

ADVICE NETWORKS AND PHYSICIANS' INNOVATIVE WORK BEHAVIOR

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ABSTRACT

In this paper we aim to investigate the impact of advice networks on Innovative Work Behavior in health care setting. We investigate a community of 181 primary care physicians in 4 different Italian regions. Social network analysis techniques and ordinal regression model were used to understand the extent to which the degree of collaboration and advice among physicians impacts on their propensity to adopt innovative available knowledge. Our findings document that the more the physicians are central in the advice network occurred with peers, the more they are likely to adopt an innovative behavior. Results also show that the more the physicians are connected with colleagues employed in hospital settings, the more they are likely to adopt an innovative behavior. Finally, we found a moderating effect of centrality degree in the advice network with peers on physicians' propensity to acquire innovative knowledge by hospital colleagues. This study provides managers with new insights about factors influencing the adoption of innovative work behavior on the workplace and suggest the use of analytical tools to map individuals' advice relationships.

Keywords: Innovative Work Behavior, Advice, Social Networks, Professionals

1. INTRODUCTION

Innovative Work Behavior (IWB) relates to a set of behaviors aimed at initiating and intentionally introducing new and useful ideas, processes, products or procedures within any organizational contexts (Farr & Ford, 1990). In this vein, scholars have largely documented the role of personal knowledge, skills, abilities and creativity in defining such propensity (Madjar, 2008; Madjar et al., 2002), as well as the impact of exogenous and contingent factors such as job autonomy and time pressure (Wu et al., 2014), leadership styles (De Jong & den Hartog, 2010) and co-workers' trust (Parker et al., 2006). In this study, we attempt to understand the role of professional networks in determining IWB. A large number of evidences report the strong impact of professional networks in the innovation process, documenting how the advice networks occurring among professionals affect adoption of innovations and the diffusion of new products (Coleman et al., 1957; Robertson et al., 1996; Mascia & Cicchetti, 2011). Several theories attempted to explain the impact of professional networks on innovative behavior, such as Rogers' diffusion of innovation model (Rogers, 2003), Granovetter's strength of weak ties theory (Granovetter, 1973), social influence theory (Valente, 1995), and social contagion theory (Christakis & Fowler, 2013).

Most of these studies have been conducted within professional organizations and in the health care sector more particularly, as a consequence of several idiosyncrasies distinguishing such organizations from others (Di Vincenzo & Mascia, 2017). Literature suggests that health care workers are high-status professionals with power and autonomy, and that these characteristics need to be balanced and integrated in organizational processes and routines used to regulate the goals and activities of the collective (Freidson 2001). In addition, their capability of dealing with complex problems effectively often requires a re-combination of their own knowledge with that of colleagues working in the same organization (Agneessens & Wittek 2012). Finally, the presence of strong professional boundaries can contribute to the formation and shape of professional networks (Currie & White 2012) which may impact on organizational features (Mascia et al., 2015). Specifically, social and cognitive boundaries delineate differences among categories in terms of professional norms, which in turn can delay or prevent the spread of innovation among professionals belonging to different occupations (Ferlie et al., 2005). Despite the presence of these abundant and well-established strands of research, we have found some research gaps that still need to be addressed in depth. Firstly, prior research focusing on the impact of professional networks on individual IWB have been grounded mainly in single organizational settings and have been based on data on individuals physically proximate. Instead, there is a shortage of studies analyzing how innovative behavior can be spread through professional networks when people are physically distant. Secondly, previous studies have mainly analyzed the relationship between IWB and professional peers' networks or between professionals affiliated to different professional communities (such as, physicians and nurses). On the other hand, there is a surprising lack of studies on the effects of professional relationships between physicians working within different healthcare settings, such as the hospital and primary care. Particularly lacking is, therefore, an understanding of whether the individual propensity toward IWB is associated to professional ties that a primary care physician has established with his or her hospital colleagues. The present study aims to fill these gaps in the literature.

2. THEORETICAL DEVELOPMENT AND HYPOTHESES DEVELOPMENT

Advice networks have been defined as “*comprised of relations through which individuals share resources such as information, assistance and guidance*” (Sparrowe et al. 2001, p. 317). In the health care industry, advice networks are of utmost importance for the diffusion of innovation process and social influence (Mascia & Cicchetti, 2011). In a professional network, individuals or clusters (or cliques) of individuals are linked, creating a system of interdependent social exchanges characterized by a trusted exchange among partners through which they have access to resources and support (Burt, 1992). In health care, advice networks play a crucial role also in transferring skills, abilities, information, and knowledge (Dopson et al., 2002). Recent research has documented an increasing importance recognized to professional relationships in explaining innovative behaviors undertaken by physicians, such as the adoption of guidelines or implementation of Evidence Based Medicine (EBM) into their daily clinical practice (Dopson & Fitzgerald, 2005; Dopson et al., 2002). Professional advice networks allow physicians to select and interpret useful and relevant information from the ever-increasing number of information sources (Coleman et al., 1966), and may provide a means for interpreting scientific findings and innovations that are particularly complex, controversial, or ambiguous (Wood et al., 1998).

The propensity to create professional advice relationships is strongly driven by homophily, that is the preference of individuals to choose others who are similar to

themselves as partners (Mascia et al., 2015). Advice relationships, and the related benefits derived from exploiting others' knowledge, therefore, are more likely to be observed between peers who belong to the same professional categories. The larger the network of similar colleagues with whom a focal physician exchanges advice, the greater the likelihood of developing greater aptitude for adopting and implementing innovative practices in patient care in the workplace. More formally:

HP1: The more the physicians are central in the advice network occurred with peers, the more they are likely to adopt an innovative behavior.

The literature mentioned above can be fruitfully applied to study advice networks amongst physicians across levels of care and its impact on IWB. It is well known that hospital physicians have a higher propensity to IWB since the production and utilization of scientific evidence is, in general, more likely to occur within hospital settings, as they are the main entry point for any innovation (Berta & Baker, 2004).

There are several reasons explaining why hospital physicians exhibit a higher level of IWB compared to primary care colleagues. First, hospital physicians are often directly involved in clinical trials, managing clinical cases enrolled for studies (Shuval et al., 2010). Second, accountable care has changed organizational models adopted by health care organizations and the way hospital physicians conduct their practice. Specifically, new arrangements have been adopted to increase team working amongst physicians with the aim to increase EBM use, the production of new clinical protocols and the implementation of clinical pathways (Suckett et al., 1996). Third, hospitals are often institutionally mandated to produce and adopt new clinical knowledge. In teaching and research-oriented hospitals such as university polyclinics, the production and implementation of new clinical knowledge are main goals for physicians (McFadyen & Cannella, 2004).

In light of this, we assume that being connected with colleagues affiliated to hospital settings exposes the focal physician to a greater likelihood of applying innovative practices to the clinical cases he encounters on a daily basis. More formally:

HP2: The more the physicians are connected with colleagues employed in hospital settings, the more they are likely to adopt an innovative behavior.

Management literature largely discusses the amount of benefits and resources exchanged within and across different networks as well as the ability of individuals to recombine different knowledge and absorb it effectively (Tortoriello & Krackhardt, 2010). Dense and embedded networks may exhibit increasing information redundancy, which, in turn, may negatively impact on the access to external resources. In the case of advice networks among peers, individuals are mediated in their system of beliefs and values as far as they are exposed to a very homogeneous social capital. In this way, the knowledge acquired through social channels accessed through the contact with others who are heterogeneous in terms of knowledge, specialties, or organizational settings, may be more difficult to interpret and use.

In a recent paper, Tortoriello et al. (2015) underlined how the external diversity occurring in the case of heterogeneous relationships requires internal diversity to be absorbed and integrated. In a healthcare context, typically characterized by heterogeneous professional skills, this situation is likely to occur. In regard of primary care physicians, the high volume of relationships exchanged between peers may result in a limited possibility of absorbing knowledge and practices from the hospital context. Specifically, the positive

effects individuals are exposed to when linked to hospital colleagues is reduced when primary physicians pertain to an extremely dense and connected system of relations with peers. These homophilous linkages make hospital contacts less credible and the access of different knowledge more difficult to occur. More formally this moderation effect has been formulated as follows:

HP3: Physicians' prominence in the advice network with peers moderates the effect of the network occurred among hospital colleagues on their propensity to adopt an innovative behavior.

3. RESEARCH DESIGN

3.1 STUDY SETTING

To explore the impact of professional networks' structure on innovative work behavior an empirical study was conducted. We collected primary data from 181 pediatricians working in 7 different Local Health Authorities (LHAs) located in 4 different Italian regions in the north, center and south of Italy. The 7 LHAs are quite different in demographic and organizational characteristics, as well as in patterns of resources allocation between primary and secondary care.

The I-NHS is a publicly funded universalistic health system that provides universal coverage through a single payer. It allocates resources to 21 regions in Italy through approximately 200 LHAs that are responsible for providing community health care services. The I-NHS represents an ideal setting to explore our research question since two distinct classes of pediatricians exist in Italy: (i) primary care pediatricians distributed on the territory and (ii) hospital pediatricians who are employed within acute care settings. The I-NHS requires that people have an identified primary care physician, either a pediatrician or a family practitioner, depending on the patient's age. Under the control of LHAs, I-NHS pediatricians may care for a maximum of 1000 pupils up to 14 years old and are compensated by capitation. Pediatricians are scattered throughout the territory running single-handed ambulatories and are thus physically and organizationally isolated. Pediatricians represent the first point of contact for most common health problems, providing acute, chronic, and preventive care, through both office and home visits. However, despite acting as gatekeepers for the prescription of drugs as well as for access to specialty and hospital care, they are legally not allowed to take care of their patients during hospital admissions, who assume the responsibility of them and can act independently.

3.2 DATA COLLECTION

A survey questionnaire was made available on-line for all sampled pediatricians for the period December 2009–December 2010. The questionnaire was initially tested through several interviews conducted with five sampled pediatricians and several hospital physicians. This allowed us to identify those diseases having the greatest impact on the pediatric population, in the specific research setting at hand. In line with what reported by the World Health Organization (WHO, 2005), they indicated gastrointestinal disorders as one the most common diseases. Thus, we decided to focus our analyses on such condition.

In total we collected 181 usable responses (80% of overall response rate). Differences in response rates across the seven LHA are also low, thus providing no concerns of

comparability. Eventually, social network analysis literature has demonstrated that centrality measures (such as the Outdegree and Indegree used in this paper) are robust even in the presence of a high percentage of missing values (Borgatti et al., 2006), thus attenuating any problems relating to this issue in the present study.

The questionnaire was structured in three different sections. The first section was focused on collecting attributional data – used as control variables – concerning information on the respondent such as, for example, LHA membership, number of subscriptions and ability to access to scientific journals, etc. The second section was focused on collecting the relational variables concerning the exchange of knowledge and advice networks among pediatricians and between pediatricians and hospitals physicians. Finally, the third section was designed to capture the propensity of physicians to use EBM. All the data collected was transferred into a single database containing variables and attributive data concerning relations for the exchange of knowledge among physicians.

3.3 VARIABLES

Dependent variable. The dependent variable, named Innovative Work Behavior, was computed as the physicians' self-reported propensity to use EBM in their clinical practice. The survey questionnaire was constructed based on prior studies and used a validated single-item measure (de Jong & den Hartog, 2010; Mascia & Cicchetti, 2011; Kessel et al., 2012), by asking physicians to answer: "How often did you use scientific evidences published in peer-reviewed biomedical journals or clinical guidelines in your practice of medicine for patients affected by specific pathologies over the last year?" This measure captured the pediatricians' self-reported frequency of EBM utilization with responses on a five-point scale ranging from 1 (never) to 5 (very frequently). More specifically, we asked this question regarding the clinical condition under investigation, namely Gastroenteric disease. Such dependent variable was obtained and used in the empirical analysis.

Exploratory variables. The exploratory variables enrolled in our models comprises a set of network centrality measures able to appreciate the advice network of primary care physicians with colleagues working both in primary care and in hospital settings. In the sociometric questionnaire we asked physicians to self-report the name of peers with whom he or she is used to share clinical opinions and or ask for advice regarding his or her clinical cases in the selected clinical condition. Moreover, we computed the number of hospital colleagues with whom the focal physician reported connections. From this information, we derived a number of matrices to compute the values of these relational variables then performed through the software UCINET 6 (Borgatti et al., 2002). Both Indegree (incoming ties of a node) and Outdegree (outgoing ties of a node) centrality measures were obtained with regard to pediatricians' advice network among peers and with colleagues affiliated to hospital settings. In order to test our Hypothesis HP3, in the model we also include an interaction term between Indegree Centrality among paediatricians and Outdegree paediatricians-Hospital.

Control variables. Further individual characteristics were finally included in our model. First, we considered pediatricians' professional tenure, which is computed as a categorical variable assuming the following value: "1= until 10 years"; "2=from 10 to 19 years"; "3= \geq 20 years". Second, we consider pediatrician's gender as a dummy variable assuming the value of 1 if the pediatrician was female, and 0 otherwise. Third, we considered regional affiliation of physicians by a categorical variable ranging from 1 to 4. Finally, since the increasing interest from policy makers toward the creation of primary care organizations and group practices, we included a dummy variable indicating

pediatricians' affiliation to any associative form, assuming the value of 1 if they belong to any and the value of 0 otherwise.

4. ANALYSIS AND RESULTS

Since of dependent variable was ordinal, we regress our dependent variable via ordered logistic regression using SPSS 20 statistical package. Table 1 presents descriptive statistics and correlation coefficients for all the variables enrolled in our analysis.

	Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8
1	Paediatricians' IWB	2.96	1.13	1	5								
2	Indegree centrality (peers) - normalized	3.79	5.13	0	28.57	0.42**							
3	Outdegree centrality (peers) - normalized	4.16	5.70	0	33.33	0.30**	0.68**						
4	Outdegree centrality (hospital) - normalized	7.71	4.63	0	27.78	0.03	-0.04	0.00					
5	Associative organizational form	0.73	0.45	0	1	-0.05	0.03	0.01	0.00				
6	Tenure (years of experience)	2.60	0.61	0	1	-0.05	-0.03	0.03	-0.01	0.27**			
7	Region	0.38	1.34	1	4	-0.09	0.03	0.09	-0.08	0.07	0.15*		
8	Gender	0.66	0.48	0	1	0.02	-0.07	-0.12	-0.03	-0.08	-0.18*	-0.18*	
9	Indegree centrality (peers) * Outdegree centrality (hospital) - normalized	27.76	47.03	0	380.94	0.31**	0.79**	0.49**	0.33**	-0.05	-0.10	-0.10	0.01

Notes: ** significance level $p \leq 0.00$; * significance level $p \leq 0.05$.

Table 1. Descriptive statistics and pairwise correlations

Table 2 reports the results from the Order Logistic Regression Model. Our findings document significantly the role of advice networks in predicting pediatricians' innovative behaviors. In particular, a higher value of indegree centrality results as associated to a higher propensity of pediatricians' to be innovative in their work behavior (OR: 0.274). In other words, our findings display that the more the pediatricians are central in the advice network occurred with peers, the more they are likely to adopt an innovative behavior. Regression Models also document a positive and significant impact of Outdegree centrality on IWB (OR: 0.097).

Variable	Coefficients	Clustered robust standard error
Indegree centrality (peers) - normalized	0.274***	(0.098)
Outdegree centrality (peers) - normalized	-0.011	(0.040)
Outdegree centrality (hospital) - normalized	0.097**	(0.044)
Associative organizational form		
No	0.182	(0.378)
Yes (omitted)	-	
Tenure (years of experience)		
1 = until 10 years	0.483	(0.666)
2 =10-19 years	0.144	(0.372)
3 = \geq 20 years (omitted)	-	
Region		
Region 1	0.617	(0.417)
Region 2	1.325	(0.893)
Region 3	1.168**	(0.553)

Region 4 (omitted)	-	
Gender		
Male	-0.120	(0.346)
Female (omitted)	-	
Indegree centrality (peers) * Outdegree centrality (hospital) - normalized	-0.015*	(0.008)
1 st cutpoint OL	-0.287	(0.523)
2 st cutpoint OL	0.913	(0.512)
3 st cutpoint OL	2.990	(0.567)
4 st cutpoint OL	4.929	(0.676)
Regression Diagnostics		
N of observations	142	
-2 Log-pseudolikelihood	361.273	
Prob > χ^2	47.764	
Pseudo R ² (Nagelkerke)	0.301	
*p < 0.1. **p < 0.05. ***p < 0.01.		

Table 2. Ordered logistic regression predicting paediatricians' IWB

Moreover, a negative and significant effect was observed in the interaction term (OR: -0.015), which seems to indicate that the higher is the level of connection with peers, the lower is the effect of hospital physicians in determining the focal paediatrician's propensity to be innovative. Such result is highlighted by the interaction plot reported in Figure 1.

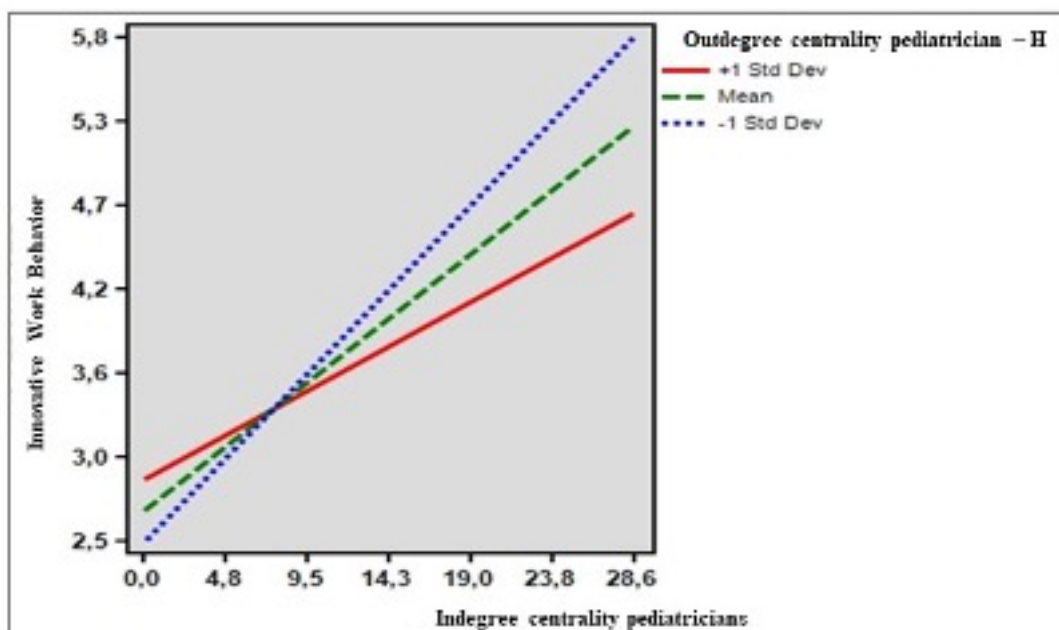


Figure 1. Interaction plot Indegree centrality (peers) * Outdegree centrality (hospital)

Finally, we provide evidence of some geographical effect in predicting the propensity of paediatricians to use EBM tools.

5. DISCUSSION

Nowadays in health care settings scientific knowledge and related innovation are crucial aspects for the effectiveness of clinical treatments. It therefore becomes dramatically important to understand how health professionals' access, use and disseminate the best and most innovative medical knowledge.

The present study contributes to fill a research gap in the exploration on how professional networks impact on IWB in the health care context, especially as concerns the processes of influence and social contagion that occur when professionals are physically distant from each other and/or when they maintain advice relationships with colleagues engaged in different health care settings (Dopson et al., 2002; Mascia & Cicchetti, 2011; Mascia et al., 2015).

The results of our empirical analysis document significantly the role of advice networks in predicting pediatricians' innovative behaviors. In particular, a higher value of indegree centrality results as associated to a higher propensity of pediatricians' to be innovative in their work behavior. These findings display that the more the pediatricians are central in the advice network occurred with peers, the more they are likely to adopt an innovative behavior. This can be explained in the light of how the sense of belonging emerged by being part of the same community facilitate knowledge sharing between peers and social capital formation, affecting consequently on the innovative behavior of individuals (Carnabuci & Diószegi, 2015; Iacopino et al., 2018).

The results also show as being connected with colleagues affiliated to hospital settings exposes the focal physician to a greater likelihood of applying innovative practices to the clinical cases he encounters on a daily basis. This result is relevant especially in light of the different propensities to adopt IWB that prior research has documented in these two different health settings (Berta & Baker, 2004; Shuval et al., 2010). The contribution of this study, therefore, is that connection with colleagues employed in hospital setting involves a positive "contagion" effect with reference to their innovative behavior.

Finally, this study analyzed the interaction between these two typologies of professional networks, i.e. advice networks between colleagues from the same or different health care settings. The results show that the most positive effects on the IWB are obtained when these two networks are balanced with each other. This contributes to an interesting line of research which argues that external diversity often also requires a certain degree of internal diversity to be absorbed (Tortoriello et al., 2015; Tortoriello & Krackhardt, 2010). This study has a number of implications for managers and policy makers. In recent years, policy makers have encouraged and supported collaborative arrangements among primary care physicians. Our results suggest that dense relationships between homogenous physicians may produce some kind of redundancy and can be reflected in an attenuation of opportunities for innovations that derive from outside (i.e. from hospital settings), ultimately hampering IWB. Policy makers may consider of supporting advice and knowledge exchange between physicians working at different levels of care.

The present study has a number of limitations that need to be taken into account when interpreting its results. First, although the present study was developed in a large and heterogeneous sample, the generalizability of the results to other health contexts still remains limited. Second, a more detailed analysis is needed distinguishing the request of advice among physicians in the different phases in the process of patient care (diagnostic, therapeutic or control), as this would shed light on the reasons why they seek advice from colleagues. Third, we did not consider the frequency of connectedness of pediatricians with their colleagues working within hospitals. Fourth, as with most network research, this was a cross-sectional study that prohibited us from determining causality among the

variables of our models. Finally, we acknowledge the possibility that some of the reported relationship in the research model may be inflated due to common method bias, which occurs – as in the present study – when all data are collected in a cross-sectional survey and the same respondents are used to collect information on the independent and dependent variables. We highlight, however, that our approach is consistent with that adopted in previous research.

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