

A Preliminary Framework for Studying University Hospitals in Regional Innovation Systems: Activity Perspective

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Abstract In this paper I present a preliminary framework for studying university hospitals in regional innovation system from activity point of view. A brief literature review on health care and health care innovations reveals that these subjects are studied in various fields of research. In this paper I also summarize the literature on regional innovation systems concentrating on the three main dimensions of regional innovation system. The literature review reveals three gaps in innovation studies: activity perspective on innovation systems, the study of health care innovations and disregard of university hospitals as focal actors in regional innovation systems. As a starting point for filling the gaps a conceptual framework is presented.

Key words regional innovation system, health care, activities, university hospital

1 Introduction

Firms and their networks have always been a popular subject in innovation studies. Also in the regional innovation system framework firms are considered the most important actors of the system. Many studies on science-based innovation have clearly shown the significance of universities for innovation although universities are involved in many other activities besides the generation of scientific knowledge e.g. Lester [1]. Also the importance of intermediary organisations and diverse institutional settings have been highlighted. Yet, there remain many organisations in regional innovation system that have not gained proper attention despite their significance for innovation. These include the university hospitals which, by and large, have been ignored innovation studies.

Health interests all people and not the least the national, regional and local authorities in a time of aging population in Europe but also in some developing countries. The graying population pose a shift in disease burden from acute to chronic care. This means growing health expenditures as the demands and needs of the patients on the health care system change [2]. Development of new drugs is not sufficient and there is a strong need for new ways of delivering care and revising the health care system.

In this paper I will present a preliminary framework for studying university hospitals in regional innovation systems from activity perspective. The framework employs literature on the activities of university hospitals or academic health centers and regional innovation systems. I start with the concept of health care and briefly illustrating how health care innovations have been studied in various research branches. Second, I will address university hospitals and their roles in health care. The third part consists of a summary on the literature on regional innovation systems. I concentrate on the three dimensions of the system: institutional structure, actors and activities, and dynamics and interaction. After that I will present some notable gaps in innovation studies. As a starting point for filling the gaps I propose a preliminary framework, its components and their relations. I will finish the paper with concluding remarks.

2 Studying Health Care and Health Care Innovation

Health care means all the actions, programmes and politics used by individuals or communities to maintain health and prevent, relieve and cure illness. The aim of health care is to generate health by using health care methods which include all drugs and devices in use of health care. These comprise screening, preventing, diagnosing, treating and rehabilitating operation and structural and funding systems. [3] Thus innovation in health care means the development, diffusion and application of new knowledge on these health care methods.

Health economics has examined health care from economic perspective since the 1960s. It is commonly regarded as an applied field of economics [4] which draws upon a wide cross-section of economics theory such as the cost-benefit literature, welfare economics and public finance, consumer theory and industrial economics [5]. Health care economics research is theoretical, applied and

policy-oriented research [4]. It treats health care organisations as economic agents that produce health services. The principal topics of health economics include: health as a concept and the value of health; factors influencing health; demand for health care; supply of health; market analysis e.g. on prices; microeconomics of health; planning, budgeting, regulation and monitoring mechanisms; and evaluation at the whole system level [4].

The focus of health management research and microeconomic appraisal is usually on the problems of care delivery processes [6]. Care delivery is about what care is provided, how it is provided, by whom, and where care is provided [2]. The principal topics in microeconomics of health care are cost-effectiveness, cost-benefits and cost-utility [4]. In health management studies the topics are varied and the principal topics are human resources, power relations, leadership, education and learning, change, and technology management. Also studying health care organisations from industrial management perspective is gaining more interest e.g. [7].

The both research branches, health care economics and management, in many ways share a common ground of the notion of scarce resources in health care. Their connection to innovation stays fuzzy and the research in this field is rarely about creating new and more often about optimizing the use of existing, limited resources. New knowledge as products or new treatment methods comes from outside to the health care system or organisation. Similarly, if change is studied and managed in an organisation there is no or only a weak connection to a wider system of innovation. In any case, innovation is not a central topic or perspective to study health care in health care economics and management.

Traditionally technological innovations have been a focal topic for historians and they have also studied innovation in health care and medicine e.g. [8] and [9]. In their research historians tend to focus on a single medical or health technology. On the other hand history studies also include comparisons between two or three technologies and their development, diffusion and use in different settings such as in a health care organisation or a health care system. There are also comparisons between different organisations and health care systems in different cities, regions or countries. The focus is on the development path of a technology and not so much on the whole innovation system and its dynamics. Yet, the overall innovation system can be present in these studies although not usually as a conscious choice.

Health care has been studied relatively abundantly also in the field of innovation studies. There are many studies on networks and innovation in biotechnology industry e.g. [10], [11] and [12] and in life science e.g. [13]. There is also a vast literature on innovation in medicine and medical devices e.g. [14], [15] and [16].

The research in innovation studies has mainly been about the development of technologies and not the change of health care as a whole. According to Edquist [17] in innovation studies, there has traditionally been a tendency to focus much more on technological process innovations and goods product innovations than on organisational process innovations and service product innovations. He also points out that it would be advisable to use a more comprehensive innovation concept and to give more attention to non-technological and intangible kinds of innovation. By looking at the technological development and trajectories the diversity of health care innovations is often brushed aside. In addition to the development of medical and health technologies such as development of drugs, medical devices and new cure methods there are many innovations in the care delivery processes, division of labour, organisation of work and health services [8]. Edquist [17] also states that such a broader orientation is implicit in the fact that we talk about systems of innovation and not systems of technological change.

3 Three Roles of University Hospitals in Health Care

There is no single definition for university hospitals as they are so varied and complex organisations consisting of many parts. In this chapter I use mostly American literature on university hospitals where the equal arrangement of different organisations can be identified as the academic health centers with their teaching hospitals. I use this literature because it approaches hospital from activity point of view that is convergent with the perspective of this paper.

Kohn [2] does not see academic health center as a single institutions. They are constellations of functions and organizations committed to improving the health of patients and population through integration of their three roles in research, education and patient care to produce the knowledge and evidence base that is the foundation for both treating illness and improving health. According to Kohn

the academic health centers vary in the emphasis placed on each of their role, e.g. the size of their research endeavours and how they combine their roles.

According to Gelijns et al. [15] the universities and their academic health centers are among the more complex institutions in modern society. They regard the academic health centers as multifunctional organisations and recognise the same three roles as Kohn. Academic health centers have a three-pronged mission: (1) they provide primary care as well as advanced specialty and tertiary care and are early adopters of the “latest” in technology; (2) they train biomedical researchers and clinicians, and thereby, shape the distribution of skills and specialities; and (3) they conduct a wide range of biomedical research activities, ranging from laboratory-based fundamental research to population-based clinical studies [15].

Gelijns et al. [15] also recognise that there is an inherent tension among various missions, but at the same time there may be “complementarities” between missions, where engaging in one mission makes the organisation more effective in pursuing the other missions. For example, the experience derived from delivering specialty care may inspire new research directions as well as enhance physician training [15].

Kohn and Gelijns et al. see academic health centers as important actors in innovation. Also Metcalfe [14], Consoli et al. [18] and Ramlogan et al. [19] have discovered the significance of university hospitals for medical innovation through empirical research. Kohn also explains how the roles and outcomes produced by the roles change. It is ultimately about the changes in people’s health care needs, in technology and in the organisation and financing of health care delivery which bring about changes in the roles of academic health centers. As the care provided by the academic health centers changes the health professionals must be prepared differently, and research inevitably seeks to answer new questions [2]. University hospitals take part in innovation in many ways, e.g. hospitals comprise a fundamental component in medical innovation systems because they are the loci of clinical practice [19]. Although the importance of hospitals and especially university hospitals, or academic health centers and teaching hospitals in the USA, in innovation systems has been acknowledged their roles in innovation have not been profoundly analysed.

4 Regional Innovation Systems

Innovation in society and more specifically innovation systems have been studied at various levels and with various scopes. These include e. g. national innovation systems [20], regional innovation systems [21], [22], sector innovation systems [23], innovative milieus [24], and technological systems [25]. In the core of innovation system literature is the view of innovation as an interactive and evolutionary process. Innovation is not seen as a single and separate event but as a process in which various organisational actors innovate in interaction [17].

A system of innovation is constituted by elements and relationships which interact in the production, diffusion and use of new knowledge [20]. This knowledge is exploited for practical, including commercial use [21]. Thus the knowledge created, diffused and used is not always in the form of commercial products or services but can have practical and social effects. More specifically knowledge may take the form of new ideas and concepts, new skills or competencies, or technological and organisational advances. An innovation system is a social and dynamic system [20]. The system is social because a central activity in the system, learning, is a social activity. Innovation in the system involves positive feedback and reproduction which makes it a dynamic system. Thus innovation is not a linear but a recursive process and the system is recursive by nature [25].

4.1 Institutional Structure of Regional Innovation Systems

The agenda for the theoretical development of the regional innovation system approach has been influenced by different theories. The major contributions to this approach have come from evolutionary, institutional and regional economics, economics of learning, economics of innovation and network theory [26]. In particular an important foundation of the analytical framework of regional innovation systems is in the ideas of Lundvall [20] on national innovation systems. National innovation systems are identifiable as national economies differ regarding the structure of the production system and regarding the general institutional set-up and as national innovation systems reflect these facts. Specifically this is shown in: internal organisation of firms, interfirm relationships, role of the public sector, institutional set-up of the financial sector, R&D intensity and R&D organisation and the training system [20].

The elements comprising the institutional structure of a regional innovation system can be identified. According to Howells [22] regional innovation systems are readily identifiable and

meaningful from national innovation systems, depending on to what extent a nation can be said to have a homogenous regional structure relating to innovation. The same components as in national innovation systems exist at regional level and these components can be used for the analysis of regional innovation systems. Nevertheless, regional innovation system is treated as a separate unit of analysis because the components of national innovation systems are delivered and responded to differently at regional level.

Like national innovation systems, regional innovation systems and their characteristics, including the institutional set-up, evolve through time to be distinctive to that certain region [21]. The institutional structure evolves in interaction with actors of the system. The interaction between structure and actors is bidirectional [22]. A region becomes distinctive as it evolves through time to an institutional repository of a certain negotiated, evolving, collective social order which establishes, to some extent organisationally, the institutional routines, norms and values by which actors may come to trust each other collectively [21]. The institutional structure facilitating innovation includes several elements: industry specialisation and structure, governance structure and its autonomy including public and private administrative set-up and intermediating structures, financial system and its autonomy including finance of activities of firms, structure of the research and development functions as a part of knowledge generation, training and competence building system, non-organisational institutions such as contracts, laws and norms and operational cultural factors [22], [21], [27].

4.2 Actors and Activities of Regional Innovation Systems

Autio [27] distinguishes two separate subsystems that constitute the main building blocks of regional innovation systems. These are the knowledge-application and exploitation sub-system and the knowledge generation and diffusion sub-system. The former consists mainly, but not exclusively, of industrial companies, while the latter comprises various, mostly public sector, institutions. There are four interest groups related to industrial companies that are customers, collaborators, contractors and competitors [27] or the members belonging to a supply chain [21] including small, large, industrial and service firms.

The knowledge generation and diffusion sub-group includes four main types of institutions: public research institutions, educational and more broadly defined skill-development institutions [21], workforce mediating institutions, and technology mediating institutions or other intermediary organisations. Intermediary organisations improve connectedness within a system, particularly through bridging ties, but they also have a role of creating new possibilities and dynamism within a system [28]. Also important actors in a regional innovation system include public and private funding organisations and non-firm organisations [21].

According to Edquist [17] the main function – or the “overall function” – in innovation systems is to pursue innovation processes, i.e. to develop, diffuse and use innovations. He continues that the activities of innovation systems are those factors that influence the main function i.e. the determinants of the development, diffusion and use of new knowledge. Edquist does not provide a final and fixed list of activities¹ but a list that will change as our knowledge about the determinants of innovation processes increases. He says that clearly there is no consensus as to which functions or activities should be included in an innovation system and this provides abundant opportunities for further research.

¹ Edquist [17] ten activities. He has used his own knowledge on innovation systems and other researcher’s lists, e.g. Rickne [29] and Liu and White [30], to compile the list. The ten activities include: (1) Provision of research and Development (R&D), creating new knowledge, primarily in engineering, medicine, and the natural sciences. (2) Competence building (provision of education and training, creation of human capital, production and reproduction of skills, individual learning) in the labour force to be used in innovation and R&D activities. (3) Formation of new markets. (4) Articulation of quality requirements emanating from the demand side with regard to new products. (5) Creating and changing organisations needed for the development of new fields of innovation, e.g. enhancing entrepreneurship to create new firms and intraentrepreneurship to diversify existing firms, creating new research organisations, policy agencies, etc. (6) Networking through markets and other mechanisms, including interactive learning between different organisations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in different spheres of the IS and coming from outside with elements already available in the innovating firm. (7) Creating and changing institutions – e.g. IPR laws, tax laws, environment and safety regulations, R&D investment routines, etc. – that influence innovating organisations and innovation processes by providing incentives or obstacles to innovation. (8) Incubating activities, e.g. providing access top facilities, administrative support, etc. for new innovative efforts. (9) Financing of innovation processes and other activities that can facilitate commercialisation of knowledge and its adoption. (10) Provision of consultancy services of relevance for innovation processes, e.g. technology transfer, commercial information, and legal advice.

The organisations and individuals of the innovation system perform the activities and institutions provide incentives and obstacles influencing the activities [17]. According to Autio [27] his division of the system into two separate sub-systems is a simplifying distinction. There is no one-to-one relation between activities and organisations: most activities can be performed by different organisation, and further, many categories of organisations can perform more than one activity [17]¹. Thus the actors have multiple roles in the system, which are linked to different activities, and researchers should be cautious of making too rough simplifications that label actors as purely knowledge generators or exploiters and diffusers.

According to Edquist [17] the set of activities is likely to be important in most innovation systems, but there are activities that are very important in some kinds of innovation systems and less important in others. Also there is a relation between different activities, they reinforce and support – or offset – one another. Hence, he says, in order to understand and explain innovation processes we need to address the relations between activities and components, as well as among different components. As innovation systems are social systems in which interaction and learning is a central feature [20] it is the interaction that actualizes the activities of the system as can be seen in the next chapter. The most of the activities reside in interaction and thus studying interaction reveals the activities and how they are performed by different actors of the system.

4.3 Dynamics and Interaction of Regional Innovation Systems

Although regions do display significantly different structures of innovation system components it is at the level of the internal dynamics of the interaction of firms and organisations and their links back to the wider institutional structure within the regional system of innovation that is so important and make regions valuable for study in their own right [22]. Also Autio [27] argues that the interaction between agents has not been in the direct focus of the analysis of NISs. According to Howells [22] regional innovation systems represent crucial arenas for localised learning and tacit know-how sharing. The institutional level mentioned earlier is still crucial and vary significantly between regions, but the regional level includes the informal links between people and the primary decision making space for firms.

The organisations of a regional innovation system are associative, meaning there is systemic, i.e. regular, two-way, interchange on matters of importance to innovation [21]. The interactions within and between organisations and sub-systems generate the knowledge flows that drive the evolution of regional system of innovation [27]. Linkages between key organisations can be specified in terms of flows of knowledge and information, flows of investment funding, flows of authority and even more informal arrangements such as networks, clubs, fora and partnerships [21].

Learning is a central function in innovation systems and the associative organisations form the regional learning system that is a part of the regional innovation system [21]. The most important learning processes for innovation are interactive and partially emanate from routine activities. These include learning-by-doing, learning-by-using and learning-by-interacting, DUI-mode, or the experience-based mode of learning (Jensen et al. 2007). Encompassing these processes a regional milieu for continuous learning may emerge, which includes an efficient and embedded culture of knowledge sharing and circulation (Kautonen 2006, p. 270). Also more deliberate searching and exploring activities [20] and scanning and invention [22] take place in innovation systems for expanding the knowledge of actors. This is the case especially in regional innovation systems that are global research and development nodes where new knowledge is created in universities and public or private research and development laboratories (Kautonen 2006, p. 270). This refers to the STI-mode, Science, Technology and Innovation, of learning based on the production and use of codified scientific and technical knowledge. Also patterns of communication and knowledge sharing are important processes as a part of the key dynamic processes fundamental to the micro-foundation of localised innovation [22].

5 A Preliminary Framework for Studying University Hospitals in Regional Innovation Systems from Activity Perspective

In the previous chapters I have identified three gaps in the regional innovation system framework and the studies on health care innovations. These are:

The activities of regional innovation systems have not been clearly defined and there is an evident need for more information on this subject

¹ However, there are limits to this flexibility – for instance, primary schools cannot carry out basic research [17].

The university hospitals have not gained the attention they deserve in innovation studies and should be lifted to the focus of research from the margin.

The focus of health care innovation studies has mainly been on technological change and the perspective should be expanded to cover the intangible aspects of innovation. Health care provides a good empirical field for that.

As a starting point to fill these gaps I propose a framework for studying university hospitals in regional innovation systems from activity perspective. This is a preliminary framework which will evolve as more empirical research is done using this framework. The main components of the framework are presented in figure 1.

Main functions and activities of RISs	Development	Diffusion	Use	Main functions and activities of RISs
	Activities of the RISs			
	Learning Modes of the RISs: STI & DUI			
Roles of university hospitals in health systems				Elements of RISs
Care	Roles of university hospitals in RISs			Institutions
Education				Actors
Research				

Figure 1 The Framework for Studying University Hospitals from Activity Perspective

On the left in the framework are the roles of university hospitals. A university hospital takes part in health care of people and the larger population through its three missions or roles, care, education and research, which were introduced in more detail in the chapter 4. A university hospital also acts in a regional innovation system through its roles. As all actors in a regional innovation system the roles of a university hospital in a regional innovation system are connected to the activities it performs. These activities are on their part connected and derived from the main function of a regional innovation system i.e. development, diffusion and use of new knowledge as presented in the chapter 5. The main function is carried out through the two modes of interactive learning in regional innovation system: the experience-based mode (DUI) and science-based mode (STI). These components can be found at the top of the framework.

Institutions and actors are placed on the right in the framework. Actors perform the activities of the system through their roles. Institutions regulate, support and may also impede the realization of the roles of the actors. Because innovation systems are social systems the roles of university hospitals, or any other actor, actualize in the interaction with other actors and institutions of the system. Interaction with the other actors takes place in different settings such as formal and informal networks, forums, arenas and partnership relations. In the interaction actors contribute to the main function of the regional innovation system through their roles in interactive learning processes that are characterised by the two learning modes. As university hospitals vary in the emphasis placed on each of their role in health care, thus do their roles differ in regional innovation systems depending on their actual operations and the characteristics the system. Empirical work is needed to gain a clearer picture of the roles and therefore no list of roles is provided in this framework.

The framework presented here is a conceptual framework and does not include methodological suggestions. There are many possibilities both in qualitative and quantitative traditions. These possibilities have to be discussed properly and in detail in future.

6 Conclusions

The regional innovation system framework is an analytical tool for studying innovation in regional context. The innovation system perspective accentuates the dynamic nature on innovation and the interaction of actors and institutions in learning processes. Regional innovation systems have a general function to pursue innovation processes, i.e. to create, diffuse and use new knowledge. Regional innovation systems include activities that are the determinants of this function. There are abundant possibilities to examine the roles the actors adopt while performing the activities and which activities are essential for regional innovation systems.

University hospitals are an essential part of health care with their three roles, i.e. care, education and research. Through these roles university hospitals are also a part of regional innovation systems. Health care and health care innovations are studied widely in many research fields and also the importance of university hospitals for innovation is being elicited in the literature. It can be expected, due to their focal status, that university hospitals as an actor in innovation will gain more attention in future.

The use of innovation system framework should implicitly lead to a focus on intangible and non-technological innovations in addition to technological innovations. The study of health care innovation offers interesting possibilities to broaden the scope of innovation studies over technological change to study change in organisational processes, systems and services.

In this paper I have identified notable gaps in innovation studies. I have also presented a preliminary framework for studying university hospitals in regional innovation systems from activity perspective to be used to fill these gaps and to be developed further. I have provided some potentially fruitful departure points for future empirical research on this topic.

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