innovation agenda.

4. My manager knows me well enough to get a feel for my creative potential.

5. I am given the time/opportunity to develop and express my creative potential.

6. If I have an idea, there is a process that I can access to have it formally considered on a timely basis.

7. Innovation is rewarded through our unit's performance management system.

Value Orientation

1. We can modify systems and processes fairly quickly and as necessary to take advantage of new opportunities.

2. We actively search for new ideas and innovations in all we do.

3. Our current operational processes are robust enough to accommodate innovation.

Patient Orientation

1. When it comes to delivering services (e.g. patient care or client services), there is effective collaboration between departments.

2. There is co-ordination as opposed to confusion among practices teams within our area.

3. Ideas and plans flow smoothly through hierarchy (from generation to consideration to implementation). That is, they don't get held up by rules and roadblocks.

4. The knowledge that we gain in interacting with patients/clients is considered when considering innovative approaches to providing the service.

Innovation Propensity

1. A coherent set of innovation goals and objectives has been communicated in our organization/area.

2. Managers have the autonomy to speed up, slow down, change course or cancel initiatives altogether.

3. Missed opportunities and mistakes are viewed as an opportunity to reflect and learn, as opposed to a basis for punishment.

Creativity and Empowerment

1. My unit uses my creativity to its benefit.

2. I know how I personally contribute to innovation.

3. There is an expectation to develop new skills, capabilities and knowledge that is directed toward supporting innovation.

1. Senior leaders support/encourage innovation in my area.

2. I am rewarded intrinsically (non-monetary rewards) for being creative.

3. Employees in this organization/area act as a team as it concerns pursuing innovation goals and objectives.

4. Innovation is rewarded through our unit's performance management system.

5. Our practice teams are comprised of key people to help with the establishment and reinforcement of innovation.

STRENGTHS AND WEAKNESSES

The primary strength of this study is it provides a quantitative and empirical construct to measure innovation culture in healthcare. This directly addresses critiques of past innovation culture measurement research, that have opined that the constructs are not specific to nor adequately address the uniqueness of healthcare. The primary weakness relates to the exploratory nature of our methods. Our results are less robust compared to other more established models, including our own non-healthcare studies. However, the evolution of surveys and models, ultimately begins with exploration and the results as presented are encouraging for subsequent validation.

MEANING OF THE STUDY

Measuring innovation culture in healthcare has a number of practical implications for healthcare management and policy development, including:

* A practical survey to measure innovation culture, from a healthcare perspective at a country, region, organization, and department level. The measurement allows for benchmarking over a period of time as well comparisons to other entities.

* Construct analysis can provide healthcare managers and policy setter guidance on resource allocation and management attention. For example, if Organizational Learning is "high" and but Innovation Propensity is "low", then managers may want to allocate more resource effort into the innovation processes of moving an idea forward versus, employee learning initiatives.

* The model provides a categorization of innovation through the dimensions and factors. This allows managers to discuss innovation in broad strategic context. It also allows researchers with a typology mindset to categorize other relevant innovative research in an integrative manner. For example, the recent study by Lloyd et al. [26] leverages the Dobni model [27] classification to explore innovation in a rural context.

* Innovation measurement provides an opportunity to advance goal setting and targeting development. We have seen through our research organizations setting improvement targets (e.g. 5% improvement in innovation culture score) or establishing concrete initiatives (e.g. establishing an innovation moment similar to a safety moment but dedicated to innovation discussions).

* Measuring innovation culture leads to increased confidence in monitoring performance of a healthcare entity. Governance models in healthcare, regardless of the degree of privatization, are increasingly demanding reporting of results. Innovation scores that are validated through research can be a significant signal of advancement and provide healthcare leaders and policy setters with a reporting mechanism to manage expectations.

* The most significant deviation in this study from the original Dobni model, was the aggregation of constructs around patient orientation. This suggests that healthcare leaders need to ensure the patient perspective is put at the forefront to ensure a strong and meaningful innovation culture as it concerns services delivery.

UNANSWERED QUESTIONS AND FUTURE RESEARCH

Further construct development through replication and repetition is encouraged to enhance validity of the innovation measurement survey. Research can be expanded in several directions. In addition to replication, causal relationships between the factors are an interesting aspect of innovation. Case studies methods would also be fruitful to understand context within the innovation determinants identified in this research. The primary limitation of this study is the size of the research sample. An increased sample size would provide greater validity and insight into scale refinement.

CONCLUSION

In conclusion, this research explored the development of innovation culture measurement construct. Leveraging the initial work of Dobni, a survey was created and tested that

contextualized the scale items for healthcare context. Adapting the Dobni model for healthcare fills a void in the academic research as innovation culture measurement studies have not been customized for healthcare. This creates future research opportunities for scholars to advance the scale items enhancing the validity of the scale items and model. Pragmatically, measuring innovation culture in healthcare provides a tangible benchmark to launch improvement efforts, track results and increase reporting capabilities. The most notable deviation to the original Dobni model was the importance of patient orientation in developing an effective innovation culture. Given the complexities of the healthcare industry and the need to innovate, measuring innovation culture can be a powerful tool for healthcare leaders and policy setters.

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Factor Items	Factor Loading
Innovation goals of your work area	
1. A coherent set of innovation goals and objectives has been communicated in our organization/area.	0.624
2. Senior leaders support/encourage innovation in my area.	0.655
3. We actively search for new ideas and innovations in all we do.	0.677
Organization/work area support for your contribution to innovation	
1. My manger knows me well enough to get a feel for my creative potential.	0.622
2. My unit uses my creativity to its benefit.	0.772
3. There is an expectation to develop new skills, capabilities and knowledge that is directed toward supporting innovation.	0.721
4. Our practice teams are comprised of key people to help with the establishment and reinforcement of innovation.	0.709
5. Employees in this organization/area act as a team as it concerns pursuing innovation goals and objectives.	0.772
6. ~~Our innovation activities are often disrupted by such things as changes in management or sponsorship.~~	~~0.110~~
7. Our current operational processes are robust enough to accommodate innovation.	0.724
8. I believe that my contributions are valued by my managers.	0.731
Your contribution to innovation	
1. ~~I consider myself to be a creative/innovative person.~~	~~0.109~~
2. ~~As an employee, I understand what innovation means and how it can benefit my area.~~	~~0.419~~
3. I know how I personally contribute to innovation.	0.601
4. ~~I have the skills and knowledge necessary to support innovation in my area.~~	~~0.296~~
5. I feel comfortable making suggestions for enhancements to processes and services.	0.630
6. I am given the time/opportunity to develop and express my creative potential.	0.726
Empowerment for innovation	
1. As an employee, I am empowered to generate ideas.	0.717
2. I am encouraged to challenge decisions and actions if I think there is a better way.	0.744
3. I believe that I am trusted to act in our unit's best interests with minimal supervision.	0.787
4. I am rewarded intrinsically (non-monetary rewards) for being creative.	0.718
Patient/client involvement in innovation	
1. ~~I believe it is important to involve patients/clients input into potential innovation.~~	~~0.407~~
2. ~~We understand what processes we must focus on to deliver value to patients/clients.~~	~~0.245~~

3. ~~Our patients/clients help us to define what is of value to them.~~	~~0.433~~
4. ~~We have a reliable and valid process that includes interaction with patients/clients.~~	~~0.380~~
5. The knowledge that we gain in interacting with patients/clients is considered when considering innovative approaches to providing the service.	0.622
6. ~~We can sense when patients/clients are either under served or over served, and make adjustments accordingly.~~	~~0.366~~

Communication and collaboration for innovation

1. When it comes to delivering services (e.g. patient care or client services), there is effective collaboration between departments.	0.550
2. ~~Logistical procedures (e.g. moving patients, equipment, scheduling tests, etc.) hinder innovation efforts.~~	~~0.077~~
3. Our unit's communications are open and honest.	0.537
4. There is co-ordination as opposed to confusion among practices teams within our area.	0.596
5. Ideas and plan flow smoothly through hierarchy (from generation to consideration to implementation). That is, they don't get held up by rules and roadblocks.	0.537
6. ~~We can quickly facilitate changes to our plans and practices based on new information, patient/client feedback, or leadership teams' desire to change.~~	~~0.456~~

Resources for innovation

1. Our unit/area is prepared to redirect or leverage current resources (administrative, human and financial) to support innovation.	0.673
2. Our unit/area has put resources (administrative, human and financial) behind our innovation agenda.	0.679
3. Our unit/area provides employees with time and space to pursue ideas.	0.573
4. If I have an idea, there is a process that I can access to have to formally considered on a timely basis.	0.676

Evaluation for innovation

1. ~~We have metrics to measure the effectiveness of our initiatives.~~	~~0.299~~
2. We can modify systems and processes fairly quickly and as necessary to take advantages of new opportunities.	0.551
3. Managers have the autonomy to speed up, slow down, change course or cancel initiatives altogether.	0.587
4. Performance management information is used for improvement rather than control.	0.759
5. Innovation is rewarded through our unit's performance management system.	0.723
6. Missed opportunities and mistakes are viewed as an opportunity to reflect and learn, as opposed to a basis for punishment.	0.645