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Hospitals as innovators in the health-care system: A literature review and research agenda

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ABSTRACT

This paper aims to improve the understanding of the role of hospitals in the generation of innovations. It presents a systematic and critical review of the interdisciplinary literature that addresses the links between the activities of hospitals and medical innovation. It identifies three major research streams: studies of the contribution of medical research and clinical staff to innovation, analyses of novel practices developed and diffused in hospitals, and evolutionary studies of technical change in the context of human health care. This is a highly heterogeneous body of literature, in which comprehensive theoretical frameworks are rare, and empirical studies have tended to focus on a narrow range of hospitals' innovation activities. The paper introduces and discusses a framework integrating different perspectives that can be used to analyze the functions performed by hospitals at the intersection with different partners in the health innovation system and at different stages of innovation trajectories. On the basis of current gaps in the literature, a research agenda is discussed for a relational and co-evolutionary approach to the study of hospitals as innovators.

1. Introduction

Studies of innovation related to human health have emerged in great abundance, on topics ranging from advanced biotechnology to improvements in health services. Many of these studies argue that hospitals are central actors in this innovation, yet these organizations are rarely addressed directly and explicitly in innovation studies. Instead, they are treated as contexts, partners, indirect selection mechanisms, and users in investigations of industrial development and the commercialization of science. In this paper, we focus on the role of hospitals in the generation of medical innovations through a systematic review of the relevant social science literature.

Hospitals, in particular, university or research hospitals, are part of health innovation systems, which can be theorized as distributed systems because of their extensive division of labor and complex collaborative approach to the application of useful knowledge (Coombs et al., 2003; Von Hippel, 1988). Hospitals perform multiple functions in health innovation systems. They are the major providers of health-care services. They are adopters and users of new technologies (thus the demand side of externally generated innovation). They are potential developers of processes and organizational innovations. Moreover, hospitals can be an integral part of the education system in which new practitioners are trained, so they can be loci of clinical experimentation and large R&D-performing institutions in their own right. Overall, they are key sites for the adoption, reproduction, and generation of medical knowledge.

The role of individual doctors as innovators has been covered extensively in the history of medical technologies but has to be understood within a complex institutional environment and in relation to long-term epistemic and cultural change (Blume, 1992; Pickstone, 2011). The role of hospitals in the consumption and implementation of innovations—both technical and clinical—has also been covered extensively in the health management, health economics, and health policy fields. However, despite notable exceptions (e.g., Djellal and Gallouj, 2005, 2007; Salge, 2012; Salge and Vera, 2009), the organizational capacity of hospitals to generate medical innovations has been underemphasized. In this paper, we are interested in assessing the role of hospitals as generators of medical innovation, broadly defined as "new drugs, devices and clinical practices introduced over time into the provision of health care" (Consoli and Mina, 2009). The rise of more open models of innovation (Chesbrough, 2003, 2006; Dahlander and Gann, 2010) makes it even more important to focus on the specific contribu-

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tion that hospitals make or have the potential to make in upstream innovation activities as leading organizations or as partners to other organizations in the medical industrial complex. For this reason, we are especially interested in the literature that covers universities, research hospitals, and academic medical centers, and their arguably growing importance in modern health innovation systems.

Health-care systems comprise heterogeneous actors who perform distinct but related tasks (Djellal and Gallouj, 2005, 2007). Although there is a division of labor among the individual participants, many of the tasks performed by each agent cannot be completed without the contributions of other agents. Thus actor groups have multiple and mutual dependencies, which create the systemic quality of health innovation (Windrum and García-Goñi, 2008). Hospitals, particularly research or academic hospitals, become central nodes in health-care networks because they perform multiple roles at key intersections of the system (Anderson et al., 1994; Ramlogan et al., 2007). First, these organizations function as brokers among different domains and sources of knowledge, such as scientific, clinical, technical, and commercial knowledge. Second, they are bridges among different modes of learning, including learning through medical practice, through basic and applied research, through technical experimentation, and learning by adapting new technologies to local contexts (Morlacchi and Nelson, 2011; Rosenberg, 2009). Third, hospitals connect health-care systems across stages in the innovation process as they can be involved in idea generation, testing/verification, implementation, and diffusion.

Hospitals contribute to new idea generation through experiential learning in clinical practice and research (both basic and clinical) by identifying problems and potential solutions. They often do so in collaboration with universities and firms under a variety of institutional arrangements (Rosenberg, 2009; Schlich, 2002). The outcomes of these activities are research outputs, insights for new inventions, and candidates for new products and processes (Chatterji et al., 2008). Some of these ideas may be spun out to form the basis for new companies or are licensed to existing firms (French and Miller, 2012).

Hospitals can initiate some product development activities internally, particularly development of new procedures, new services and organizational arrangements, and new tools and methods. In the product development phase, however, hospitals mostly interact with established firms to transfer knowledge about the clinical context in which the new product candidates can be used. They are then involved in testing and documenting the effectiveness, safety, and efficiency of new product candidates, thus influencing technology selection (Windrum and García-Goñi, 2008). Activities linked to learning and adaptation in the user context is a fundamental role for hospitals, along with development of a range of service innovations to support the implementation of new technology or new treatments. In addition, hospitals can shape opportunities for technological learning because experimental practice can lead to new idea generation, both as incremental improvements upon existing techniques or services, and as ideas for new products (Djellal and Gallouj, 2005; Metcalfe et al., 2005).

Fig. 1 describes the multiple roles that hospitals *can* play in the generation of novelty within health care and medicine, which sets the parameters for the present study. Without implying strict linearity in these stages or dimensions, we propose that at any point in time a range of parallel and stepwise innovation activities occur in relation to the organizational context of a hospital.

The twin objective of the paper is to provide an overview of the state of the art on this interdisciplinary problem and to outline a conceptual framework that can be applied to the study of hospitals from an innovation system perspective. By highlighting the multiple roles hospitals play in distributed health innovation systems, we argue that the contribution of these institutions must be understood in relational and co-evolutionary terms: hospitals are sources of novel ideas as well as conduits for innovation generated elsewhere is the system. We argue that a more comprehensive perspective on the role of hospitals is important to better inform policy by stressing the system-level impacts hospitals have on the innovative performance of health-care service and manufacturing activities.

We use a systematic review methodology and sample widely in the heterogeneous and multidisciplinary research literature on this topic. In the next section, we present our methods and data. Three thematic strands of contributions emerge that differ in their perspectives and levels of analysis, which are articulated in more detail in Section 3. In Section 4, we synthesize and discuss the key findings. Having identified contributions and knowledge gaps, Section 5 concludes by highlighting emerging issues for further research.

2. Review method

The paper is based on a systematic review approach (Littell et al., 2008), which aims to make the literature selection and review process transparent and replicable. We started from the factual premise that research on hospitals and innovation spans many disciplines, empirical approaches, and publication channels. A highly heterogeneous body of knowledge presents the challenge of capturing the breadth of relevant contributions and synthesizing insights and main findings across several scientific domains. We address this challenge by using a maximum variation sampling strategy (Suri, 2014).

To select the literature for inclusion in the literature review database, multiple searches were carried out on search terms such as “medical innovation,” “medical and/or health-care innovation systems,” and “innovation and hospitals/academic medical centers/university hospitals/research hospitals.” Identical searches were conducted in three databases with broad coverage: ISI Web of Science, Scopus, and PubMed. The first set of keyword searches was conducted in ISI Web of Science (WoS; on the title, keywords, and abstract) on the terms “innovation and hospitals,” yielding 895 publications. Identical searches were conducted in Scopus and PubMed to verify that the searches generated the relevant research literature, thus validating our research strategy. Scopus and PubMed have broader coverage of publication types, including also books, book chapters, and practitioner-oriented publications. The procedure described in Table 1 was followed for each database. In Scopus and PubMed, the initial searches on innovation and hospitals yielded a larger number of hits (15,072 and 505). In these databases, we set requirements that publications should include an abstract, and searches were conducted on title/abstract/keywords, to enable a replication of the search procedures.

As seen in Table 1, searching on the keywords “hospital” and “innovation” generates a large number of hits, which have to be reduced to meet review feasibility constraints. We therefore added a third term to narrow the scope of the search. After running the three queries, 307 abstracts from WoS, 638 abstracts from Scopus, and 203 abstracts from PubMed were downloaded and reviewed—a total of 1148 abstracts. All these abstracts were read, and a decision was made as to whether the text was relevant in accordance with the inclusion and exclusion criteria in Table 1. The procedure was applied on abstracts and then on the full text of all documents that matched the criteria.

As an additional measure to ensure that we were not missing relevant publications, we also searched for publications that included the keywords “innovation” or “technology” in their title in selected journals that prior searches had identified as the four that published most frequently on this topic. This procedure provided information

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