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# Innovation in hospitals: piloting a tool for investigating contributions of hospital employees to innovation

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## Abstract

This paper addresses the question of how hospital employees contribute to the generation of innovations and to what extent hospitals function as a conducive environment for innovative work. The motivation behind this exploratory study was primarily to identify the diversity of innovation activities in hospitals, with the goal of developing and testing a survey tool that can adequately capture this diversity. Although conceptual and empirical research on the characteristics of medical and health related innovations has been carried out, the role of hospitals in such innovations is more often assumed rather than empirically tested. We argue that innovation in public hospitals is still not well understood and contribute to understanding through a pilot study carried out in four public hospitals in Norway. A preliminary analysis indicates that there are different modes of innovative work in hospitals, as suggested by some of the literature, and that different kinds of employees are involved in distinct sets of activities. The survey tool that we developed seems to be able to capture the diversity of innovation-related activities, but there were problematic aspects related to the sampling and recruitment of respondents. Suggestions for further exploration and testing are discussed.

## **Introduction**

*What kinds of innovation activities are prevalent in hospitals, and how are they organized and supported?* This paper reports a pilot study set up to answer these questions and to address innovation activities in hospitals directly. We know a lot about innovation in firms and we also know a lot about innovation activities in universities based on rich data about the activities, partnerships, and outputs of academic employees (see Perkmann et al., 2013). Hospitals are often black boxed in innovation studies (Thune & Mina, 2016). Our initial idea was first and foremost that hospitals and hospital employees are not merely recipients of innovations developed outside which they simply implement in patient care, but that they are active participants and partners in health innovation systems. How this role is carried out in terms of the concrete innovation activities has, however, received little systematic study. In addition, we started with an assumption that hospitals, with their complex organizational structure, the unique nature of many of their activities, and special types of employees, may require a methodological tool developed specifically for this context.

Hospitals are part of health innovation systems that can be conceptualized as “distributed systems” due to their extensive division of labor and complex collaborative approach to the generation and application of useful knowledge. Innovation, in the form of new diagnostic tests, medical tools or treatments often emerge out of inter-institutional and inter-disciplinary research, technology and clinical communities that work in joint efforts to utilize research results to improve health outcomes for particular patient groups. Hospitals are regarded as among the most important actors in this system, as they perform multiple functions and represent an important node or linkage between other actors and parts of the system (Consoli & Mina, 2008, Ramlogan et al., 2007), but they have been subject to few systematic studies of their diverse roles within innovation (Thune & Mina, 2016).

The role of hospitals within research and innovation systems has been described as “hidden” because it is not captured well by traditional indicators and approaches (Hicks & Katz, 1996; Hopkins, 2006). This may particularly be the case in areas of health innovation that are not economically lucrative or have significant industrial impacts, such as development of new diagnostic tests or development of new therapies for rare diseases (Hopkins, 2006; Lander & Atkinson-Grosjean, 2011). Hospitals contribute substantially to the overall production of new knowledge with health and medicine (Hicks & Katz, 1996), and also have an important role in “translation” of insights from basic science to clinical or practical applications. The role of hospitals as users of and implementers of innovations has been discussed extensively in the fields of health management, health economics, and health policy. However, despite notable exceptions (Djellal and Gallouj, 2005, 2007; Salge and Vera, 2009; Salge, 2012) the organizational capacity of hospitals to generate innovations themselves has been much less emphasized in the literature. There is also little systematic evidence from the micro level within hospitals, i.e. the concrete innovation-related work that the employees may be engaged in.

To our knowledge, and supported by the conclusions of a recent large-scale review of the literature on innovation in hospitals (Thune & Mina, 2016), there is little empirical knowledge that has addressed hospitals’ and their employees’ innovation activities in all their diversity. Specifically, there is a large discrepancy between literature that has looked into generation and development of innovations in medicine and literature that has addressed management of innovation in hospitals more generally. The context of the hospitals does not figure strongly in the first literature, whereas the latter lacks a substantial understanding of the complexities of the innovation processes. Some efforts have been made to distinguish between different kinds of innovation investments in hospitals (Salge & Vera, 2009), but these are based on a narrow set of indicators.

Mindful of the limited empirical and theoretical research available, and inspired by increasingly sophisticated survey instruments developed for academic researchers' societal engagement, we decided to carry out an exploratory study of hospital employees' innovation activities, to address our research questions. In line with existing knowledge, we assumed that hospitals and their employees carry out various roles related to generating, developing and implementing innovations. In particular, we wanted to look at differences between innovation activities that may be defined as "research-driven innovation" as well as innovation activities related to developing new tools and services closely related to clinical and administrative practices; activities that the case hospitals refer to as "user-driven innovations" (see also Salge & Vera, 2009; 2012) or innovations developed in the context of practice.

User or practice driven innovation is a broad category of different activities that are related to the development of new ideas to solve particular problems in the hospitals and for the patients. These may entail research activities and development of new medical products but also new services, processes or organizational innovations. Research driven innovation refers to ideas for new products such as diagnostic tests, medical tools or drugs that emerge from research communities or translational medical communities within hospitals. The initial ideas might nonetheless emerge from practice and not research. The categorization of different innovation activities do not necessarily reflect different kinds of innovation processes, as most innovation activities in hospitals combine knowledge from research as well as practice.

We considered it necessary to collect information from individuals in different parts of the hospital organization including very different types of clinical, care and support facilities. Ideally the individuals should cover different professions such as nurses, medical doctors, radiologists, physical therapists and more. We also wanted to address the issue of differences between types of hospitals by including respondents from organizations of varying size and research intensity. Furthermore, we assumed that organization and management processes and support could differ substantially between different kinds of innovation activities, and also the perceived drivers and barriers for innovation. Because innovation activities in hospitals are quite unique, development of managerial practices or policies to support innovation need to be based on detailed knowledge of how innovation activities are carried out and how drivers and barriers are perceived. Since a similar tool did not exist and the context in which we wanted to implement the survey is complex, we decided to develop and pilot test the tool among a sample of informants in four hospitals in Norway. In this paper, we describe the construction of the tool and use the preliminary descriptive data collected to discuss implications for further development and empirical research.

### **Literature on hospitals as organizations that promote innovation**

There is a large and heterogeneous literature on hospitals and their role in the generation of innovations (Thune & Mina, 2016). A common theme is the attempt to conceptualize hospitals' innovativeness, on the ground that this under-theorized and under-investigated (Djellal & Gallouj, 2007; Salge, 2009; Windrum & Garcia-Goni, 2008). This is a perspective shared with the research literature that treats hospitals as 'hidden' research systems (Hicks and Katz, 1996; Lander and Atkinson-Grosjean, 2011; Lander, 2013). A common idea here is that R&D and innovation activities in hospitals are underestimated because they involve activities and participants that are not adequately captured by standard R&D&I indicators such as publications, patents, and new products. Rather, the development of new medical knowledge and ideas for new products and services emerge within a complex interplay between scientific units, clinical units and commercial units, and often involve

incremental improvements and adaptation through learning in practice (Morlacchi & Nelson, 2011). The innovation processes are therefore difficult to observe and measure systematically.

Moreover, a recurrent issue in the literature is that hospitals are very different from one another and to some extent also from other organizations. Hospitals are often public organizations but in many countries public hospitals co-exist with private hospitals that can be both non-profit and for-profit. They may have different functions and specializations within a regional or national health care system. Some authors mainly discuss so-called general hospitals (Djellal & Gallouj, 2005; 2007; Salge, 2012; Salge & Vera, 2009) while a few others look hospitals with strong research capabilities, i.e. academic medical centers or research/university hospitals (Anderson et al., 1994; Rosenberg, 2009).

Within this complex empirical context, a range of issues about innovation processes and performance have been explored. Several papers have attempted to conceptualize hospital innovativeness (Anderson et al 1994; Djellal & Gallouj, 2005; 2007; Rosenberg, 2009) or explore empirically hospitals' innovation activities in relation to hospital characteristics (Salge, 2012; Salge & Vera, 2009). Another stream of literature addresses the organizational features and management practices that are conducive to innovation in hospitals (Dias & Escoval, 2013; 2015; Hernandez et al., 2013; Lee & Hong, 2014; Ugurluoglu et al., 2013; Yang, 2014).

These papers also differ in the types of innovations they describe. Relatively few look at the role of hospitals in the generation of new or improved products (such as medical devices or new treatments/drugs) (Chatterji et al 2008, Rosenberg 2009, Weigel 2011). The majority of studies in this group focus on generation and implementation of medical services (treatment regimes, organizational practices and patient care) (Schultz et al., 2012; Thakur et al., 2012) or a combination of product and process innovations (Anderson et al., 1994; Djellal & Gallouj, 2005; 2007). For example, Djellal & Gallouj (2005) conceptualize hospitals as service providers and focus on the multiple operations run by hospitals and on their outputs. Their claim is that innovation and improvement work can occur in all aspects of hospitals' operations, often in interrelated ways in "service bundles".

Another example of an inclusive conceptualization of innovation in hospitals is found in the work by Salge & Vera (2009; 2012), who identify two modes of hospital innovativeness: science-based and practice-based innovation. They look at the relationship between investment in different kinds of innovation activities and performance, and hypothesize that investments in both science-based and practice-based innovation are beneficial to hospital performance. Salge (2012) also investigated the organizational factors that influence sustained investment in these two types of innovation activities. The results indicate that in particular science-based innovation in hospitals is dependent upon certain organizational features of hospitals, such as specialization, financial slack, and strategic direction.

Several other papers also report studies of organizational characteristics and managerial practices that may promote innovation in hospitals. Some authors have made an attempt to investigate whether hospital organizations foster learning, creativity and entrepreneurial attitudes among employees (Dias & Escoval, 2015; Garcia-Goni et al., 2007; Hernandez et al., 2013; Lee & Hong, 2014; Raadabadi et al., 2014), and try to identify the influence such features have on hospitals' innovation performance (Dias & Escoval, 2013; Yang, 2014). The results from these studies are not conclusive but seem to indicate that hospitals that emphasize employee learning display higher innovation performance. Notably, however, these studies are not explicit about the types of innovations hospitals promote and whether these features are beneficial for the generation of novelty or implementation of and experimentation with innovative solutions.

The papers reviewed all look at the heterogeneity of innovation activities and considerable differences that characterize different units involved in the generation of innovation within hospitals. These papers conceptualize the roles of hospitals in innovation in different ways. We may distinguish between papers that focus on hospitals as large service organizations and papers with a focus on innovative products developed in a hospital context. Among the former, a key message is that hospitals perform multiple functions but that their role is that of system-integrators across functions (Anderson, 1994; Djellal & Gallouj, 2005; 2007, French & Miller, 2012; Rosenberg, 2009; Salge, 2012; Salge & Vera, 2009). Among the latter papers, the focus on product innovation is associated with an emphasis on the role that hospitals and clinical sites play in idea generation, as well as in the implementation and post implementation improvements of new medical treatments and technologies (Schultz et al., 2012; Weigel, 2011; Wu & Hsieh, 2011). Taking an inclusive view of hospitals functions in innovation, Figure 1 illustrates the different functions hospitals may play in innovation processes, and also illustrates that the role of hospitals are carried out in an interplay with a range of other organizations in the health innovation system.

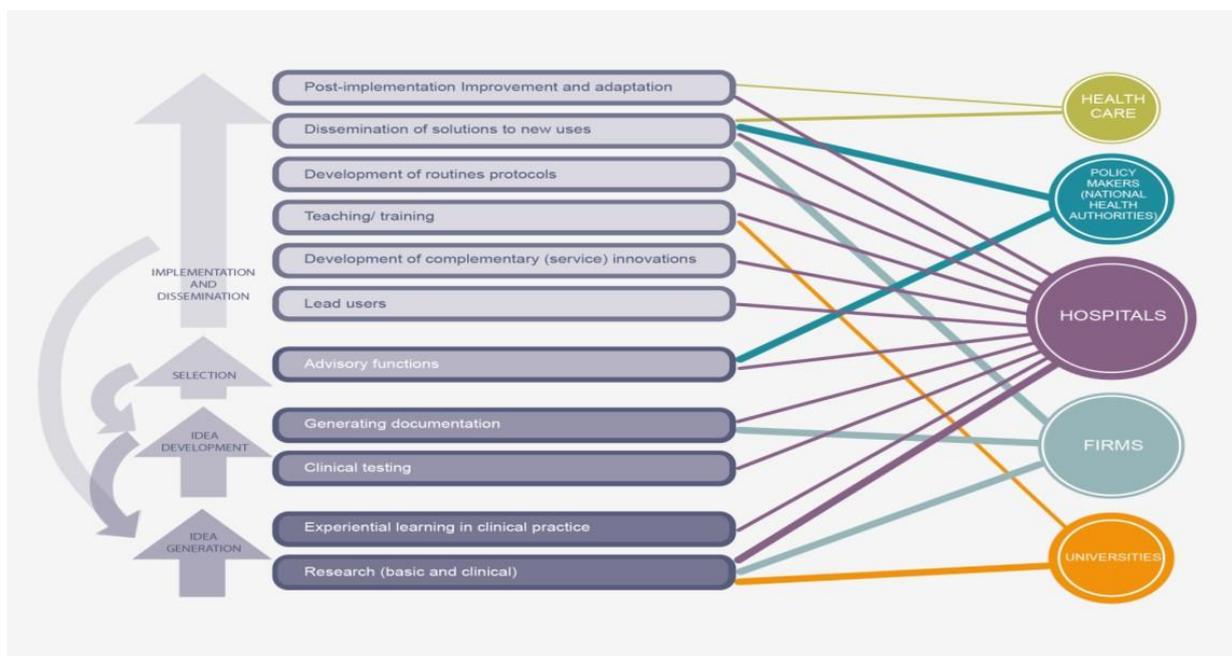


Figure 1: Hospitals in innovation (from Thune & Mina, 2016)

The questions we address in this paper are whether this inclusive perspective on innovation functions of hospitals is relevant for understanding hospital's role in innovation and how hospitals and their employees contribute to innovation. Moreover, how are these diverse functions organized within hospitals, and do organizational features and managerial practices employed in hospitals support different kinds of innovation processes to the same extent? As discussed above, the available research suggests that the necessary organizational support is different for so-called research-based versus practice-based innovations. For the latter, supporting creativity and learning among employees have been found to be important, whereas the first kind is more dependent on R&D investments and strategic prioritization of R&D (and typically found in academic hospitals). Having in mind the complexity of innovation tasks and the potentially highly distinct ways that innovation processes are managed within hospitals, we wanted to explore to what extent and how hospital employees are involved in these different functions. Second, we wanted to investigate the organization and management of innovation tasks – again seen from the perspective of hospital employees that have been involved in innovation activities.

## Methodology

### *Constructing an innovation measurement tool for public hospitals*

We took a deliberately broad and inclusive perspective on innovation activities when designing the survey. As prior research has found that hospitals have multiple and complex roles in generating, developing and diffusing innovations, we assumed that hospital employees are involved in different innovation activities and contribute to many different kinds of innovations and innovation processes. We therefore needed to develop a tool that took account of the heterogeneity of tasks, processes and innovations hospital staff were involved in, as well as information about hospital employees and the context and work situations in which these activities are carried out. This would make possible a classification of innovation activities, as well as an analysis of drivers and hindrances for different kinds of innovation work being carried out in hospitals. We also wanted to target different types of hospital personnel including medical doctors, nurses, technical and administrative staff. Most likely these are involved in different types of innovative work and probably also have different concepts with which this work is understood and described.

To develop the survey instrument, we drew on the innovation in health care and medicine literature, as described above, as well as literature on innovation surveys at the employee level of analysis. We started out with surveys about innovation and engagement among academic employees (Abreu et al., 2009; Thune et al., 2014), a prior survey among innovation in public service organizations (Garcia-Goni et al., 2007), as well as survey items on innovation culture, organizational learning and creativity among employees (Amabile et al., 1996). Innovation surveys, such as the Community innovation survey, were considered less relevant both due to the level of analysis and the economic nature of many of the questions (turnover, share of turnover of new products, main markets etc.).

In the process of constructing a first version of the survey that outlined main issues and questions of interest, we interviewed and consulted with key informants. Interviews were carried out with prolific inventors in hospitals, hospital managers and owners of hospitals in Norway. The questionnaire was discussed in a regional innovation network where all hospitals are represented, and feedback on the whole questionnaire as well as particular questions was received from individual hospital-based inventors, hospital innovation managers, and healthcare administrators. This served several purposes. First, the questions needed to be adapted to the hospital setting and to include innovation activities that the hospitals themselves regarded as important. Second, the concepts and terms used in the questions and items needed to be relevant for and understood by the intended informants. Despite the popularity of “innovation”, high degrees of uncertainty and disagreement surrounded what the term would encompass in the hospital context.

Based on this knowledge, we developed a questionnaire<sup>1</sup> that had several questions about hospital employees’ participation in innovation related activities. We also included questions about innovation collaboration and main partners in innovation activities inside and outside hospitals, echoing similar surveys from other sectors but using hospital-relevant response categories. There were also questions about the employees’ ambitions and motivation to participate in innovation activities, and a range of questions about how the employees perceived the management and support of innovation in the hospitals, their experience of the innovation culture in the hospital, and their knowledge and use of specific innovation support organizations and instruments. There was also a range of questions about the informants (age, educational level, position) and their place of work (hospital, department).

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<sup>1</sup> A copy of the questionnaire can be obtained by contacting the lead author.

### *Sampling, administrating and analyzing*

As we regarded an exploratory approach necessary, we decided to carry out a pilot study to gain more knowledge about the target population and the best way to administer the survey, as well as getting further feedback on the questionnaire items. In the pilot, a sample of employees in four hospitals in the southern part of Norway participated. The four hospitals are quite different in size and profile, but they all carry out research and innovation activities as well as clinical tasks. Two of the hospitals are large university hospitals (academic hospitals) with a broad range of medical specializations; the third is a regional/general hospital and the fourth is a specialist hospital within orthopedics and rehabilitation. The aim of the pilot was primarily to gain experience with the implementation of innovation surveys in the health and care sector and to develop and test the survey tool with a sample of hospital employees.

Because the study was defined as a pilot, we also defined the target sample to be hospital employees with known experience with innovation work in hospitals. All four hospitals that participated in the survey have a department responsible for research and innovation activities, and they have to some extent initiated activities to support innovation activities in the hospitals (information activities, resources and funding for innovation, networks and contact points for employees interesting in developing ideas for innovations, etc.). It was therefore decided to use the hospitals' innovation managers and their broader networks to hospital employees to recruit informants. We asked each innovation manager to send us a list of names and contact information for persons working in their hospitals that fit the target population.

We received names and email addresses to 111 people that were seen as suitable informants for the pilot questionnaire. From these we received 52 responses. Two responses were dropped due to incomplete answers. Because the sample size and the number of observations is very limited, there are few statistical analyzes that can be carried out to test relationships between variables. We therefore have mainly performed descriptive analyses of the material as well as analyses of differences between groups of respondents (Pearson Chi-square and likelihood ratios) and correlational analyses to look at relationship between variables. Summary information about the individuals who responded to the survey is given in Table 1.

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Gender</b>		
Men	22	44
Women	28	56
<b>Workplace</b>		
Hospital A	24	48
Hospital B	8	16
Hospital C	13	26
Hospital D	5	10
<b>Main work tasks*</b>		
Research	13	20
Clinical work	13	20
Administration and management	66	60
<b>Education</b>		
Doctorate	12	21
Clinical education on master level	7	12
Other master education	21	36
Clinical education bachelor level	9	16
Other bachelor level	3	5
Other education	6	10

<b>Age (average)</b>	48 years (31 to 64)
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Table 1: Summary of informants who participated in the pilot study.

Table 1 shows that there is a predominance of individuals holding administrative or managerial positions in the sample. Several of these have however also indicated that their work also involves research activities and/or patient-oriented work. The extent to which people in managerial or leadership roles are more active in innovation related work than other employees is uncertain. Another survey of hospital staff indicate that staff with leadership responsibilities are more often involved in innovation work and are more motivated to participate in such tasks than other staff (first-line staff, i.e. doctors and nurses) (Garcia-Goni et al., 2007). It is nevertheless important to note that the sample is more skewed towards people in administrative and leadership positions more than we expected. The implications of this are discussed in the concluding part of the paper.

## Results from the pilot survey

### *Hospital employees' participation in innovation activities*

To investigate hospital employees' participation in different kinds of innovation activities, we created a set of items where informants initially answered if they had participated in five main groups of activities (yes or no):, Idea development, reporting of new ideas, commercialization of new ideas, experimentation and testing of new solutions in practice, and implementation and dissemination of new solutions. The activities cover the main phases of the innovation process as described in Figure 1 - from idea generation to implementation of new solutions. If informants answered "yes" to any of the initial question in each group, they were given a more detailed question about the kinds of activities they had been involved in and how often this had occurred during the last three years.

<b>Have you participated in any of the following activities during the last three years?</b>	<b>Proportion (frequency)</b>
Participated in developing ideas for new services, products, procedures etc.	90% (45)
Disclosed ideas for new products, services	50% (25)
Participated in commercialization of new product ideas	22% (11)
Experimenting and testing new solutions in clinical practice	40% (20)
Implementation, dissemination and training in the use of new products/services	70% (35)

Table 2: Participation in the five main innovation activities

As Table 2 shows, most informants have been involved in developing new ideas and in the implementation and use of new products and services. Half of the informants have disclosed new ideas for innovations, while a very small minority have been involved in developing new ideas into commercial projects.

Looking more into the details under each main activity in Table 3, we see that under the heading "developed ideas for new innovations", quite a substantial number of informants claim to have contributed to the development of new ideas; particularly development of ideas for new services and new processes. Moreover, table 3 shows that half of those who answered that they participate in developing ideas for new services do so at least twice a year, while 33 percent of informants who have developed ideas for new products or organizational models / processes claim to have done so more often than two times a year during the last three years.

How often have you participated in the following activities?	Twice a year or more	Once a year or less	Never
<b>Developed ideas for new innovations</b>			
Developed a new product idea	33 %	29 %	33 %
Developed an idea for a new service	47 %	31 %	20 %
Developed a new idea for a process or organisational change	33 %	38 %	24 %
<b>Disclosed ideas for new innovations</b>			
Disclosed a research driven innovation	12 %	52 %	32 %
Disclosed a user-driven innovation	20 %	40 %	28 %
Disclosed ideas to external partners	12 %	12 %	68 %
<b>Commercialized an innovation</b>			
Filed a patent	9 %	64 %	27 %
Licensed out a technology develop in hospital	9 %	18 %	73 %
Established a company based on technology developed in the hospital	0 %	18 %	73 %
<b>Experimenting and testing</b>			
Participated in clinical trials or clinical test	10 %	33 %	43 %
Tested/experiemented with new solutions	57 %	29 %	10 %
Tested/experiemented with new solutions developed in my department	43 %	48 %	10 %
<b>Diffusing and implementing</b>			
Developed new routines/procedures for use of innovations	46 %	34 %	11 %
Training employees in use of innovations	14 %	34 %	40 %
Participated in dissemination about innovations in health care	60 %	34 %	6 %

*Table 3: Participation in innovation activities – detailed categories*

More than half of the respondents have disclosed new ideas to a commercialization unit or a separate unit responsible for developing user-driven innovations in the hospitals. Only 22 percent – or 11 people in the sample – have participated in activities related to the commercialization of new product ideas; these have primarily been involved in patent applications.

Table 3 shows how often informants participated in activities related to experimentation and testing of new solutions in clinical practice. In total, 40 percent responded that they have participated in such activities during the past three years. The majority of those who responded said that they more often than twice a year test new solutions in practice. Most have experimented and tested out new solutions that were initially developed within the hospital unit in which they work. Few informants have participated regularly in clinical trials or clinical testing of new technologies.

The second most frequent activity among the informants is related to the implementation and dissemination of innovations in the health sector. 70 per cent have participated in such activities. Most informants participate regularly in information work on new solutions or they develop routines and procedures for use of new products (over 80 percent of the respondents say that they perform such tasks at least once a year), while approximately 50 percent have participated in the training of hospital staff in the use of new technology.

The main pattern of hospital staff's participation in innovation activities seen from these data is that hospital employees are mainly involved in activities in the early stages of the innovation effort (brainstorming and experimentation) and in the later stages of putting to use and developing new routines for using new innovations. Furthermore, the results indicate that the hospital employees who participate in such activities do it regularly.

Looking at group differences, we find some statistically significant differences between the groups in the material. Informants who have research as their main work task are more active than others in the development and disclosure of new ideas, and also in commercialization activities. People in research positions are also more active in information and training activities related to the introduction of new solutions in hospitals compared to other employees. Female informants are more often involved in

developing new procedures for use of new products and in the development of new processes or organizational innovations in the hospitals.

Looking at relationships between innovation activities, we find statistically significant correlations between participation in developing new product ideas, disclosing new ideas to TTOs, participation in clinical testing and participation in information diffusion and training of employees in the use of new technologies. The employees that are mainly involved in this kind of work are employees with research as a main work task. We also find an association between development of ideas for new processes and services, participation in experimental practices and development of new routines in the use of new technologies. Employees who do not have research as a main work task are more involved in these kinds of activities. These patterns of associations indicate the presence of two main modes of innovations; one directed to development of new products and one towards development of new processes and services.

### *Culture for innovation in hospitals?*

In the pilot study, one ambition was to examine the drivers and barriers to innovation at hospitals both at the individual level and at the hospital level. Hospital managers and owners, as well as a range of Norwegian policy documents, had pointed at “lack of culture for innovation” as a central barrier to promoting innovation in the hospital sector. We created a comprehensive question with a number of items representing different aspects of hospitals’ organizational context innovation. In the innovation literature, there is a broad literature on how characteristics of the organizational culture, teams and other work contexts influence innovation performance (see e.g. Amabile et al., 1996; West & Anderson, 1996; Anderson & West, 1998; Cohen & Bailey, 1997; Crossan & Apaydin, 2010). In addition we asked several questions about the perceived support for innovation work hospital employees received from the hospital management. The aim here was also to analyze whether characteristics of work situations influenced hospital employees’ participation in innovation activities (Salge & Vera, 2009).

The main impression from the data is that hospital employees perceive that the organizational culture and the management is supportive towards innovation work (more than 80 per cent agreed with this statement). The majority of informants also agree that the work they perform is conducive to learning and that there is room for experimenting with new solutions. However, most informants experience that there is insufficient space and time in their work routines to develop and test new ideas. Overall, more than 50 percent of the informants in the pilot claim that they often experience barriers when working with innovation.

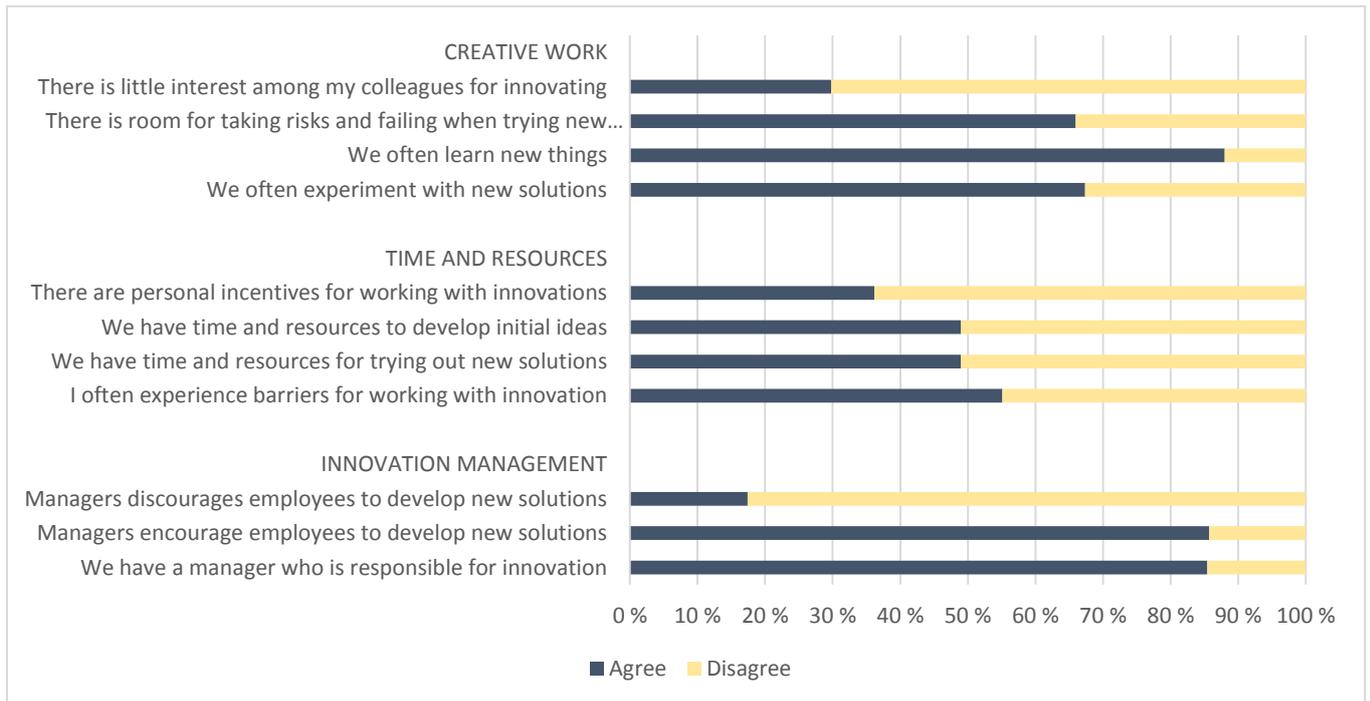


Figure 2: Assessment of hospitals' innovation culture and support for innovation

It is not easy to see a simple pattern in these responses. The respondents expressed that it is important to work with innovation and that they receive support and opportunities to develop new ideas. The challenges are primarily found in the opportunities during the workday that hospital employees have to prioritizing time for working with developing and following up new ideas. Looking at the correlations between responses, we find statistically significant correlations between having a manager responsible for innovation and employees' experience of support and personal incentives for working on innovation. Having a manager responsible for innovation is also associated with less experienced barriers and resistance for working with innovation. However, we cannot see an association between innovation management and perceived time to work with innovation. There is also a statistically significant association between having time to experiment with new solutions, acceptance of risk and failure, and experience of managerial support, and a significant association between managerial resistance and resistance among colleagues for working with innovation.

There are less significant differences between groups of informants in the answers to these questions that expected. The main group difference is about the perception of allowance for taking risks and potentially failures. Employees in mainly in patient-oriented work or in administrative positions agree to a lesser extent to this statement, as can be expected, compared to people with research as a main task.

We have also looked at correlations between the answers to the questions about innovation culture and degree of participation in different innovation activities, and find some statistically significant relationships. There is a significant correlation between having participated in developing new ideas for new services, products and procedures and experience of barriers for innovation. However, employees who have disclosed innovation ideas experience less barriers that their colleagues who have not disclosed their ideas for new innovations. Hospital employees who have participated in activities related to implementation and dissemination of new innovations, are more likely than others to have experienced barriers to working with innovation.

Time to work on the ideas is perceived as another important barrier to innovation, but we cannot see a clear connection between this and participation in innovation activity. Persons who have disclosed ideas for innovations, more often than their peers claim to have sufficient time and resources to develop new ideas and to follow them up. It appears that the informants who are the least active innovators are experiencing the greatest barriers and feel that they have too little time to work with innovation.

## **Discussion and concluding remarks**

### *What do our pilot data indicate?*

To summarize, the data collected through the pilot study are far from conclusive, and the goal was to explore the tool with a view to gain knowledge relevant for further research. First, we find that hospital employees are engaged in a variety of innovation related tasks – not all to the same extent, but nonetheless this preliminary finding warrants a broad approach to innovation activities. We find that most the employees are engaged in the early and later phase of the innovation process, and particularly in development of ideas for new innovations through research and experimental practices, as well as in diffusion, development of new routines for the use of new solutions, and in training and information activities about new innovations.

Our data also indicates that there are two different modes of innovation in hospitals. One is oriented towards development of new product ideas, which requires systematic research and testing. Employees that have research as one of their work tasks are involved in this, and it usually requires collaboration with external organizations and support from external sources. The other indicated mode of innovation in hospitals concerns development new processes or services, based on experimentation and learning in practice situations. This finding is largely in line with the perspective of Salge & Vera (2009; 2012) about two modes of innovation that co-exist in hospitals. Our data indicates that employees involved in developing new product ideas are also involved in the implementation and diffusion stages, and that both research and experimental clinical practice are important sources for new product ideas. The differences in modes of innovation appear to be related to the kinds of innovations (products vs services/processes) rather than what is the main input (research or user experience) to the innovation process.

Looking at innovation management and support for innovation in hospitals, our data indicates that hospital employees mostly experience a culture conducive to innovation in hospitals. The most significant barrier, according to the informants, is having enough time in a busy workday for actually working with developing the new ideas for products or services. Employees with research as one of their main tasks and employees who have been involved in product innovation, experience less barriers and more support for doing innovation related work, compared to their peers.

Employees who work in hospitals with a proactive approach to innovation work and with a designated innovation manager, experience more support and a more conducive culture for working with innovation, but not more time to work on innovation. Employees with less experience with innovation and employees that mainly have been involved in service innovation, seem to experience more barriers and less support for innovation work.

### *Lessons learned from the pilot study and implications for further work*

These findings from our pilot data obviously need to be checked in further and more comprehensive studies. When it comes to the innovation survey tool for hospital employees itself, our overall assessment is it worked fairly well. There was little missing data and the questions did pick up the underlying variance in innovation activities that we assumed would be important. Different types of

personnel (doctors, nurses, administrative staff) were able to complete it and stated in the comments section that they perceived the questions as relevant and easy to respond to. There is a clear potential for using the questionnaire in a larger-scale survey to investigate more systematically topics such as differences between positions/professions in hospitals and differences between types of hospitals.

This requires a carefully thought out strategy for data collection; our main problem with the survey was in the sampling and recruiting stages. We had difficulties recruiting enough people to answer the survey, primarily because the number of people included in the initial sample was small (111). As described above, we utilized contracts working in each hospital to sample relevant informants (employees with some experience or interest in innovation activities). We therefore had limited control over the sampling procedure, although we did have several discussions with the ones doing the sampling about what kinds of informants we perceived to be relevant. One issue that might have influenced the sampling is that the concept “innovation” is still quite alien to hospital employees, and therefore our contact persons might have considered a more limited group of employees to be relevant, compared to our intention to sample broadly.

In the questionnaire, several of the informants commented that they have the role of being the innovation coordinator in their department, but have had less experience in actually carrying out the innovation activities themselves. We are therefore uncertain whether we have reached what was our intended target group (people with practical experience with innovation) in the pilot phase. To assess this, we asked the informants to assess in different ways whether this survey was relevant for them. 30 percent did not see themselves as being in the target population for the survey. 16 percent perceived that the questions were not relevant to them, and 24 percent thought it was difficult to respond. This suggests that further testing and a full-scale administration of such a survey need to be based on a different approach to sampling and informing potential informants. A particular challenge in the hospital setting could be that relevant personnel such as doctors and nurses are not necessarily in a work setting where it is possible for them to answer electronic questionnaires (e.g. due to hectic schedules and limited computer and email access at work).

With a view to possible further development, we see the main challenge ahead connected to defining and reaching the target group. Some of the respondents argued that only persons who have received funding for innovation projects should receive such a survey, which would be very different from our intentions of a broad-based employee-level innovation survey in the hospital setting, but might fit a rather limited and formal perspective on innovation activities in the hospitals. A better alternative might be to send a survey to all employees of certain functions or departments. For information security reasons, this can perhaps only be administered internally within the hospital, as hospitals have a very restrictive policy for sharing information about their employees. Another possible approach would be to embed some of the questions from this survey tool in questionnaires that map working conditions of hospital employees (as Salge and Vera 2009, 2012 based parts of their analyses on). This would mean however, a substantial loss of information about innovation activities (due to space concerns in omnibus surveys). Another approach could be to target specific groups of professionals and use professional associations to recruit and administer the survey, or to use a snowball sampling strategy and to get the first group of informants to share the survey within their networks. Several approaches for further research are possible, but all require collaboration with hospital owners and managers.

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