Inter-physician interaction across levels of care and EBM adoption in pediatric care

Abstract

Physicians around the globe are increasingly encouraged to adopt guidelines, protocols and other scientific material when making clinical decisions. Extant research suggests that the clinicians' propensity to scientifically ground their practice, an approach called evidence-based medicine (EBM), is strongly associated with the professional collaborative networks they establish and maintain with peers. But how do professional networks across levels of care influence the frequency with which physicians adopt EBM? In this paper we explore whether and how the connectedness of primary care physicians with colleagues working in hospital settings is related to their frequency of EBM adoption in clinical practice. We used survey data from 120 pediatricians working in six different local health authorities (LHAs) in the Italian NHS. Social network and attribute data concerning single physicians were collected, as well as their self-reported frequency of EBM adoption. Professional networks and EBM adoption were studied for three major pathologies in pediatric care: asthmatic, gastro-enteric and urinary pathologies. Network measures were used to capture the degree of connectivity that physicians exhibited with hospital colleagues. Ordinal regression analysis was employed to test the association between the territorial pediatricians' connectedness with their hospital colleagues and the reported frequency with which they use EBM. Our findings documented that there is a positive association between the number of relationships with hospital colleagues and the frequency of use EBM in all the pathologies investigated. Results also indicated that a number of contingencies reflecting the different organizational contexts to which physicians are affiliated to influence the frequency with which pediatricians use EBM. Contrary to our expectations, it was found that clinicians' affiliation to formal collaborative arrangements is at odds with the likelihood of reporting higher frequency of EBM use.

1. Introduction

Modern medicine is innovating at an increasingly faster rate, and it is impossible for health professionals to constantly monitor and understand all of the relevant information in any domain. Seeking clinical information, and in particular seeking information about Evidence Based Medicine (EBM), is a daunting task especially as far as physicians are concerned. There are at least three reasons for that.

Firstly, there is too much information to scan. Heathfield and Louw (1999) estimated that medical knowledge increases fourfold during the professional lifetime of a physician. The superabundance of medical knowledge production makes it impossible for any doctor to remain thoroughly updated.

Secondly, due to population aging trends, today's health needs are increasingly complex, because of the spread of co-morbidities. Medicine and the medical education, at the opposite, are increasingly specialized, thus requiring a higher need of a difficult integration (Nicolini et al., 2008). The time when health professional bureaucracies (Mintzberg, 1979) could be coordinated just through standardized capabilities has ended. In 2001, Mintzberg himself (with Glouberman) reshaped his model by considering that a doctor's work cannot be just a question of pigeonholing – placing the case in a category and thus depersonalizing the patient ("*the heart in Room 5*"). Only mutual adaptation could cope with the unpredictable problems that arise in healthcare, the authors pointed out. This implies that healthcare needs also peer collaboration, informal communication, teamwork, other than the integration of different capabilities (p. 75). Physicians need to exchange information among them, but to what extent do they do that?

Thirdly, it is increasingly difficult to standardize a care path through some clinical guidelines. Every patient has a clinical history that must be taken into account. Treating patients therefore would mostly require what Wenger (2000) named situated intelligence: the

ability to match the cognition processes with the contextual situation. According to Morris (1999), only 10-20% of the cases encountered by a typical doctor can be handled by having recourse only to theory. For all the other cases, the doctor must rely on his/her (or others') practical experience and not on scientific knowledge.

As a results, EBM is not widely adopted in clinical practices. For instance, in pediatric care, Flores, Lee, Bauchner, & Kastner (2000) found that practice guidelines are used by 35% of pediatricians, in part by 44%, and not at all by 21%. The consequences of the unmet information needs of doctors are unbearable. According to the World Health Organization (2005), seven million children die every year of preventable deaths. The "know-do gap", that is the inability to translate clinical research results to patient bed treatments, costs too much in human and social terms.

A recent stream of research focuses on the role of social relationships in satisfying physician's clinical information needs (Dopson et al., 2002; Gabbay e le May, 2004; Dopson & Fitzgerald, 2005; Keating et al. 2007; Boyer et al., 2010). Social relationships are in general considered to play a pivotal role in influencing healthcare professionals' information seeking and learning behavior (e.g., Fattore et al., 2009; Mascia & Cicchetti, 2011).

The general understanding of this literature is that social relationships are used by clinicians in combination or even *in substitution* of evidence-based information sources, such as clinical guidelines and Cochrane Collaboration Reviews. Rarely physicians seek clinical information through formal sources; on the contrary, for the most part they rely on their colleagues' experience (Sargeant et al., 2010). Personal contacts among colleagues are the main enablers of knowledge exchange (Dopson et al., 2002) and source of learning (Sargeant et al., 2010). Physicians ask for advice especially for reducing uncertainty in the diagnostic phase and for selecting the right treatment (Salvatore, 2006). In an ethnographic study, Gabbay and LeMay (2004) confirmed that, rather than on guidelines, physicians largely rely

on *mindlines,* i.e. internalized and tacit guidelines developed on the basis of experience by clinicians.

Another point of view is that social relationships actually *strengthen* the adoption of EBM guidelines. Colleagues act as supporters in the implementation of EBM. Chou, Vaughn, McCoy, & Doebbeling (2011) have documented that GPs adherence to evidence-based guidelines is higher when they have more opportunities to discuss and share protocols, for example, when they are located in the same ambulatory facility. In other words, collaboration through team working increases the likelihood of adopting EBM.

Despite the generalized acceptance of the importance that inter-physician relationships play for information seeking behaviors, there is still a dearth of study exploring the role of collaborative relationships across different healthcare sectors. Particularly lacking is an understanding of whether the individual propensity towards EBM is correlated with professional ties that a primary care clinician has established with his or her hospital colleagues. This topic is important in light of the different propensity to use EBM that prior research has documented in these two different health settings (Shuval et al., 2010).

This paper intends to fill this gap by responding to the following question: Is there an association between the social relationships for clinical information seeking that primary care physicians maintain with hospital colleagues and the frequency with which they adopt EBM in their practice?

2. Theoretical Background

The influence of social relationships in EBM implementation may be explained by different network-based theoretical mechanisms: Rogers' (2003) diffusion of innovation model, social influence theory (Coleman et al. 1966; Valente, 1995; Valente & Rogers, 1995;

Valente & Davis, 1999), Granovetter's (1973) strength of weak ties, and social contagion theory (Christakis & Fowler, 2012).

Rogers' (2003) model of diffusion of innovation included these main elements: (i) the features of the innovation affect the adoption rate; (ii) innovations spread over time according to a S-shaped curve: first among innovators and early adopters, then among late adopters; (iii) there are 5 stages in the adoption process: knowledge, persuasion, decision, implementation, and confirmation; (iv) individuals may modify innovations or give up using them.

The social influence theory is a derivation of Rogers' model and argues that when those people who are the most integrated (or "central") in a community adopt an innovation then its diffusion accelerates (Valente, 2010: pp. 180). These opinion leaders have the fundamental role of translating the innovation for the rest of the community. Opinion leaders usually get to know innovations earlier than others because they are the most connected people in the community. The first study that reported the importance of opinion leaders in the diffusion of innovation in healthcare was made by Coleman et al. (1966). They studied the diffusion of new drugs among physicians and found that doctors who received three or more nominations as communication partners were more likely to adopt the new drug earlier. This study is the first to recognize the importance of interpersonal networks in the adoption process.

The strength of weak ties theory (Granovetter, 1973) argues that since networks tend to be formed of close cliques of friends only few people are open to connect to different groups. These out-group (weak) ties are particularly important for the group because they are more likely to be conducive of novel information. Strong connections among the members of the same group, in fact, are likely to spread the same old information. Only the ties with some external groups may pass novel information for the group.

However, as Valente (2010) highlighted, the theory does not necessarily implies that weak ties are conducive of innovations. Actually behavioral change is more likely to happen through strong ties rather than weak ones. More recent studies on the impacts of the diversity of social ties (Jehn, Northcraft & Neale, 1999; Reagans & Zuckerman, 2001) found that social networks are especially beneficial in terms of creativity, new ideas and innovation when they link individuals who are heterogeneous in terms of background, ethnicity, and other personal characteristics.

The last theory, social contagion, has two mechanisms in place. Contagion by cohesion implies that "the attitudes and behaviors of the others to whom they are directly connected influence network members"; contagion by structural equivalence states as "others who have similar structural patterns of relationships within the network influence people" (Monge & Contractor, 2003: pp. 174-5).

Contagion by cohesion explains the degree of similar behavior within a group (West et al., 1999; Christakis & Fowler, 2012). Network density is a measure of cohesion that can be correlated with the similarity of behavior. As they report in this review article, Christakis and Fowler (2012) since 2007 have successfully used social contagion theory to explain the spread of different health behaviors and life styles: obesity, smoking, alcohol consumption, health screening, happiness, loneliness, depression, sleep, drug use, divorce, cooperative behavior, influenza, sexuality and sexual orientation, as well as tastes in music, books, and movies.

Contagion by structural equivalence was applied in healthcare by Burt (1987), who reanalyzed Coleman et al. (1966) data achieving different results: doctors are more influenced by those colleagues who are connected to the same others. The rationale is that individuals copy the behavior of people who have a similar role in their social structure because otherwise they may be replaced by them. They cannot to afford the embarrassment

of being “the last to espouse a belief or practice that has become a recognized feature of (those) occupying his status” (Burt, 1987).

Many of the lessons from the above literature review can be fruitfully applied to study collaborative interaction amongst pediatricians across levels of care and its impact on the frequency with which them use EBM. Since connections between hospital and primary care sectors may be considered weak, whether the diffusion of new practices and behaviors relies on Granovetter’s strength of weak ties, on the theory of social contagion by density, as well as on opinion leaders theory can be explored.

Hospital pediatricians have a higher propensity to use EBM since the production and utilization of scientific material is, in general, more likely in hospital settings (Berta & Baker, 2004). There are several reasons explaining why hospital physicians exhibit a higher level of EBM adoption than what their primary care colleagues usually do. First, hospital physicians are often directly involved in clinical trials, assisting clinical cases that are enrolled for studies. Second, in many western European countries a number of public reforms have changed the internal organization of hospitals and the way hospital physicians conduce their practice. Some important examples on what concern new organizational arrangements are the clinical directorates, implemented in countries such as the UK, Italy or Australia. In these countries such new arrangements have been adopted in order to increase team working amongst physicians staffed in the same department, with the aim to increase EBM adoption and the production of new clinical protocols and pathways (e.g., Lega, 2008). The introduction of clinical governance tools such as medical audit, risk management etc. has also represented a significant variation in the way physicians behave and perform within hospitals, reorienting their activities towards EBM (Scally & Donaldson, 1998). Finally, hospitals are often institutionally mandated to produce new clinical knowledge. In teaching and research-oriented hospitals such as, for example, university policlinics, the production of new clinical

knowledge is one of the main objectives of physicians (e.g., McFayden & Cannella, 2004). In this context, the acquisition of knowledge already available is an important prerequisite for knowledge production.

Primary care pediatricians have been shown to be less prone to adopt EBM (e.g., Fabiano et al., 2012). This happens because new knowledge regarding recommended care, in general, seems to be less "usable" by primary care physicians because of the difficulties they face in adopting new available evidence to individual cases (Mickan & Askew, 2006; Caldéron et al., 2011). Primary care physicians, in addition, often neglect to appraise evidence appropriately because of their lack of knowledge in clinical epidemiology and biostatistics (Shuval et al., 2010). Finally, the possibility for physicians to scientifically ground their clinical decisions are likely affected by the level of evidence for practice (Tucker, Nembhard & Edmondson, 2007), which seems much higher in technology-intensive organizations such as hospitals rather than in primary care settings.

Although there are several ways through which physicians learn and acquire competencies along their career, accessing the experience of other colleagues is one of the main sources of learning for them. In a study conducted on 142 high-scoring family doctors, Sargeant et al. (2006) documented that informal learning through medical colleagues appeared to be fundamental source of learning. Especially valuable to their maintaining professional competence was the collaboration they establish with hospital peers, who in turn appear capable, respectful and informed about the activities that family physicians perform on the territory. Although informal, this learning from work experiences appears to be largely intentional.

In light of the above discussion, we assume that family pediatricians who are more connected to hospital pediatricians are more exposed to EBM adoption behaviors and hence more likely to adopt EBM frequently.

3. Materials and Methods

3.1 Research Setting

To explore the impact of the structure of the professional networks on the use of EBM guidelines an empirical study was conducted. We collected data from 120 pediatricians working in seven different local health authorities (LHAs) in the Italian National Health Service (I-NHS). 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 national government is responsible for defining the core benefit packages and ensuring that basic coverage is provided to the entire population, whereas each region is almost entirely responsible for the organization and delivery of health care services (Lo Scalzo et al., 2009).

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 up to a maximum of 1000 children up to 14 years old and are compensated by capitation. Pediatricians are scattered throughout the territory running single-handed ambulatories, thus being 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 (Del Torso et al., 1997). However, despite they act as gatekeepers for the prescription of drugs as well as for access to specialty and hospital care, pediatricians are not allowed by law to take care of their patients during hospital admissions. The latter are under the responsibility of the sole hospital physicians, who can decide for themselves what care should be delivered.

Given the great importance of knowledge and information exchange between the physicians working in the two different levels of care, some Italian Regions recently placed

particular emphasis on promoting formal clinical pathways for patient referrals and a closer integration between primary and secondary care (Lo Scalzo et al., 2009).

In addition, in the last few years health policymakers have promoted the creation of primary care organizations grouping together pediatricians among them and with primary care specialists. The 2005 national GP contract included new organizational solutions respectively named associations, networks, and group practice. *Associations* consist of sets of pediatricians coordinating opening hours from Monday to Friday up to 7 p.m., implementing clinical-diagnostic guidelines for the most prevalent diseases, and holding regular meetings to review the quality of the activities and to promote the adoption of common prescriptive behaviors. The *network* form implies, in addition to the association features, sharing the electronic patient records, a network connection of the ambulatories, and access to the Local Health Trust system for the reservation of laboratory test and specialty visits. *Group practice* implies, in addition to the network features, working in the same facility and sharing administrative and clinical staff (Fantini et al., 2012).

The main goal of these organizational forms is to foster EBM diffusion, collaboration and knowledge exchange between physicians, as well as between physicians and other professionals, and simultaneously to obtain an integration of services leading to reduction in costs, economies of scale and sharing of spaces and technological equipment (Damiani et al., 2007; Fantini et al., 2012).

It is still unclear wheatear these goals have been achieved or not. As for EBM adherence, Fantini, Compagni, Rucci, Mimmi & Longo (2012) have recently found that "organizational models are significantly associated with better adherence to evidence-based guidelines for diabetes management. In contrast, for stroke, heart failure, and post-AMI, the impact of the organizational model appeared to be rather weak or limited to one or two indicators" (pg. 74).

The setting of our study is represented by seven LHAs belonging to four different Italian regions located respectively in the north (1 LHA for Veneto and 1 for Emilia Romagna) and central-southern Italy (1 LHA for Lazio and 4 LHAs for Abruzzo). The seven LHAs are quite different for demographic and organizational characteristics, as well as for patterns of resources allocation between primary and secondary care. On what concerns resources availability, the main difference is in the fact that the two regions of central-southern Italy are currently under bail-out plan given to a cumulative deficit in the public health expenditures from 2001 to 2010. The plan, under resources constraint, imposed the development of formal regional turnaround plans containing actions to address the structural determinants of costs (Ferrè et al., 2012). On the contrary, the regions placed in the north of Italy are in a favorable financial balance, and currently have resources to be used for organizational innovation in primary care as well as for investments in technology and clinical pathways development. We believe that this may increase the value of the results of this study showing whether there are differences in the behavior of pediatricians working in regions with a different degree of resource availability.

Table 1 around here

As for demographic and structural characteristics, Table 1 provides a brief description of the surveyed LHAs. Differences in this case are related to the geographic dimension (in terms of square kilometers) and the population residing in each LHA. The heterogeneous of LHAs comprised in our study may be useful to provide some "external validity" of the research results (Van de Ven, 2007). In addition, with reference to the phenomenon of EBM

adoption, the different contexts allow us to isolate the different relational dynamics occurring between hospital and territorial structures, and between the territorial structures themselves.

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 preliminary tested through a number of interviews conducted with five sampled pediatricians and several hospital physicians. This allowed us to identify those diseases having the greatest impact for children in the pediatric age in the specific research setting at hand. In line with what reported from the World Health Organization (WHO, 2005), they indicated asthma, gastrointestinal disorders, and urinary tract infections as the most common diseases. Thus, we decided to focus our analyses on these three kinds of illnesses.

Data collection was made possible thanks to the collaboration a wide range of actors: CEOs, medical directors, and representatives of pediatricians' unions of each LHA. The response-rate of the questionnaire was as follows: LHA1 89%, LHA2 25%, LHA3 65%, LHA4 57%, LHA5 36%, LHA6 12%, LHA7 46%. The overall response-rate, considering the different number of pediatricians within each LHA, was 44%. This result can be considered satisfactory given the difficulty in collecting data among physicians working in heterogeneous and widely distributed areas. We know that the differences in response rate in the seven LHA could create a bias in the results, especially as far as social network measures are concerned. However, social network analysis literature has demonstrated that centrality measures (such as the *indegree* used in this paper) are robust even in the presence of a high percentage of missing values (Costen-Bader & Valente, 2003; Borgatti, Carley, & Krackhardt, 2006), thus attenuating any issues relating to this issue in the present study.

The questionnaire was structured in three different sections. Following previous literature (Mascia & Cicchetti, 2011), the first section was focused on collecting attributive data – used as control variables – concerning information on the respondent such as, for example, tenure, 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 between pediatricians and hospitals physicians. These variables, used as independent variables in the econometric model, aimed to reconstruct the social networks between pediatricians at territorial and hospital level. A number of matrices were prepared in order to compute the values of the relational variables, which was then performed through the software UCINET 6 (Borgatti et al., 2002). The third section was designed to capture the propensity of physicians to adopt EBM. All the data collected were 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 following item was adapted from previous studies assessing the frequency of EBM adoption (McColl, Smith, White & Field, 1998; Shortell et al., 2001; Mascia & Cicchetti, 2011; Mascia et al., 2011) and then inserted into the survey questionnaire submitted to physicians: "*How often did you use scientific evidences published in peer-reviewed biomedical journals in your practice of medicine for patients affected by the following 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 frequent*). We asked three different questions regarding the three distinct pathologies under investigation, namely the Asthmatic, Gastro-enteric and Urinary diseases. Three dependent variables were obtained and used in the empirical analysis.

Independent variable: The main explanatory variable of the present study is the degree of collaboration that primary care physicians exhibit with colleagues working within hospitals. Several items were designed and inserted into the sociometric questionnaire asking to pediatricians: "*Do you have ongoing collaborative professional relationships with hospital pediatricians regarding the discussion of clinical cases, specific problems or any other issues related to your practice of medicine?*" "*If yes, could you please specify the name of these colleagues and that of their hospital to which they are affiliated to?*". Because collaborating colleagues are likely to be different according to the particular disease treated or type of problem encountered, a set of different questions was specified for the three pathologies considered. We counted the number of hospital colleagues to whom surveyed physicians reported to be connected to, thus obtaining a measure that in network terms is called *Degree Centrality.* In general centrality measures are employed to capture the importance of single nodes that compose a network (Wasserman and Faust, 1994). Degree Centrality is a particular centrality indicator defined as the number of relations incident upon an actor of the network, i.e. the number of direct ties that an actor has. The use of this particular centrality measure seems particularly appropriate in the present context. In general, the extent of an actor's access to resources is related to the number of ties she or he establishes and maintains with others. Especially relevant for gathering access to intangible and knowledge-based are the *direct* relationships that the actor has with colleagues (Burt, 2007). Because our intention was to explore the association between primary care physicians' connectedness with hospital colleagues and contagious effects in terms of EBM adoption, the centrality indicator employed is well-suited in the present context because of its ability to capture the degree of physicians' direct exposure to information, knowledge and habits adopted by colleagues working in a different context of care.

Control Variables: Other factors that may influence the self-reported frequency of EBM use into clinical practice were controlled for. Taking into account previous studies on EBM adoption (among others, Coleman et al., 1966; Mascia & Cicchetti, 2001), several individual characteristics of physicians were considered. *Gender* is a variable assuming the value of 1 if the pediatrician was female, and 0 otherwise. The years of previous experience accumulated by pediatricians within the NHS were also considered through a set of dummy variables, labeled *Tenure NHS,* which considered whether the years accumulated fall into one of the following classes: "< 10 years", "10-19 years" and "≥ 20 years". The first dummy was considered as baseline category into the regression models. Because the frequency with which EBM is adopted is likely affected by the number of patients under treatment by physicians, we also included a set of dummy variables considering whether the number of patients assisted by sampled clinicians falls into one of the four following classes: "≤ 30 patients", "31-60 patients", "61-90 patients" and ">90 patients". Because this variable was referred to the specific pathologies investigated, we obtained a distinct set of binary variables for the Asthmatic, Gastro-enteric and Urinary diseases. Again, the first dummy was considered as baseline category into the regression models. Consistent with previous studies, three additional variables were entered into the model. A first continuous variable, labeled *Number of article subscriptions,* captured the physician's scientific orientation taking into consideration their number of subscriptions to scientific journals (Coleman et al., 1966). The second is a binary variable called *Availability of Information* that was built to capture the difficulties in accessing EBM as perceived by physicians (Mascia & Cicchetti, 2011). A specific item of the questionnaire survey asked: "During day activities of your work, do you usually encounter obstacles in obtaining and accessing to information, guidelines and EBM?". The variable assumes the value 1 if the pediatricians' answered "yes" to the former question, and 0 otherwise. A third binary was included to capture the difficulty in

contextualizing the healthcare research evidence to the specific clinical cases treated as perceived by sampled physicians. A specific item of the questionnaire survey asked: “Do you usually have difficulties to contextualize information, guidelines and other scientific evidence into your daily medical practice?”. The variable assumes the value 1 if the pediatricians’ answered “yes” to the former question, and 0 otherwise.

Since the particular organizational context in which clinicians work may influence their use of EBM, as a number of a wide range of other behaviors, we entered into the model a set of dummy variables that considers pediatricians’ affiliation to the different LHAs. In addition, we considered the membership of individual physicians to formal collaborative initiatives within their primary care organizations. Previous studies have shown that collaborative initiatives such as associations, networks and group practices stimulate interaction amongst primary care physicians, influencing as a consequence their behaviors and attitudes (Fattore et al., 2008; Fantini et al., 2012). Because it cannot be excluded that pediatricians’ collaboration with other primary care colleagues would influence the use of EBM, we built and entered into the model a set of dummy variables taking into account whether sampled pediatricians operated in solo or were engaged in one of the following available collaborative arrangements: Association, Network (ICT-based interaction) and Group practice.

4. Analysis and Results

Table 2 provides a description of some characteristics of sampled pediatricians. A great majority of respondent pediatricians were female (65.8%). Most physicians who responded completely to the survey reported to have a tenure within the NHS of 20 years or more (80, 66.67%), and most reported of using EBM occasionally in the treatment of asthmatic (40, 33.33%), gastro-enteric (46, 38.34%) and urinary diseases (47, 39.17%). As

regard institutional affiliation, almost one third of the respondents were affiliated to the LHA 1 located in Central Italy, whereas the rest of them were almost equally distributed across LHAs from 2 to 7 located in the North and South of Italy.

Table 2 around here

Table 3 shows the regression results. It is worth noting that because in our analysis the dependent variable is the physicians' frequency of EBM use, reported on an ordinal scale from 1 to 5, an ordinal logistic regression model with maximum likelihood was used to produce estimates (Scott-Long and Freese, 2006). To offer further assurance against the lack of independent observations due to the nestedness of sampled individuals in the territorial contexts where the various LHAs were located, we also adjusted the standard errors for the clustering of physicians within regions.

The analysis was performed through different models. Model M1 tested the association between the physicians' self-reported frequency of EBM use and the control variables. In addition to the variables included in Model M1, Model M2 includes the relational variable that measures the degree of connectivity of territorial physicians with hospital colleagues. Models M1 and M2 were estimated separately for each pathology investigated. The software Stata version 10 was used for analysis.

Table 4 around here

The results displayed in Table 3 shows that the coefficients for the variable *Network Degree Centrality* are positively and significantly associated with the dependent variable across all the pathologies investigated, asthmatic (β = 0.206; $p< 0.01$), gastro-enteric (β = 0.252; $p< 0.05$) and urinary (β = 0.464; $p< 0.01$). In addition, the increase of the R-square values in models M2 with respect to models M1 clearly indicates that more variance is explained after the network variable is included. Overall, this provides support for the hypothesized positive relationship between the physicians' connectedness with their peers working in hospital settings and the frequency with which they make use of EBM.

Amongst the control variables included, those regarding the affiliation to the different LHAs, the membership to formal groups, as well as the number of patients assisted were significantly associated with the dependent variable. In particular, for all the pathologies considered, it was found that pediatricians in the LHA 2 (in the Emilia Romagna Region) were more likely to self-report a more frequent use of EBM than those in the LHA 1, which is the baseline category of the model. Physicians in LHAs 4, 5 and 7 (all in the Abruzzo Region) were in contrast less likely to self-report a more frequent adoption of EBM than those in the organization assumed as baseline. This evidence overall seems to suggest that the peculiar contingencies reflecting the different organizational contexts to which physicians belong likely influence the frequency with which they use EBM. Regional financial distress, for example, is a contextual factor that may have an impact on the generalized degree of EBM use. Abruzzo is one of those Italian regions in which the healthcare deficit led to a mandatory Budgetary Balance Plan ("Piano di Rientro") under the direct control of the Italian Ministry of Economy. The shortage of financial resource produced several restrictions for LHAs' budget for pediatric care.

As anticipated, pediatricians' membership to formal collaborative initiatives was also significantly associated with their self-reported frequency of EBM adoption. Although the

association between the peculiar collaboration arrangement and the dependent variable differs across diseases, the sign of the coefficients was always found to be negative.

Findings also document that pediatricians with longer tenure are more likely to use frequently EBM for the treatment of asthma and less likely to use EBM for the treatment of urinary trait infections.

Finally, for two out the three pathologies considered the results show a significant association between the number of patients assisted by pediatricians and their self-reported EBM use. This association is negative for parameters representing intermediate volumes of patients assisted by clinicians. Taken together, the results of our estimates seem to suggest a curvilinear relationship between the dependent variable and the number of assisted patients, with the frequency of EBM use being minimized at intermediate volumes of patients assisted. These results, which surely need further and careful inspection, offer fruitful avenues for future research aimed at exploring how volumes of patients treated influence the use of EBM into clinical practice.

5. Discussion

This paper was aimed at investigating whether and how the degree of social connectedness of primary care pediatricians with their hospital peers was associated with the use they make of EBM practices. The present study contributed to the previous literature in two ways. First, although a plethora of healthcare management studies explored formal integration and coordination mechanisms between primary care and hospital physicians, much less explored are the informal mechanisms through which they use to collaborate, communicate and exchange relevant clinical knowledge. Our findings revealed that the transfer of important attitudes and behaviors is another important benefit that territory-hospital integration may provide. Consistent with prior research, our study documented that

the structure of inter-physician relationships influence the frequency of EBM use, showing in particular that collaborative ties across levels of care may further benefit -other than other important behaviors- the adoption of EBM into clinical practice.

Second, we contribute to the discussion regarding how doctors learn. Extant research documents that there are three main sources through which physicians learn (Schmidt, Norman & Boshuizen, 1990; Sargeant et al., 2006): the patients they visit, the evidence they access and read, and the colleagues with whom they discuss clinical issues. The work of Gabbay and le May (2004) introduced the dichotomy "mindlines" versus "guidelines" showing that, rather than being combined together, these two sources are likely to be perceived as substituted in physician practice. Largely conditioned by past experience and relationships with colleagues, physicians' mindlines strongly influence their propensity to adopt new practices and innovation (Gabbay & le May, 2004). In contrast with this approach, Chou, Vaughn, McCoy, & Doebbeling (2011) found that team working increases the likelihood of adopting EBM. In the analyzed cases, however, we hardly can find real team working. Italian mono-disciplinary pediatric organizational forms support the share of patients, of information, and at the most, of knowledge, but do not support nor seek the increase of team working. Actually, recent studies have documented that highly constrained social networks reduce the adoption of EBM (Fattore et al., 2008; Mascia & Cicchetti, 2011), thus resulting in groupthink and limited openness to new external sources. Our findings expand this evidence, showing that the likelihood for physicians to adopt EBM is positively related to the link they exhibit with colleagues working in a different healthcare setting increases but, at the same time, negatively associated with their membership to groups composed by homophilous colleagues. "*Although joint membership in the same collaborative arrangement does not necessarily imply a social relationship, it nonetheless provides the opportunity for actors to interact, thus increasing the probability that pairwise ties will*

develop between actors" (Fattore et al., 2008: pp. 143). Hence, whereas establishing collaborative ties with peers tends to increase in general a physician' openness to resources and learning opportunities (Sparrowe et al., 2001), the degree of connectedeness with homophilous colleagues, in the present case represented by physicians working at the same level of care in the same formal group, is likely to limit her or his access to innovation and novel practices. This result might be explained in part by the lack of diverse knowledge and groupthink that being exposed to homogenous partnering colleagues is likely to induce in physicians' behaviors and propensity to adopt innovation (Jehn, Northcraft, Neale,1999; Reagans & Zuckerman, 2001). In addition, given the limited amount of time that people can dedicate to social relationships (Burt, 1992), pediatricians' membership to formal collaborative arrangements may hinder their possibility to effectively maintain ties with hospital colleagues.

Another important result we have documented is the influence of physicians' affiliation to organizational contexts on the frequency with which they use EBM. Our findings showed that the affiliation to the different LHAs significantly influenced this behavior. Other than indicating that organizational conditions strongly predict EBM adoption in clinical practice, in light of the different geographical location of LHAs across Italian regions, our study indicates that regional differences are also reflected in this important physician behavior. While interesting, this result surely deserves more attention in future studies through the analysis of primary care governance models across regions.

Eventually, we found that behaviors may be affected by the types of patients to be treated. Long tenured pediatricians treating children with asthma are more likely use EBM than younger pediatricians. The reverse occurs in treating children affected by urinary trait infections. This difference may be explained by analyzing the complexity of care across diseases. Flores, Lee, Bauchner, & Kastner (2000) also found that asthma guidelines were the

most adopted among pediatricians. Amon the 100 different practice guidelines used, the most commonly used were those for asthma (77%), hyperbilirubinemia (27%), and otitis media (19%). Timmermans and Mauck (2005) explain several reasons for considering asthma an "ideal disease for clinical practice guideline development and implementation". Thus we may conclude that the results about asthma should be considered a special case, and that the results about urinary trait infections are the most generalizable: older (and more expert) pediatricians are less likely to adopt frequently EBM guidelines.

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. Further research should include a larger number of pediatricians and LHAs, taking into account other specialties in addition to the peculiar one studied here, in order to see whether the results we found are the same. Given the peculiar organization of pedriatic care in Italy, we strongly persuade further analyses on physicians' connectedness across levels of care and EBM behaviors in other specialties.

Second, a more detailed analysis is needed distinguishing the request of advice and opinions among physicians in the different phases in the process of patient care (diagnostic, therapeutic or control), because in this way it would shed light on the reasons why those who already use guidelines seek advice from colleagues.

Third, we did not consider the frequency or intensity of connectedness of pediatricians with their colleagues working within hospitals. However, given the relative limited number of colleagues with whom territorial physicians declared to being connected to, we assume that all these relationships are important and strong.

Finally, as with most network research, this was a cross-sectional study that prohibited us from determining causality among the variables of our models. In other words,

it may be, as we claim, that the degree of connection with hospitals influences EBM use, as in social contagion theory. However, the reverse is also plausible: pediatricians who more frequently use EBM may be more likely to connect with hospital colleagues who have a similar higher use of EBM. Future studies conducting longitudinal analyses are needed in order to extend the validity of our results.

6. Conclusions and implications

A first contribution made by this study is in capturing the degree of connectivity that territorial physicians exhibited with their hospital colleagues, as well as its impact on EBM adoption. Within LHAs where there are many relationships connecting pediatricians to the hospitals the use of guidelines is more frequent compared to those in which relationships are few. Our results show as the connection with large hospitals, where the application of EBM is more common, involves a positive "contagion" effect for the connected pediatricians. LHA's managers should employ analytic tools to map professional cross-boundaries relationships and encourage for these, especially as regards the benefits that from them may arise. In addition, identifying physicians with a prominent role in the professional networks can help to recruit these physicians as opinion leader for implementing changes and disseminating EBM faster and with more chance of success.

A second contribution made in this study concern the debate about health policy that in recent years have encouraged and supported formal collaborative arrangements among pediatricians. In line with the literature on groupthink, our results suggested as too cohesive relationships between homogenous physicians belonging to formal collaborative arrangements would produce redundancy and closure towards opportunities and innovations coming from outside the group, in turn hampering EBM adoption. Policy makers may remodel incentives to primary care in order to foster EBM adoption, i.e. by stimulating a

stronger collaboration between pediatricians and hospital physicians. Cross-boundaries collaboration between physicians working at different levels of care may be employed to counterbalance the risk of groupthink.

A third and final contribution of this study regards the status of the pediatricians. Our study reveals that EBM users are more central in the network of advice relationships, increasing in turn their reputation among colleagues. We believe that, especially within regions and LHAs that encourage complex forms of collaboration among specialists in primary care, this can have a positive impact on career and managerial responsibilities.

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Table 1 – Characteristics of sampled organizations

	Region	Sq Km	# of social/health districts	# of hospitals	Total population	% population < 14 years
LHA1	Emilia Romagna (Center)	2,915	6	9	853,319	12.6%
LHA2	Veneto (North)	710	2	3	218,849	14.4%
LHA3	Lazio (Center)	723	6	4	534,605	14.32%
LHA4	Abruzzo (South)	5,035	4	12	304,068	12.26%
LHA5	Abruzzo (South)	5,172	8	10	397,415	12.87%
LHA6	Abruzzo (South)	1,225	5	8	323,720	13.66%
LHA7	Abruzzo (South)	1,947	4	4	288,000	13.55%

Table 2 – Characteristics of sampled physicians (N = 120)

	Asthma	Gastro	Urinary
Self-reported frequency of EBM adoption, N Physicians (%)			
Very frequently	14 (11.67)	10 (8.33)	11 (9.17)
Frequently	29 (24.17)	24 (20.00)	21 (17.50)
Occasionally	40 (33.33)	46 (38.34)	47 (39.17)
Rarely	22 (18.33)	22 (18.33)	22 (18.33)
Never	15 (12.50)	18 (15.00)	19 (15.83)
Gender, N Physicians (%)			
Male		41 (34.2)	
Female		79 (65.8)	
Tenure NHS, N Physicians (%)			
< 10 years		8 (6.67)	
10-19 years		32 (26.67)	
≥ 20 years		80 (66.67)	
N assisted patients, N Physicians (%)	38 (31.66)	32 (26.67)	68 (57.67)
≤ 30 patients	36 (30.00)	17 (14.16)	34 (28.33)
31-60 patients	14 (11.67)	9 (7.50)	9 (7.5)
61-90 patients	32 (26.67)	62 (51.67)	9 (7.5)
> 90 patients			
N of journal subscriptions, Mean ± SD (range)		2.90 ± 1.61 (0-10)	
Availability of Information, Mean ± SD (range)		0.46 ± 0.30 (0-1)	
Limited usability of EBM, N Physicians (%)			
Yes		18 (15)	
No		102 (85)	
LHA Affiliation, N Physicians (%)			
LHA 1		40 (33.33)	
LHA 2		15 (12.5)	
LHA 3		11 (9.17)	
LHA 4		15 (12.5)	
LHA 5		15 (12.5)	
LHA 6		10 (8.33)	
LHA 7		14 (11.67)	
Affiliation to formal groups, N Physicians (%)			
In solo		33 (27.5)	
In Association		60 (50.0)	
In Network (ICT based interaction)		12 (10.0)	
In Group		15 (12.5)	
Network Degree, Mean ± SD (range)	2.02 ± 1.35 (0-7)	1.97 ± 1.28 (0-7)	1.84 ± 1.17 (0-6)

Table 3 – Ordinal logistic regression predicting primary care pediatricians' frequency of EBM utilization

	Asthma		Gastro-enteric		Urinary	
	Model M1	Model M2	Model M1	Model M2	Model M1	Model M2
Gender (1= female)	-0.232 (0.336)	-0.118 (0.365)	0.236 (0.259)	0.458 (0.285)	0.155 (0.187)	0.262 (0.224)
Tenure NHS < 10 years (omitted)	-	-	-	-	-	-
10-19 years	0.561 (0.450)	0.618** (0.266)	0.134 (0.515)	0.068 (0.580)	-0.317 (0.467)	-0.433 (0.489)
≥ 20 years	0.498*** (0.142)	0.641*** (0.234)	-0.168 (0.403)	-0.096 (0.418)	-0.672*** (0.192)	-0.726*** (0.266)
N assisted patients ≤ 30 (omitted)	-	-	-	-	-	-
31-60 patients	-0.483 (0.341)	-0.605** (0.293)	0.158 (0.649)	-0.096 (0.654)	-0.360* (0.171)	-0.217 (0.210)
61-90 patients	-2.235*** (0.706)	-2.360*** (0.660)	-0.334 (0.620)	-0.712 (0.797)	-0.491 (0.742)	-0.618 (0.845)
> 90 patients	0.215 (0.399)	0.117 (0.377)	-0.276 (0.414)	-0.326 (0.548)	0.165 (1.073)	0.231 (0.967)
N journal subscriptions	0.091 (0.068)	0.075 (0.064)	-0.088 (0.054)	-0.130 (0.072)	0.020 (0.078)	0.027 (0.087)
Availability of information	0.214 (0.248)	0.045 (0.311)	0.572 (0.428)	0.444 (0.520)	0.845 (0.440)	0.861 (0.609)
Limited usability of EBM	-0.092 (0.628)	-0.182 (0.739)	-0.634 (0.611)	-0.630 (0.757)	-0.670 (0.471)	-0.932 (0.690)
LHA 1 (omitted)	-	-	-	-	-	-
LHA 2	2.212*** (0.385)	2.234*** (0.333)	1.772*** (0.354)	1.848*** (0.256)	1.635*** (0.345)	1.396** (0.277)
LHA 3	-0.865 (0.649)	-1.390* (0.809)	-0.203 (0.676)	-0.165 (0.666)	-0.328 (0.661)	-0.810 (0.774)
LHA 4	-1.411*** (0.260)	-1.951*** (0.220)	-0.506*** (0.167)	-0.921*** (0.248)	-0.829*** (0.258)	-2.010*** (0.460)
LHA 5	-1.582*** (0.117)	-1.976*** (0.089)	-1.754*** (0.415)	-1.989*** (0.311)	-1.443*** (0.089)	-1.896*** (0.079)
LHA 6	0.733** (0.364)	0.670*** (0.162)	1.153*** (0.099)	1.075*** (0.229)	0.680 (0.813)	0.744 (0.508)
LHA 7	-2.163*** (0.360)	-2.769*** (0.342)	-0.927*** (0.322)	-1.387*** (0.225)	-0.727*** (0.147)	-1.562*** (0.226)
In Solo (omitted)	-	-	-	-	-	-
In Association	-1.137** (0.426)	-1.204*** (0.441)	--0.052 (0.352)	-0.013 (0.409)	-0.276 (0.471)	-0.135 (0.392)
In Network (ICT-based Interaction)	-1.185* (0.686)	-0.857 (0.654)	-0.831** (0.327)	-0.349 (0.256)	-0.812* (0.425)	-0.254 (0.343)

In Group	-0.784*** (0.144)	-1.068*** (0.074)	-0.688 (0.693)	-1.117 (0.757)	-0.687 (0.650)	-1.150** (0.590)
Network Degree Centrality		0.212*** (0.063)		0.254** (0.115)		0.514*** (0.164)
1st cutpoint OL	-5.921 (0.967)	-5.904 (1.130)	-4.692 (0.490)	-4.481 (0.335)	-4.645 (0.455)	-4.132 (0.435)
2nd cutpoint OL	-3.988 (0.783)	-4.031 (0.897)	-3.068 (0.331)	-2.923 (0.453)	-3.245 (0.391)	-2.761 (0.483)
3rd cutpoint OL	-2.072 (0.812)	-1.950 (0.959)	-1.521 (0.260)	-1.294 (0.373)	-1.719 (0.292)	-1.136 (0.416)
4th cutpoint OL	-0.101 (0.692)	0.129 (0.828)	0.497 (0.293)	0.833 (0.241)	0.384 (0.245)	1.105 (0.416)
5th cutpoint OL	1.821 (0.384)	2.087 (0.551)	2.043 (0.285)	2.410 (0.289)	1.931 (0.223)	2.720 (0.350)
Regression diagnostics						
Number of Observations	120	120	120	120	120	120
Log-pseudolikelihood	-156.255	-149.324	-166.956	-160.718	-168.061	-159.560
Prob > χ^2	0.000	0.000	0.004	0.009	0.006	0.002
Pseudo R^2 (Negelkerke)	0.433	0.484	0.309	0.340	0.310	0.367

Note: Clustered robust standard error in parentheses; $p < 0.1$ *; $p < 0.05$ **; $p < 0.01$***