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Communities of Practice: Telemedicine and Online Medical Communities

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ABSTRACT

E-health and telemedicine have had limited success across the European Union (EU), but using online collaborative technologies to support a community of practice may enable a sustainable healthcare community. In this paper we introduce a virtual medical community that enables geographically-dispersed medical experts to collaborate and share their knowledge in order to improve health care provision. This research confirms that media richness is not required for sustainable communities of practice, that there is greater effectiveness in knowledge sharing when virtual medical communities develop into communities of practice, and that communities of practice are sustainable when shared knowledge enhances medical practice.

KEYWORDS

Web2.0, communities of practice, social networking, e-health.

1. INTRODUCTION

Collaborative technologies enable communication, coordination and cooperation (Nitchi, Mihăilă, & Podean, 2009), can facilitate effective group interaction (Gupta, Mattarelli, Seshasai, & Broschak, 2009), and can enable distributed groups of people to communicate, structure and share information anytime and anywhere (Bélanger & Allport, 2008). Collaborative technologies and social networking enable social interaction which may be synchronous or asynchronous between actors who are geographically or temporally dispersed.

Rheingold (1993) suggests virtual interactions enabled by computer mediated communication technologies may lead to new community formation and identity expression online. Social networks such as Facebook, Teitter and LinkedIn etc. are a form of virtual community and have gained tremendous popularity. "This new form of virtual community is generally based on Web 2.0 technologies, which aim to further enhance the reciprocity of the social interaction and exchange between community members by encouraging users to add value to the application as they use it" (Zhang, 2010 p1).

The term 'Community of Practice' was coined by Lave and Wenger (1991) and further developed by Wenger (1999) to describe the way that individuals who are united in action, and in the meaning that action has for them and for the larger collective, act collectively for the benefit of individuals within the group as well as the group as a whole. Communities of Practice exist within and outside organizations, may span organisational boundaries, as well as spanning domains of specialist practice and knowledge.

Telemedicine can be defined as a system of healthcare delivery using information and communications technology (ICT) as a substitute for face-to-face contact between provider and client, easing such problems as: limited access to care, especially for the geographically disadvantaged; uneven quality of care; and cost inflation (Bashshur, 1995). However, telemedicine may also be viewed as a collaborative activity among medical professionals who communicate and interact virtually due to their geographical dispersion, (Panteli & Sims, 2010), and such activities are therefore technology-mediated. Gröne and Garcia-Barbero (2001) suggest that not only does telemedicine enable the diagnosis and treatment of patients at a distance, but may also be used as "a long-distance training tool for health care professionals".

Communities of Practice within telemedicine, using online social networking as an enabling technology, offers the potential to bring together temporally and geographically dispersed actors to work towards a common purpose. A virtual medical community of practice might take the shape of a social network, using collaborative technologies similar to other social networking communities. It may also take the shape of a virtual learning environment (VLE). VLEs enable groups to engage in online or 'e' learning.

The literature suggests that specialist healthcare practitioners in communities of practice that establish professional relationships, share common concerns and sets of problems, can increase their knowledge, enhance practice quality, and increase their confidence in their ability to provide care (Jiménez-Zarco, González-González, Saigí-Rubió, & Torrent-Sellens, 2014; Meins et al., 2015). Such communities can lead to a perception of increased efficiency as well as better communication between professionals and improved care (Díaz-Chao, Torrent-Sellens, Lacasta-Tintorer, & Saigí-Rubió, 2014; Jiménez-Zarco et al., 2014). The literature also suggests that online communities of practice where care providers have limited access to communication, or opportunities for consultation, can enable knowledge sharing and lead to enhanced practitioner knowledge (Jiménez-Zarco et al., 2014; Meins et al., 2015). This research provides empirical evidence to support these propositions from the literature and also demonstrates that it is not the richness of communication or the complexity of the technology that is important.

This research studies a group of geographically-dispersed medical experts using collaborative technologies. Their practice involves specialised medicine practiced in isolation, away from colleagues and organisational support. Their practice involves medical support for expeditions and people in extreme environments such as mountain climbing and polar expeditions. Because the members are geographically-dispersed and operate to a large part in isolation, it was not possible to interview them. The literature suggests that telemedicine is not as well used in Europe as anticipated (May et al., 2003; Thielscher & Doarn, 2008) but where communities of practice do develop their continuity relies on members perceiving that they receive benefits from membership. This research also finds that when virtual medical communities develop into communities of practice, there is greater effectiveness in knowledge sharing and communities of practice are sustainable when shared knowledge enhances medical practice.

The remainder of the paper is structured as follows. The next section discusses online communities. The section after that will discuss communities of practice. The following section introduces the context of the case study: Case 1. The case study will then be used to examine the potential use of an online community to develop a community of practice.

2. ONLINE COMMUNITIES

Informal networks are critical to knowledge creation and sharing (Huysman & De Wit, 2004). Collaborative technologies enable informal networks to interact across geographic and temporal boundaries. The term 'on-line community' encompasses a wide range of Internet fora including markets and auction sites, bulletin boards, listservers, social networking sites, blogs, gaming and shared interest sites (Miller, Fabian, & Lin, 2009). On-line communities enable asynchronous, immediate, interactive, low cost communication and weblogs offer asymmetric communication (Silva, Goel, & Mousavidin, 2008). Stanoevska-Slabeva (2002) suggests that on-line communities are characterised by strong relationships between participants, community-specific structure and modes of discourse, common vocabulary, common meaning, shared history, community rituals, continuity of communication and a common on-line meeting space. She identifies four types of community: discussion or conversation; task- or goal-oriented; virtual worlds; and hybrid communities.

On-line communities provide affiliation, belonging, power, prestige and entertainment (Macaulay et al., 2007). Digital interaction is embedded in, influenced by, and influences, social networks. These online communities can create substantial value for participants, including social support, increased sales, enhanced knowledge and innovation (Agrawal, Gupta, & Kraut, 2008). The biggest challenge for a virtual community is the supply of knowledge (Chiu, Hsu, & Wang, 2006).

Vidgen et al (2013) suggest there is ongoing debate about the relationship between networks and communities. For some (on-line) networks are (on-line) communities (Duan, 2009; Lea, Yu, Maguluru, & Nichols, 2006), for others networks are a mechanism for managing communities (Ganley & Lampe, 2009). Wasko et al. (2009) find similar characteristics in networks as in communities. Online communities can be seen as complex social networks where participants establish connections over time (Panzarasa, Opsahl, & Carley, 2009).

Social networking sites are a type of on-line community that have grown in popularity. Social Networking leads to connection-sharing, social capital generation and effective communication (Boyd & Ellison, 2007). Social Networking sites tend to be structured around a niche audience, which is ideal for the development of communities of practice. Using social networking to build communities of practice is not new, CHIplace and CSCWplace were designed for people involved in the design and use of computer applications (Churchill, Girsensohn, Nelson, & Lee, 2004). For some, community interaction can take place both online and offline, with face-to-face meetings taking place in conferences, seminars, meetings and workshops. The use of face-to-face interaction builds stronger relationships between members and aids in the cohesiveness of virtual groups (Panteli & Duncan, 2004); thus, for many, social networking may be expected to have both online and offline elements.

The online element of social networking may be rich, including text, images, video, sound, or any combination of these. It may be presented in the form of a blog, or webpage, or a fully interactive site. However, the online element may not be rich, but in the form of text via a forum, a blog, or email. Vidgen et al (2013) find no link between media used (e.g., video), the content (topics discussed), and community building. Perhaps community building relates more to external reputation, writing style, or topicality.

Panteli and Duncan (2004) suggest that ad-hoc and temporary teams often do not have the time that traditional trust theories see as enabling familiarity among team members, promoting trust; but trust is important and needs to develop. However, interactions between key players that can be described as “situated”, emerging from the “scripted, pre-scripted, co-scripted, re-scripted and unscripted computer-mediated interactions of virtual players”, that “elicit the process of trust development within the temporary setting of virtual teams, constituting a type of trust relationship that is mutually negotiated and jointly constructed” (Panteli & Duncan, 2004 p1). In online communities that are loosely tied, that cannot be described as teams, trust may also be important. In many cases the offline element is an important element of community cohesion. In online communities of practice there may be off-line contact that is important in building familiarity and trust.

Vidgen et. al. (2013) suggest that blogs are increasingly popular, yet little researched (Lee & Trimi, 2008; Silva, Mousavidin, & Goel, 2006), and there is a paucity of empirical studies about the use of blogs. Blogging is evolving and research that catches reality in flight may be difficult (Lee & Trimi, 2008). A blog is a weblog and consists of online posts by owners and comments (user-generated content) by others. Some blogs are principally a medium for one-way communication, i.e., used for publicity, product promotion, and managing public relations, and, as such, do not lead to community building.

There is however, evidence of communities evolving around blogs (Efimova, Hendrick, & Anjewierden, 2005), with explicit rules regarding membership, moderators, profile information, net etiquette, tacit warrants for discerning pertinent posts and specific techniques of discipline (Miller et al., 2009). There are a number of sub-types of online community: relationship – usually groups clearly delimited demographically, interest – around a defined topic, and communities of practice – focused on a domain of knowledge (McDonough, 2002).

Electronic communication using information and communication technology (ICT) differs fundamentally from offline communication (Walther, 1996), it can be hyper-personal and offers unique challenges and opportunities. Credibility comprises a cognitive (logical) component and an affective (emotional) component (Evans, Novicevic, Martin, & Dorn, 2008). The cognitive component involves trustworthiness and expertise along with reliability and competence; the affective component involves empathy. Credibility is positively correlated with message acceptance by recipients. Haythornthwaite (2002) maintain it supplements other forms of contacts. The question remains as to whether the social capital developed in virtual communities is strong enough to overcome barriers to knowledge sharing.

3. COMMUNITIES OF PRACTICE

A community of practice brings together individuals who are united by common goals and meaning, who act together collectively (Lave & Wenger, 1991; Wenger, 1999). The ability of communities of practice to enable members to create and share knowledge is an important capability (Brown & Duguid, 1998; Cole, 1998). The mutual engagement, joint enterprise, shared goals, and common modes of communication provide communities of practice with their ability to meet the needs of members while remaining informal and emergent in nature. Thus communities of practice cannot be imposed in a deliberate top-down approach, but emerge from loose organisational ties (Thompson, 2005).

Wenger (1991) defines communities of practice as “groups of people who share a passion for something that they know how to do, and who interact regularly in order to learn how to do it better.” Members of virtual communities are often deeply engaged, and tend to have a high level of interaction and participation (Zhang, 2010). These users of technology form a dense web of relationships, interacting together online as a community in order to accomplish a wide range of jointly held goals, and to maintain existing relationships (Dholakia, Bagozzi, & Pearo, 2004).

Communities of practice unite people in learning and knowledge sharing; driven by development of member value, emerging from individuals’ desire to learn, share knowledge, and develop common practices (Vidgen et al., 2013). Online communities of practice have been shown to improve communication between medical practitioners leading to improved care and improved practice efficiency (Díaz-Chao et al., 2014). They allow individual medical practitioners with common interests and objectives to create networks of trusted individuals. In doing so they create and share knowledge, learn collaboratively, and enjoy a higher satisfaction in the collaborative learning process (Jiménez-Zarco et al., 2014). As a result they achieve a number of benefits, including cost reduction, faster management, better care quality and improved accuracy of diagnosis. There is evidence of a perception of increased efficiency and effectiveness, higher satisfaction with knowledge sharing and effective collaboration with other members of the community (Jiménez-Zarco et al., 2014). Online, or

virtual communities of practice are especially beneficial to medical practitioners who practice in environments with limited access to communication, limited opportunities for consultation, and such communities facilitate multidisciplinary collaboration and enhanced healthcare practice leading to increased confidence in practice ability and improved patient care (Meins et al., 2015). Communities of practice can contribute to socialising, externalising tacit knowledge and internalising explicit knowledge. They involve self-selecting members: professionals bound together informally through problem solving and solution seeking, thereby generating knowledge, developing members' capabilities to build and extend knowledge (Manville & Foote, 1996; Wenger & Snyder, 2000). Communities of practice exist for as long as there is interest in maintaining the group or people have a reason to connect.

Those attempting to develop communities often have no direct control over the contribution of discretionary effort and so must look for subtle means to exert influence and promote effectiveness (Cross, Laseter, Parker, & Velasquez, 2006). Cross et al. found that appropriately connected communities of practice are able to yield substantial benefits for members when collaboration amongst community members decreases unnecessary time spent on tasks (e.g., reinventing the wheel), improves the consistency and quality of activities, and "drives innovative solutions by leveraging expertise distributed throughout the community" (Cross et al., 2006 p56). Such collaborations are becoming vital for the organisation of actors involved in knowledge-intensive work. This research seeks to determine whether communities of practice can emerge from online social networks.

Panteli (2010) suggests that telemedicine consists of groups of people, members of specialised occupational groups, who share a common practice and are not co-located nor do they necessarily have frequent contact. Due to their characteristics and common interest in sharing knowledge and practice, these groups can develop to communities of practice (Brown and Duguid, 2001; Wenger, 1998), and subsequently promote virtual medical communities of practice. In this research a group of people who share a common specialisation involving specialised medicine practiced in isolation, away from colleagues and organisational support, are chosen as a case organization. In the next section the proposed theoretical framework is discussed.

4. THEORETICAL FRAMEWORK

Telemedicine uses synchronous and asynchronous communication between healthcare providers and patients, and between healthcare specialists (Gröne & Garcia-Barbero, 2001; Maheu, Whitten, & Allen, 2002). In this research we investigate a group of healthcare specialists (Case1) who interact online, engaging in asynchronous communication. Telemedicine consists of groups of medical specialists who share common practice but who are not co-located, and do not necessarily have frequent contact; it forms an important medium for the transfer of medical knowledge and expertise, across distances, in a technology-mediated environment (Panteli & Sims, 2010). Panteli (2010) suggests that "telemedicine services provide an important empirical setting for investigating the processes by which knowledge transfer may occur, and the ways in which individual members may develop their learning". Communities have effective communication, are connection-sharing, and generate social capital (Boyd, 2007).

Communities of practice share certain characteristics. They develop member value, share common practices (Vidgen et al., 2013). They form from self-selecting members, who engage in externalising tacit knowledge and internalising explicit knowledge, are professionals bound together informally through problem solving and solution seeking (Manville & Foote, 1996; Wenger & Snyder, 2000). Their members also share common modes of discourse and vocabulary, common meaning and shared history (Stanoevska-Slabeva, 2002). Communities of practice have community-specific structure, community rituals, continuity of communication and a common on-line meeting space (Stanoevska-Slabeva, 2002). They are collaborative (Paul, 2006).

Within telemedicine communities of practice, knowledge transfer, knowledge discovery and knowledge creation take place (Díaz-Chao et al., 2014; Jiménez-Zarco et al., 2014; Meins et al., 2015; Paul, 2006). Trust is an important element in online communities (Jiménez-Zarco et al., 2014; Panteli & Duncan, 2004; Paul & McDaniel Jr, 2004), trust is a central issue in most economic and social transactions, especially in an online context where there may be lots of uncertainty (Pavlou, 2003). Credibility and trust are closely related (Marshall, Moncrief, Rudd, & Lee, 2012). Credibility based trust is usually impersonal and relies on reputation information creating the impression that the other party is reliable and honest (Ba & Pavlou, 2002). Once an individual perceives goodwill, trust should be created (Adjei, Noble, & Noble, 2010; Marshall et al., 2012). Communities of practice grow credibility and trust (Panteli & Duncan, 2004; Wellman & Haythornthwaite, 2002). When trust prevails, partners are more confident in being open with each other and members of communities perceive higher levels of confidence in their abilities and enhanced practice (Jiménez-Zarco et al., 2014; Meins et al., 2015).

Perceived usefulness is a key component of technology acceptance and very important for healthcare professionals acceptance and use of ICT (Chau & Hu, 2002; Davis, 1989; Gefen & Straub, 2000 ; Grandon & Pearson, 2004). There is evidence of the perception of efficiency and effectiveness in collaboration with the

members of the online community of practice positively influencing the perceived satisfaction with the community, and the degree of individual participation in the community affects the degree of perceived satisfaction (Jiménez-Zarco et al., 2014). This research posits that if telemedicine practitioners believe that they are enhancing their relationships and participating in a community that provides social support, and enables knowledge sharing and creation, then the perception of usefulness of the community will lead healthcare professionals to continue participation in the community, contributing to the sustainability of such services.

European Union (EU) countries face expectations that healthcare providers promote, increase and broaden the use of telemedicine services and share their experiences (Panteli & Sims, 2010). Yet, in some European countries telemedicine is not thriving (May et al., 2003), and in other countries telemedicine faces significant challenges (Thielscher & Doarn, 2008). For telemedicine services to become sustainable, healthcare professionals must perceive that they gain value, sharing and creating specialist knowledge. It is not sufficient to create a community if interest and enthusiasm wane and eventually disappear. If knowledge and support is derived from being part of a community, then that community is more likely to be sustainable. Panteli and Sims (2010) argue that it is important for long run success to create a feeling of win-win situations and for participants to achieve mutual benefits.

5. METHODOLOGY

A single case study is adopted. The goal is to obtain realistic and rich data (Hennig-Thurau et al., 2010). The case of this research is a group of people who share a common specialisation involving specialised medicine practiced in isolation, away from colleagues and organisational support.

Orlikowski and Barley (2001) identify three broad genres of information systems (IS) research: One, the impact of IS; Two, the development, deployment and use of IS; Three, the organisation and management of IS resources. This research examines the impact of IS on the daily work and support for doctors working in isolation in remote locations. It also examines the deployment and use of very simple and basic IS that enables interactions between members of a community. Organisational change cannot be understood without considering “changes in the technology infrastructure on which economic and organisational activity rests” (Orlikowski & Barley, 2001:147). In this research the ubiquity of smartphone and portable personal computing, along with the easy availability of satellite phones, enables computer mediated communication in even the most remote locations.

There is a need for research on how organisations influence the design, use, and consequences of technology, and how organisational processes, systems, and culture shape the design and use of technology (Orlikowski & Barley, 2001). This argument points to the organisation as the unit of analysis. Organisations are active players constrained by and shaping their environments, the technological environment and the digital economy is an emergent, evolving, embedded, fragmented, and social phenomenon shaped as much by cultural forces as technical ones (Orlikowski & Barley, 2001). According to Orlikowski and a Barley (2001) understanding IT and organisational change requires a study of social, cultural, and political factors, as well as an appreciation for how assumptions, norms, values, choices, and interactions between organisations influence the technological environment. IT artefacts are shaped by interests, values, and assumptions of users, and are thus embedded in some time, discourse, and community (Orlikowski & Iacono, 2001). IT artefacts are not fixed or independent but dynamic, and emerge from social and economic activities (Orlikowski & Iacono, 2001). Change occurs as organisational actors improvise, innovate, and adjust how they work in organisational routines over time (Orlikowski, 1996). As actors within organisations appropriate new technology in their work routines they experiment, adapt to local conditions, respond to breakdowns and contingencies, create shifts in structure and organisational coordination, improvise and act opportunistically, as they develop their evolving use of the technology. These changes are at the micro-level of individual actors, but the effects are upon the organisation as a whole. Organisations in such contexts are increasingly turning away from stable bureaucratic control structures to flexible self-organising learning organisations with a high degree of autonomy amongst organisational actors (Orlikowski, 1996). This research examines how a group of users adopt technologies that are suitable for their own purposes, choosing simple forms of computer mediated communication over complex technologies, viewing the technology as a “black box” – something they do not need to understand as long as it is intuitive and easy to use.

5.1 Case organisation

The members of the case organisation (Case 1) are all specialised medicine doctors working in conditions of complete or semi isolation, sometimes available 24/7, where challenges arise often without warning, and when support is not easily available. The case study community is designed to address the complex needs of communication, knowledge sharing, and social inclusion by building an online community of practice. The

members of the community of practice are all doctors, medical professionals, with a concern for medical confidentiality.

Because of the particular medical specialisation of this community, and their relative scarcity, disclosing the nature of their practice would make it possible to identify who they are, thus in order to preserve anonymity this research does not disclose that information. Because they practice in very remote locations it was not possible to conduct interviews. However, they do communicate through blog interaction and by email, thus it was possible to send out a survey questionnaire by email, circulated by the blog webmaster.

The community structure is built around a blog and an email list. Interaction takes place by blog postings, comments on the blog postings, and emails between members. There are no formal offline face-to-face meetings for the community, but some members may meet through membership or participation in other communities.

5.2 Case study research

Case study can be described as a scientific method (Galliers, 1994) and as an empirical study investigating contemporary phenomenon in a real life context (Yin, 1994). Yin (1994) states that case study is applicable where the research question asks 'how' or 'why'. It is also applicable where control over behaviour is not required, and where there is a focus on contemporary events.

Case study is also appropriate where the subject area is context rich (Bell, 1993; Cohen & Manion, 1989; Yin, 1994). This study fulfils each of these criteria: virtual communities of practice use ICT Technologies in an practice-based setting, the real-world setting means that the researcher has little control over behavioural variables, and the subject area is contemporary and context rich. Case study will enable research within the case organisation, providing rich detail and the potential to reveal complex, embedded interactions.

What is more, case study can include different methods of data collection (Cohen et al., 1989), and the researcher can add to data collection methods during the study if it becomes necessary (Eisenhardt, 1989). Case study can collect qualitative data (Cohen et al., 1989; Eisenhardt, 1989; Yin, 1994) and in this study a questionnaire asking open ended questions was used so as to gather rich qualitative data.

While case study allows the capture of detail and the analysis of many variables, the method is criticised for difficulty of generalisation (Galliers, 1994), and because case studies can be seen as idiosyncratic since they could be derived from potentially untypical organisations. However, when using case study, researchers are not necessarily looking for generalisation from a sample to a population, but rather they are looking for the plausibility and logical reasoning when describing the results from the cases, and drawing conclusions from them (Walsham, 1993). Generalisability from a sample to a population, from a causal relationship, is not the purpose of this case study; analytic generalisation from an individual case is sought (Yin, 1994), supported by the validity of explanation and plausible reasoning in analysis.

5.3 Method

Because the members of Case 1 do not meet face-to-face, and work in semi isolation, it was not possible to arrange face-to-face interviews. Therefore a questionnaire with open questions was used (Table 1). This enabled respondents the freedom to be forthcoming about issues that they considered important, but also maintained a certain structure to the responses. There was only one opportunity to contact the community participants thus there was no way to run a pilot. The questionnaire was built around themes that arose from the literature and reviewed by colleagues before being distributed.

Question
1. Are you a frequent user of the Case 1 website or blog?
2. If not, why not?
3. If so, why
Case 1 as community of practice
4. Do you think Case 1 is a community? Does it have a distinct identity?
5. Does Case 1 build social cohesion (social, non-professional interaction)?
6. Does Case 1 facilitate greater effectiveness of practice?
7. Does membership of Case 1 facilitate enhanced quality of care?
8. Does membership of Case 1 facilitate greater cost effectiveness?
9. Does membership of Case 1 facilitate greater consistency of practice?
10. How is trust built between you and other members?
Knowledge sharing
11. Is there shared language, approaches, systems and tools between you and other members?
12. Do you acquire, share, and retain knowledge? If so, how is this done?
13. Does formal consultancy (paid) take place between members, or referred by members?
Technology and communication richness
14. What kind of technology do you use to participate in Case 1?
15. Is communication in the form of text, voice, images, or video?
16. Is communication synchronous, asynchronous, or both?
17. Do you use mobile communication?
18. Do you use any collaborative tools or systems?
Usefulness
19. What kind of benefits do you gain from membership?
20. Do you find contribution and or collaboration easy to achieve?
21. Do you find problems with access to technology, bandwidth, complexity of systems or tools?
Sustainability - is Case 1 growing in:
22. Size (number of members)
23. Scope (the types of issues it deals with)
24. Activity levels (the frequency of interaction)
25. Activity types (different types of activity taking place)
26. Why do members leave?
27. Why do members remain?

Table 1 Questionnaire questions

The questionnaire was distributed by email to all of the members of the email list and 18 useable responses were received. Not all of the answers to the questions were in the form of discussion, some were simple yes and no answers; however, where respondents did answer more fully it was deemed to indicate that this was considered an important issue by the respondent.

The responses to the questions and samples of the responses are used to illustrate the perceptions of members of the community. The next section of this paper presents responses to the questions.

6. FINDINGS

In this section a summary of the responses to the questionnaire is presented in a table (Table 2).

Question	
1. Are you a frequent user of the Case 1 website or blog?	All but one of the respondents reported that they were frequent users of Case 1: e.g. respondent 3 stated "Yes I read it whenever a message comes up"; respondent 11 stated "I receive the blogs and scan most and read a few". Some did not use all of the channels available for interaction: e.g. respondent 15 stated "I read the emails but infrequently visit the website", and also stated the reason: "Time – I read emails daily but do not get time to browse"
2. If not, why not?	Respondent 10, the only one to report they were not a frequent user of Case 1 stated "Don't understand how to blog and rarely have time to be proactive and look at the web site"
3. If so, why	Most respondents answered in some detail, e.g. respondent 1 stated: "Keeping me in contact with colleagues and reducing my professional isolation, access to

	cutting edge discussions and good advice/latest research”; respondent 3 stated “Because there are a lot of new ideas, answers to old ideas, informative discussions and erudite peers around on the maillist”; respondent 17 stated “Thought provoking questions & cases, advancement of my knowledge, the knowledge that if I have a problem then others will provide advice”
Case 1 as community of practice	
4. Do you think Case 1 is a community? Does it have a distinct identity?	All but three respondents were affirmative: Case 1 is a community. Those who were less sure offered reasons: respondent 6 stated “Probably”; respondent 7 stated “Depends upon definition of community but definitely a group of likeminded people”; respondent 11 stated: “It certainly seems to have regular contributors so in that sense I suppose is a community”
5. Does Case 1 build social cohesion (social, non-professional interaction)?	Ten respondents agreed that it did so, e.g. respondent 8 stated “Yes ++”; respondent 18 stated “Of course!”. However, some were not so sure: respondent 2 stated “It does build social cohesion but probably not non-professional interaction”; Several respondents identified that face-to-face meetings were an important part of social cohesion, e.g. respondent 4 stated “Yes, it is very good to be able to put faces to names at meetings etc. though the original Case 1 blog was founded by people who knew each other beforehand, of course” and respondent 15 stated “It gives contact with people one may then meet at conference”
6. Does Case 1 facilitate greater effectiveness of practice?	All but one respondent was clear that Case 1 did facilitate greater effectiveness of practice, respondent 18 stated “I have no doubt it does”, although two respondents were a little cautious about this: respondent 14 stated “Probably”. Respondent 12 did not answer this question.
7. Does membership of Case 1 facilitate enhanced quality of care?	All but four respondents were clearly in agreement that membership of Case 1 facilitate enhanced quality of care, e.g. respondent 18 stated “I have no doubt it does”, and nine respondents simply answered “yes”. Some agreed but were guarded: respondent 2 stated “Yes in that it enhances reflective and questioning practice”; respondent 2 stated “It is difficult to measure but apparently it facilitates enhanced quality of care”, and respondent 2 stated “yes - gradual effect, hard to quantify I guess”
8. Does membership of Case 1 facilitate greater cost effectiveness?	Only two respondents were confidently affirmative, answering “yes”. Others were unsure; e.g. respondent 3 stated “I am not sure”, respondent 2 stated “Not sure about that, certainly gets us thinking and on the whole that usually comes up with good clinical judgement and reduction in investigations. But it can encourage further investigations when you cross from the primary care to secondary care type mentality”
9. Does membership of Case 1 facilitate greater consistency of practice?	Four respondents were quite unsure about the answer to this question; respondent 2 responded that the did not know, respondent 14 stated “God knows”, respondent 15 stated “I have seen no evidence of this”. However, ten of the other respondents were very positive: respondent 4 stated “Yes. Good practice tends to be replicated”
10. How is trust built between you and other members?	All of the respondents appeared sure that trust was there, and all of them responded in some detail offering explanations about how trust was built: e.g. respondent 9 stated “Those who reply are giving peer reviewed resources and with no overt ego!”, and respondent 10 stated “By understanding their practice and appreciate that they have the same problems as I have as a sole practitioner”. Thus Credibility based trust is built from reputation information demonstrating that information is reliable and honest(Ba & Pavlou, 2002)(Ba & Pavlou, 2002). Many identified face-to-face meetings as a part of trust building, e.g. and respondent 15 stated “Most long standing members are familiar either by name or in person. Recognizing and utilizing decent advice will garner respect and trust”, respondent 5 stated “Know many personally from meetings or having worked with them in the past”.
Knowledge sharing	
11. Is there shared language, approaches, systems and tools between you and other	Only one respondent replied “no”, all of the others were affirmative to a greater or lesser degree: e.g. respondent 1 stated “Yes, the international language of medicine”, respondent 4 stated “Yes but occasionally there is still too much

members?	specialized jargon/acronyms”, respondent 4 agreed “Generally but still far too many unexplained acronyms”.
12. Do you acquire, share, and retain knowledge? If so, how is this done?	One respondent did not answer this question, one was clearly surprised by it: respondent 7 stated “Stupid question; everyone learns”, others were more thoughtful, respondent 1 stated “I have certainly gleaned a lot from reading, and have also presented my own cases”, respondent 4 stated “Yes, see various answers above if a new treatment is suggested and proved to be effective then one tends to carry on using it”, respondent 4 stated “Yes – i note things , print things and prepare stuff for appraisal purposes”, and respondent 10 stated “Yes. Often print off emails streams to make a CPD summary”
13. Does formal consultancy (paid) take place between members, or referred by members?	Only one respondent replied that there was occasional paid formal consultancy between members, or referred by members respondent 18 stated “Rarely”. All of the others either stated “no”, or that they did not know
Technology and communication richness	
14. What kind of technology do you use to participate in Case 1?	This question did not directly address any of the research propositions, but was thought that it might be useful in understanding the following questions. Most replied that they used a PC (9) and one Mac. However, the responses were too vague to reach any conclusions about what technology was used.
15. Is communication in the form of text, voice, images, or video?	All respondents used text, half used images, and four appeared to use video. Only one reported using “telecom” which I presume means voice.
16. Is communication synchronous, asynchronous, or both?	Only one, respondent 10, stated “synchronous”; five stated “both”; nine reported that it was asynchronous; three did not give a definite reply
17. Do you use mobile communication?	Eleven of the respondents reported using mobile devices to interact with Case 1; but for one it was infrequent, respondent 12 stated “Seldom if I can help it (retired from clinical duties).”
18. Do you use any collaborative tools or systems?	None of the respondents reported using collaborative tools or systems, but four did not know what was meant by the question – which probably means that they do not.
Usefulness	
19. What kind of benefits do you gain from membership?	All of the respondents perceived that they did gain benefits from using Case 1. All either claimed that they gained knowledge, understanding or information: e.g. respondent 9 stated “Access to wide knowledge base of practitioners who work in same area.”, (some believed earlier questions addressed this, e.g. respondent 4 stated “See above.”)
20. Do you find contribution and or collaboration easy to achieve?	The majority perceived contribution and or collaboration either achievable, or easy to achieve. One respondent (3) stated “Not really, only tried once and it was a bit lengthy but achieved my aim”; respondent 11 stated “I don’t contribute”; respondent 13 stated “I think it is probably easy to achieve but rarely actually do”; and respondent 17 stated “Easy to do but collaboration is more questionable”
21. Do you find problems with access to technology, bandwidth, complexity of systems or tools?	Only one respondent replied that they did experience problems, respondent 4 stated “Yes. Mostly down to my ignorance but [anonymous] is extremely helpful in this regard!”. The rest appeared to be comfortable with technology.
Sustainability - is Case 1 growing in:	
22. Size (number of members)	Seven respondents replied “yes”, one did not answer the question, the rest did not know.
23. Scope (the types of issues it deals with)	Thirteen respondents replied “yes”, one replied “no”, one did not answer the question, the rest did not know.
24. Activity levels (the frequency of interaction)	Only one respondent replied “yes” to this question, so it is assumed that since the others were unaware of increased frequency of interaction, it was not increasing for them
25. Activity types (different types of activity taking	The respondents were not offering any definitive support for any increase in different types, but respondent 11 stated “Perhaps more non clinical issues being

place)	raised”
26. Why do members leave?	None of the respondents appeared to know why anyone had left Case 1, but many offered suggestions.
27. Why do members remain?	The respondents appeared to believe that members remain due to all of the benefits they had already detailed (one did not answer this question); respondent 11 confirmed “Because they obtain support and advice”

Table 2 Questionnaire questions and responses

Discussion of the findings and conclusions drawn are presented in the final section. In the next section the responses to the questionnaire are analysed.

7. DISCUSSION AND ANALYSIS

The literature suggests that telemedicine services provide opportunities for communities to emerge. The responses to the questions appear to support the proposition that the services provided by Case 1 do indeed lead to the development of a community. This claim can be supported directly by the respondents: all but three respondents think Case 1 is a community; all but one of the respondents reported that they were frequent users of Case 1. Furthermore ten respondents believe that Case 1 builds social cohesion. Online communities can be characterised as complex social networks where participants establish connections over time (Panzarasa et al., 2009). The responses to the questionnaire appear to confirm that this is the case: there is social cohesion; the community has a distinct identity; almost all respondents are frequent participants in the community over time.

The literature also suggests that where telemedicine communities exhibit the appropriate characteristics, communities of practice will emerge. Data from the respondents appears to support this proposition. Appropriate characteristics include:

- They develop member value – all but one respondent was clear that Case 1 did facilitate greater effectiveness of practice.
- Members share common practices (Vidgen et al., 2013) – all but four respondents agreed that membership of Case 1 facilitated greater consistency of practice, all but one agreed that there are shared language, approaches, systems and tools between members.
- They form from self-selecting members – membership of Case 1 is entirely voluntary and elective.
- Members engage in externalising tacit knowledge and internalising explicit knowledge – all but one respondent agreed that members acquired, shared, and retained knowledge.
- Members are professionals bound together informally through problem solving and solution seeking – all but one respondent agreed that membership facilitates greater effectiveness of practice; all but four respondents agreed that membership facilitates enhanced quality of practice and greater consistency of practice. Although only two respondents believed that membership facilitated greater cost effectiveness, the main aim of Case 1 is not financial, but professional practice.
- Members share common modes of discourse and vocabulary, common meaning and shared history - all but one respondent agreed that are there shared language, approaches, systems and tools. However, some complained about “too much specialized jargon” and “far too many unexplained acronyms”.
- They have community-specific structure, community rituals, continuity of communication and a common on-line meeting space - all but three respondents think Case 1 is a community; community rituals are less obvious but blogging, emailing and responding to questions from the community could be seen as community rituals. Continuity of communication is evidenced by prolonged membership. The common on-line meeting space is primarily the blog, but this is enhanced by an email list.
- They are collaborative – although none of the respondents use any collaborative tools or systems, they all commented on problem solving, knowledge sharing, and support.

The literature suggests that telemedicine communities of practice enable members to develop credibility and trust. Once again, data from the respondents appears to support this proposition. All of the respondents appeared sure that trust was developed, and all of them found this question sufficiently important that they responded in some detail offering explanations about how trust was built.

The literature also suggests that telemedicine communities of practice are sustainable because healthcare professionals perceive them as being useful. All of the respondents appeared to believe that members remain in the community because they derive benefits from belonging to it: “they obtain support and advice”; have “access to wide knowledge base of practitioners who work in same area”; glean “a lot from reading”; and they present their own cases. What is more, the community is still growing, albeit slowly.

These findings are summarised below (Table 3 Key Findings Table 3):

Literature	Finding
Telemedicine services provide opportunities for communities to emerge.	Case 1 is a telemedicine community that has grown from a self-selecting group of specialist medical practitioners.
Where telemedicine communities exhibit the appropriate characteristics, communities of practice will emerge.	The appropriate characteristics for a community of practice exist in Case 1, and it can be described as a community of practice that has emerged as a result of collaboration between and knowledge sharing amongst a group of specialist medical practitioners.
Telemedicine communities of practice enable members to develop credibility and trust.	All of the respondents were clear that there is trust amongst the members of Case 1.
Telemedicine communities of practice are sustainable because healthcare professionals believe them to be useful.	Case 1 membership is slowly growing and members frequently participate and interact with each other.

Table 3 Key Findings

This research studies a group of geographically-dispersed medical experts using collaborative technologies. Their practice involves specialised medicine practiced in isolation, away from colleagues and organisational support. This research is based on the propositions that telemedicine services provide opportunities for communities to emerge; that where telemedicine communities exhibit the appropriate characteristics, communities of practice will emerge; that telemedicine communities of practice enable members to develop credibility and trust; and that telemedicine communities of practice are sustainable because healthcare professionals perceive them to be useful. The case study conducted by this research appears to support all four of these propositions from the literature.

While communities of practice are emergent they still require structure, and access to ICT Technologies. Communities of practice that emerge within existing organisational structures such as professional organisations or corporations may have easy access to the ICT Technologies hardware and software that is needed to support a communities of practice, but simple technology may also be effective: in Case 1 only a blog, a webpage and an email list was used to structure the community. This suggests that media richness and complex technology are not necessary conditions for telemedicine communities of practice to emerge.

8. CONCLUSIONS

The literature suggests that telemedicine through on-line communities of practice involve self-selecting members of professionals bound together informally through problem solving and solution seeking, thereby generating knowledge, developing members' capabilities to build and extend knowledge (Manville & Foote, 1996; Wenger & Snyder, 2000), this is the how Case 1 membership is formed and access to knowledge is important. Communities of practice enable asynchronous, immediate, interactive, low cost communication and weblogs offer asymmetric communication (Lee & Trimi, 2008; Silva et al., 2006) and this is the situation with Case 1. Although community interaction can take place both online and offline and the use of face-to-face interaction builds stronger relationships between members and aids in the cohesiveness of virtual groups (Panteli & Duncan, 2004), thus social networking may have both online and offline elements, Case 1 uses only online communication. This research found that where members do meet face-to-face it is through communities other than Case 1. The media content may not be rich, but in the form of text via a forum, blog, or email and Vidgen et al (2013) find no link between media used and community building, case 1 uses email and blogs without rich media yet maintains a persistent community of practice. Credibility is positively correlated with message acceptance by recipients (Haythornthwaite 2002) and for practitioners in case 1 credibility and trust are important and related to message acceptance by recipients. Communities of practice exist for as long as there is interest in maintaining the group or people have a reason to connect, but is social capital developed in virtual communities strong enough to overcome barriers to knowledge sharing? This research contributes to our understanding of on-line telemedicine communities of practice by demonstrating that, for Case1, the social capital developed from being a member of Case is sufficient to overcome barriers to knowledge sharing and leads to the community continuing to grow.

8.1 Practitioner application

The outcomes of the research have the potential to be generalised to other populations who might also benefit from such communities of practice using collaborative technologies. The use of online communities of

practice should be encouraged in order to improve communication between healthcare practitioners so as to improve the creation and sharing of knowledge, enhance collaborative working and improve healthcare practice. In order to ensure continued use of telemedicine communities of practice it is important to establish credibility and trust in information shared through the community. As long as members believe that they are benefiting from membership they are likely to continue to participate in the community.

8.2 Academic Implications

Social media based communities of practice do not require rich media, simple text through email and blogging is sufficient. Even though in some EU countries telemedicine is not thriving (May et al., 2003), and faces significant challenges (Thielscher & Doarn, 2008), if communities of practice enable knowledge creation, knowledge sharing and collaborative working, the benefits from participation in a community of practice are sufficient to overcome barriers to knowledge sharing and leads to community sustainability.

8.3 Further research

Further research could continue to track the progress of the Case 1 community of practice as it evolves over time. A richer picture might emerge if members of the community of practice could be interviewed, and their stories can be used to better understand the effectiveness of using collaborative technologies to facilitate a professional community of practice.

Other telemedicine communities could be studied, broadening our understanding of what makes a telemedicine community of practice effective and sustainable.

The survey developed by this study could be adapted (e.g., with Likert scales) and used in a larger quantitative study to determine the generalisability of the findings.

8.4 Limitations

The limitations of this study include the difficulty of reporting on specific actors and their actions where they involve confidential medical data. The research is further limited by need for anonymity of the case organisation and its members. The total membership for Case 1 was over 500, thus the response rate for the survey was extremely low. However, generalisability from case study can be achieved, not in the form of positivist research where one is looking for a causal relationship from a sample to a population, but from analytic generalisation (Yin, 1994), supported by the validity of extrapolation from individual cases by plausible reasoning used when analysing the results of the study and drawing conclusions from them (Walsham, 1993).

The case organisation is small, its membership ad-hoc, and it is a group of geographically-dispersed medical experts whose practice involves specialised medicine practiced in isolation, away from colleagues and organisational support. As such it is a very interesting case, but difficult to access, and the number of respondents to the questionnaire was very small. Because the members are geographically-dispersed and operate to a large part in isolation, it was not possible to interview them. Thus this research can be criticised for having a very small sample size, and it does not have the rich data usually associated with qualitative research; nor does it have the large sample size and rigorous statistical analysis associated with quantitative research. Nevertheless, the findings in this case study represent an interesting contribution to the study of healthcare communities of practice, telemedicine and online medical communities.

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