This is an author produced version of a paper published in Behaviour & Information Technology. This paper has been peer-reviewed but does not include the final publisher proof-corrections or journal pagination.

Citation for the published paper:

Gustafsson Friberger, Marie; Falkman, Göran. (2013). Collaboration processes, outcomes, challenges and enablers of distributed clinical communities of practice. Behaviour & Information Technology, vol. 32, issue 6, p. null

URL: <https://doi.org/10.1080/0144929X.2011.602426>

Publisher: Taylor & Francis

This document has been downloaded from MUEP (<https://muep.mah.se>) / DIVA (<https://mau.diva-portal.org>).

RESEARCH ARTICLE

Collaboration processes, outcomes, challenges, and enablers of distributed clinical communities of practice

(Received 8 June 2010, resubmitted 30 December 2010, revised 9 June 2011)

Modern healthcare's need for knowledge sharing and bridging the research-practice-gap requires new forms of collaboration, in which clinicians of varying clinical and research expertise work together over geographical and organisational borders. To support such distributed communities of practice (CoPs), an understanding of their collaboration processes, outcomes, challenges, and enablers is needed. The paper examines these issues through a case study of a long-running CoP, the Swedish Oral Medicine Network (SOMNet). SOMNet's main form of collaboration is monthly telephone conference meetings centred on case consultations. Cases are submitted by the clinicians via a Web-based system. The methods used were interviews, observations, and a questionnaire. The work adds to previous research by studying a distributed CoP explicitly focused on supporting the transfer of scientific results from researchers to practitioners.

We found that the regular meetings give a rhythm to the community. The centrality of cases means an immediate benefit for the submitter while the

community is provided an authentic context for learning. SOMNet yields opportunities for help and learning for diverse expertise levels; the type of benefits is affected by the participant's degree of oral medicine knowledge and collaboration involvement. There are challenges in accommodating varying levels of expertise and encouraging those less experienced to participate. Enablers of the collaboration include the participation of experts, meeting facilitators and well-adapted ITs.

Keywords: communities of practice, clinical collaboration, knowledge translation, medical team meetings, medical informatics, dental informatics

1. Introduction

Given the rapidly expanding research in healthcare, it is difficult for a clinician to have a grasp of all aspects of their evolving field. This leads to a need for *continuing health education* (CHE) and for asking other practitioners for advice, i.e., *case consultations*. However, getting new discoveries into practice, referred to as *knowledge translation* (KT), is a time-consuming process that faces several individual and organisational barriers (Straus *et al.* 2010).

One way of promoting clinical learning and knowledge sharing is through *communities of practice* (CoP). A CoP is a group of people who share “a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis” (Wenger *et al.* 2002). CoPs are focused on problem solving and decision-making, and, thus, CoPs in healthcare focus on how medical decisions are made in a given domain. The use of CoPs has been proposed both for CHE (Parboosingh 2002) and for KT (Barwick *et al.* 2009).

Given the centrality of case discussions to clinical practice, they are an intuitive focus for a clinical CoP. Including both researchers and clinical expertise is beneficial for KT and for resolving cases (McDonald and Viehbeck 2007). The researchers provide insight into the state-of-the-art of the domain as a scientific field, as well as skills in finding and assessing the importance of research articles. At the same time, clinical expertise is needed when relevant research evidence may not be available (Mullen and Streiner 2004), and the value of such expertise cannot be disregarded (Haynes *et al.* 2002). Clinical and research expertise, as well as knowledge needs, are often spread among organisations. When a CoP is not co-located and seldom communicates through face-to-face communication, it can be described as a *distributed* CoP. A distributed clinical CoP enables the participation of clinicians and researchers who might have otherwise had little contact. At the same time, the lack of physical meetings entails the need for clear collaboration processes and information technology (IT) support.

The problems addressed in this paper are related to the understanding of distributed clinical CoPs in which members have large variations in clinical and research expertise and where the dissemination of scientific results is a central issue. In order to support distributed clinical CoPs, both organisationally and in terms of adequate IT, several questions need to be answered: Which processes of collaboration are effective? Which outcomes can be seen, in terms of, e.g., clinical and professional development impacts? What are the challenges and enablers of a distributed clinical CoP? The paper examines these questions through a case study of a long running CoP within the field of oral health care.

The consistent and appropriate use of research results in clinical practice has been identified as an important factor to improve patient care. The sharing of knowledge between researchers and practitioners has been promoted as a key enabler for achieving

this goal (Conklin *et al.* 2011). A conception of KT within the medical domain is the *Promoting Action on Research Implementation in Health Services* (PARiHS) model, in which KT is described in terms of three factors: the level and nature of the knowledge being translated, the organizational context, and the method of facilitating the dissemination and implementation of the knowledge (Kitson *et al.* 1998, 2008). Clinical collaboration and knowledge sharing have been studied within related contexts, such as teleconsultations and multi-disciplinary team meetings (MDTM). In teleconsultations (e.g. Lundvoll Nilsen and Moen 2008, Boeddicker 2006), the participants are usually one specialist (or a hospital) and one general practitioner (or a primary care unit). MDTMs are a means for providing coordinated, collaborative care, as they allow different clinicians to discuss treatment options, and offer alternatives to chosen treatment plans (Walsh *et al.* 2010). The MDTM fills both diagnostic and educational roles, and the case narratives of an MDTM serve an information sharing function (Kane and Luz 2009).

Teleconsultations, MDTMs, distributed clinical CoPs, and clinical KT (e.g., PARiSH) share an overarching goal of general improvement and harmonisation of patient care. However, the present study focuses on distributed collaboration where there are more than two types of participants, which sets it apart from the common format of teleconsultations. The studied distributed CoP makes the case discussions available to a larger group of clinicians, while adding challenges related to handling a larger and heterogeneous group. This study also has commonalities with the format of the MDTM, but without the emphasis on the coordination between the different roles and disciplines involved in caring for a specific patient, and with more loosely coupled participants. Within the studied collaboration, there is little variation with respect to the discipline, but much variation in the other aspects, such as degree of specialisation, experience, focus on clinical work or on research, access to external evidence, location, and level of partici-

pation. Clinical collaborations also vary with respect to the purpose of the collaboration, which includes improving patient care, continuing education, and promoting research. The studied collaboration touches on all of these, but with more emphasis on promoting research than has been seen in publications such as those previously mentioned. Oral health care is an area related to, but different from, medical health care, due to dentists collecting, displaying, and analyzing medical data differently compared to their medical counterparts (Schleyer and Spallek 2001). Thus, the presented study answers the call for more research on specific cases to reveal contextual factors that influence the KT process (Conklin *et al.* 2011).

The presented study of a distributed clinical CoP within oral health care is important for several reasons. First, it contributes to the understanding of clinical collaborations in general, where the results are relevant for both tele-consultations, MDTM and KT. At the same time, we describe a collaboration that is unique, with respect to its longevity, its distributed consultations involving both clinicians and researchers, and its integrated technical support based on the collaboration. In a recent review of 26 studies of the use of CoPs within the healthcare sector, only one CoP had both researchers and practitioners as community members, with the specific aim of sharing knowledge between the two groups (Li *et al.* 2009). Second, we believe that collaborations of the sort presented here are a valuable means of knowledge management in modern medicine, and that healthcare organisations can use our characterization to initiate their own distributed clinical CoPs, to support collaboration within other medical fields. This way, the presented work adds to the sought-after research on factors that influence organizational context and methods facilitating the translation of knowledge in a specific context (Rycroft-Malone *et al.* 2004). Third, given that the single previously studied CoP aimed at sharing knowledge among researchers and practitioners is based on the sending of emails between com-

munity members (Russell *et al.* 2004), the presented work, with its solid foundation in modern Semantic Web-based techniques, can be used to inform the development of more advanced IT solutions for distributed clinical CoPs, since an in-depth understanding of the functioning of a collaboration is necessary to provide it with adequate IT support.

The purpose of this study is to explore the collaboration processes, outcomes, challenges and enablers of a distributed clinical CoP where members have a large variation in expertise and research experience. This has been carried out through a case study of a geographically distributed clinical CoP, the Swedish Oral Medicine Network (SOM-Net). The community members are mainly clinicians and researchers who have a special interest in oral medicine,¹ a sub-discipline of dentistry. The practice is centred on case consultations, focused on generating ideas for diagnosis and treatment, and with an intent to include more external evidence as the basis for decisions as well as to spread and harmonise oral medicine knowledge. The case consultations take the form of monthly telephone conference meetings, where clinicians submit cases for discussion. The collaboration is supported by the Swedish Oral Medicine Web (SOMWeb), a Semantic Web-based system based on SOMNet's forms of collaboration.

This article complements previous publications that have focused more on the SOMWeb system itself. Anonymous (2008) provides an overview of the SOMWeb system and its development, as well as initial results related to collaboration process, outcomes, and barriers. In the present article, these results are expanded and further analysed. Moreover, the described challenges and enablers have not been presented in this elaborated form before. Anonymous (2010) offers a different angle by presenting impacts of

¹Oral medicine concerns diseases related to the oral and paraoral structures. This includes the principles of medicine related to the mouth, as well as diseases specific to the orofacial tissues and oral manifestations of systemic diseases.

the system on the collaboration, identified through log analysis, interviews, and analysis of cases. It describes system impacts on membership, case submission, chairpersonship, and the community of practice as a whole.

We begin with a brief presentation of the settings for this study, the SOMNet collaboration (Section 2). The collaboration was studied using methods of interviews, observations and a questionnaire (Section 3), which resulted in a detailed analysis of the collaboration process, outcomes, challenges and enablers (Section 4). We discuss the implications of the analysis of SOMNet's collaboration and relate it to the works of others (Section 5). Finally, conclusions of this study are presented (Section 6).

2. The SOMNet Collaboration

Oral medicine often deals with disorders of low prevalence, which means that cooperation between geographically distributed clinics is needed to collect diverse and numerous cases for analysis, as well as to provide a means of consultation and learning for a broader audience. For these reasons, in the early nineties, four hospital unit clinics began holding telephone conference supported meetings for discussing cases. This evolved into the SOMNet collaboration, which holds monthly telephone conference meetings to discuss difficult and interesting cases. This collaboration is carried out under the auspices of the Swedish Oral Medicine Society (SOMS),¹ a professional organisation which provides specialist education in the form of a certification with both theoretical and practical components.

The members of SOMNet are mainly dentists with an interest in oral medicine. The members vary with respect to level of expertise, research experience, and employing

¹<http://www.soms.se/>

organisation: Among the participants are general practitioner dentists, hospital dentists, specialists in oral surgery and oral medicine, professors, and several oral pathologists. Both public clinics and private practices are represented among the general practitioners. During the spring of 2010, around twenty clinics have joined each meeting. At each of these meetings, there are between one and ten participants, with an average of three.

SOMNet has used various forms of IT support, as discussed in Section 4.4.4. The SOMWeb system was launched in 2006. In January 2009, when the evaluation period was over, SOMWeb had 120 registered users located at 74 clinics. It had been used at 23 meetings and the case repository contained 121 cases.¹

3. Methods

To study the collaboration and knowledge sharing of SOMNet, a variety of methods were used: an online questionnaire, interviews with participants, and observations of teleconference meetings. Table 1 summarizes figures related to the methods used. This section also discusses ethical considerations.

3.1. *Interviews*

A semi-structured interview format was used; the interview guide included themes such as submitting cases, meeting participation and preparation, knowledge needs and benefits of SOMNet. In selecting interviewees, we used a combination of maximum variation sampling (with respect to location and membership length) and snowball sampling, with elements of convenience sampling.

¹To give an indication of its use since, in May 2011, SOMWeb had 300 registered users at 200 clinics, had been used at 45 meetings and contains 224 cases.

Nine members were interviewed. Three of the interviewees have been members of SOM-Net from the mid 1990's, three have been members for at least four years, and three have joined more recently. Two of the respondents are oral pathologists and do not see patients themselves. The other seven all work at hospitals, and two of them have a research background. This is representative of those with a high level of participation in SOMNet. Of the interviewed, six are men and three women. The average age of the dentists was 55 and they had been practicing for an average of 31 years.

The first author conducted the interviews, each lasting between 35 and 85 minutes. The interviews were recorded and transcribed. Patterns in the interview data were identified and coded through content analysis (c.f. Patton 1990). The interview questions were used as initial themes for coding the interviews, but matters that came up spontaneously during the interviews were also included in the coding.

We set out to collect data on the process and outcomes of SOMNet. However, as the interview data was analysed, several themes relating to challenges and enablers became apparent.

3.2. *Observations*

The purposes of the observations were to elucidate how cases are presented during telephone conference meetings and how clinicians behave locally during these meetings. The first author conducted all observations, taking notes both of what was said during the telephone conference as a whole, and what the participants said and did locally. Ten meetings were observed: six at the clinic for oral medicine at the Sahlgrenska Academy in Gothenburg, and four at four other clinics in Sweden. The first is a hospital unit clinic specialising in oral medicine, while the other four are dental units of hospitals not specialised in oral medicine.

In analysing the data, descriptions of meeting procedure and case presentations were generalised from observations and notes. However, no content analysis of what was said at the meetings was carried out.

3.3. *Questionnaire*

The online questionnaire contained both open-ended and closed questions formulated by the authors. These were checked by our clinical contact previous to distribution. Questions related to, e.g., participation in telephone conferences and whether the respondent had submitted cases. The questionnaire was made available for one month in the spring of 2007. Requests to complete it were made at a SOMNet meeting, on the news page of the SOMWeb system, and by e-mail to approximately 60 members, which was all of the members at the time. In total, 24 completed the questionnaire. Of these, thirteen worked in dental units in hospitals, six in specialist clinics, three in public dental care, and two in private practice. Eighteen had worked as dentists twenty years or more, four for ten to twenty years, one for five to ten years, and one for zero to five years. The average age of the respondents was 51, with thirteen women and eleven men.

3.4. *Ethical Considerations for SOMWeb*

No information is available in SOMWeb that will reveal the identity of the patient in the presented cases. The case data that each presenter provides does not contain any personal information, except age, gender, and country of birth. En face images are prohibited and intraoral images do not disclose any identity. All members of SOMNet have signed a professional secrecy agreement as part of their clinical assignment. It is the individual submitter's responsibility to ascertain the patient's approval for discussion of their case at SOMNet's meetings. SOMNet suggests that a note should be made in the patient

record that this has been done.

4. Results

The results of the study of the collaboration of SOMNet begins with a description of SOMNet's process of collaboration (Section 4.1), i.e., their meetings, which includes the meeting structure, considerations in submitting cases, and the participants' meeting preparations. Outcomes (Section 4.2) include professional development impacts and clinical impacts. Challenges of the collaboration (Section 4.3) include accommodating varying levels of expertise, using external evidence in everyday work, and the clinicians' lack of time. Finally, enablers of the collaboration (Section 4.4) include the presence of a champion and facilitators, the involvement of experts, the structure of the collaboration, and well-adapted IT-support. Tables 2 and 3 summarize the results of the study.

4.1. *Collaboration process*

4.1.1. *Meeting structure and activities*

This section presents the overall structure of a SOMNet meeting, what happens during a case presentation, and how practicalities of the meetings are handled. The SOMNet distance consultation meetings are held once a month (four times in the spring and four in the fall). During meetings, each location is part of a telephone conference. In addition to this, meeting participants refer to case information and images, here referred to as case descriptions. These case descriptions are submitted through the SOMWeb system (see Section 4.4.4). The submission form (marked A in the figure) includes questions about current medications and tried treatments, for example, and a list of allowed values is shown for each question. If a needed value is missing from the list, the user may enter it

into the value list. The questions are grouped into categories such as general anamnesis, diagnosis, and oral status. The form also includes a free text part, where the user can enter information not captured in the questions of the form. Images associated with the case are also submitted from this form.

The time scheduled for each meeting is one hour, during which three to six cases are introduced for the first time, and up to three follow-up cases are presented. A chairperson facilitates the meeting by, for example, heading and summing up discussions as well as guiding the transition between case presentations.

When presenting a case, the case submitter usually tells the story of his or her meetings with the patient, the treatments attempted, and the results. After, and sometimes during, this short presentation, the other participants ask questions of clarification. Depending on the kind of case presented and the clinician's purpose for discussing it, the participants will suggest possible diagnoses and treatments. Similar cases or general treatment strategies will sometimes accompany the suggestions. A broader discussion may ensue, for example, about reported side effects of medications or whether a certain treatment is suitable in general. The chairperson usually starts summarising when several options have been put forth, and suggestions are given to the presenter.

All the members do not participate in every meeting. Where the participants of a clinic sit during meetings depends on the number of participants. If there are one to three participants at a clinic, they usually sit in front of an office computer. For larger numbers, a meeting room with a projector is normally used. SOMNet has much experience with teleconferences and there is a flow in the conversation even though participants cannot see each other. Most identify themselves before giving their comments. If several members at one of the clinics choose to have a whispered, local discussion among them, the flow in conversation is quicker and more interactive.

4.1.2. *Case submission*

The interviewees gave three main purposes for presenting cases: seeking advice regarding diagnosis or treatment, raising a general issue for discussion, and educating other members. A submitter may have several motives for bringing a case to the meeting, and these motives vary with the submitter's expertise. A clinician who has less experience, due to seeing fewer patients with oral medicine conditions, tends to seek advice. The more experienced clinicians will normally consider submitting cases that will be of the greatest value to the entire community, as expressed by Dentist 1:

I like to add cases that are original and have current interest. That is, cases where there could be something new. But I also bring up typical cases, but maybe with some new angle on diagnostics or treatment that we may not have considered before. Or cases that have been brought up previously that I can illuminate with a new case. (Hospital dentist 1; research background)

This example points toward a fourth purpose for presenting cases, not explicitly mentioned by the respondents: building one's professional reputation. The submission of rare cases, as illustrated below, may be viewed in the same manner:

Of course, it is always more fun to find something that nobody else has seen before. It is like collecting stamps. If you have a [rare stamp], then you want to show it off. So there is a little bit of vanity in it. (Hospital dentist 1; research background)

This category of case submissions may give junior members the impression that only very unusual cases are interesting. We will return to this tension in Section 4.3.1.

Six out of seven interviewees had submitted cases, not including the two pathologists, who do not see patients. Seven out of 24 questionnaire respondents reported that they

had submitted cases to the SOMWeb system. In the questionnaire, 16 responded that they had thought about adding a case to SOMWeb but had not done so, while four had not. One person did not reply to the question. In response to an open-ended follow-up question on why a case had not been added, five gave reasons related to missing images and data, four indicated a lack of time, and two said that the case felt too banal. The most common response to a questionnaire question on what would motivate the respondent to submit more cases was ‘more time’. Later, we will return to the issues of what cases are of interest (Section 4.3.1) and the lack of time (Section 4.3.3).

4.1.3. Meeting preparations

Participants can prepare for the meeting by reviewing case descriptions and images prior to the meeting. While reviewing the cases they try to form their own opinion of them, which they find increases the benefit of participation:

I usually want to [go through the cases], because otherwise I think it is hard to follow. (Hospital dentist 2)

It was also indicated that there is an obligation towards the case submitter to review the case before the meeting, preparation which is not directed at the individual’s learning but at the needs of the case submitter and community.

All the interviewees replied that they usually go through the cases before the meeting, either the same day or the night before. Of the twenty-four questionnaire respondents, six replied that they always prepared, eleven that they sometimes prepared, three seldom prepared, and one never prepared (three respondents, who had not taken part in any meetings, did not answer the question).

The designated chairperson carries out a more thorough review of the meeting’s cases. This involves searching for applicable research literature as well as recollecting similar

cases of their own. The chairperson also reflects on the sort of help needed by the case submitter and how to lead the case discussion:

You look at a case for maybe five to ten minutes. Sometimes it is self-evident. And sometimes you ask yourself ‘What is this?’. And then you look at it longer. The case of [name of member] for today’s meeting I looked at for maybe two minutes, just to understand what the question was. And then how to handle it, that I spent more time on. How to introduce it at the meeting. But that I wouldn’t have spent time on if I wasn’t chairing the meeting. (Hospital dentist 3; research background)

4.2. *Collaboration outcomes*

4.2.1. Professional development impacts

Based on the interviews, three main impacts related to professional development were identified:

- case-based learning and knowledge sharing,
- building identity and maintaining enthusiasm, and
- introducing external evidence to clinical practice.

The case discussions of SOMNet provide opportunities for learning for its members, even though they may have differing levels of expertise. For a case submitter, there are direct diagnosis and treatment suggestions. However, meeting participation was found beneficial regardless of whether you submitted cases or not:

I have never sent in a case for discussion. But I can say that over the years I have participated I have acquired knowledge that helps me solve cases that come in today.
(Hospital dentist 2)

For members listening to the discussion of others, there is an opportunity to assimilate different strategies and viewpoints in a social setting. Less experienced members are exposed to the reasoning and knowledge of the experts, while the expert members obtain access to new findings and get the opportunity to share their knowledge.

Another dimension of the collaboration relates to social aspects, such as identity building, enthusiasm, and collegiality:

It is the exchange of experience. There are always new changes that you haven't seen before. Listening to others' problems and new treatment methods. It is great.

It is like working at a very big clinic. (Hospital dentist 4)

SOMNet can also be seen as a way of making the experts more approachable and known to non-experts, as indicated by more experienced members often being contacted by meeting participants after the meetings to get further treatment details.

While suggestions from other clinicians is one way of obtaining input on cases, research literature is an important source of external evidence. One goal of SOMNet is to increase the use of such sources in clinical practice. The meeting chairperson searches for relevant research findings for each case and the interviewees find that the inclusion such findings bring a sense of closure to the discussions. Furthermore, participants from research institutions use SOMNet to make practitioners aware of new research findings. This means that members who do not use research findings as part of their everyday work still get an opportunity to be introduced to key developments.

4.2.2. Clinical impacts

The interview responses point toward two main clinical impacts of SOMNet:

- the improved care for individual patients through access to external expertise and evidence, and

- the overall alignment of treatment models within the discipline.

These impacts are based on responses to questions of how SOMNet has helped resolve specific cases and how SOMNet equipped them to handle new cases. However, a thorough assessment of the clinical impact of SOMNet is beyond the scope of this study. Thus, the magnitude of these impacts is unknown.

Oral medicine has many diseases with low prevalence, making case-focused collaboration especially valuable:

We often have rare diseases, so everybody doesn't have experience with everything. I still see first cases, after 40 years. And that means it is a big advantage with SOMNet that here we have 30–40 experienced people where there is always somebody who has seen something similar. (Hospital dentist 1; research background)

All respondents gave examples of how they had been helped through the suggestions of SOMNet. During the time SOMNet has been operating, several cases have received immediate attention and proper treatment has been commenced instantly. A case with an unusual necrotic tongue lesion was diagnosed with giant cell arthritis and high doses of corticosteroids were immediately administered which may have prevented blindness as a serious consequence. Unique oral mucosal lesions have also been recognised in patients with psoriasis. Three different members of the network identified this lesion and the separate clinicians had most likely not discovered the association to psoriasis.

The other clinical impact of SOMNet is an overall alignment of treatment models within the discipline. Several interviewees reported submitting cases because they sought to discuss different paths of inquiry or treatment alternatives. One reason for this is to find out how the others handle the advantages and drawbacks of an action. Another interviewee touched on having a clearer conception of treatment models and that SOMNet enables

her to more systematically look at how complex cases are handled.

4.3. *Collaboration challenges*

4.3.1. Accommodating varying levels of expertise

As seen in Section 2, SOMNet has a large variation in the clinical and research expertise of participants. While this variation means that a wide group of clinicians have access to the collaboration by being able to submit cases and take part in the discussion, the variation is also a challenge, as it affects who submits cases and who speaks at meetings.

Most of the cases are supplied by a few specialist clinics. One reason for this is that these see more patients with specifically oral medicine conditions and thus have more relevant cases, giving the impression that these clinics have a greater responsibility to submit cases. However, the questionnaire and interview responses also indicate that one reason for not submitting a case is concern over revealing knowledge gaps or cases not being “advanced enough”. This is a concern for the more active members, as expressed by Dentist 5:

I think what scares people is that the top names submit a lot of cool cases and there are a lot of treatments and lengthy discussions about these at the meetings. And then there is somebody at a small clinic who doesn’t know much about oral medicine and who has found something strange and doesn’t know what to do. I think they may be a bit inhibited then. The thing is that you could submit something that for many participants is a very banal change... but for this person it isn’t... and to then dare to present it and [...] then there are twenty other people listening who have seen such a change during the past week. (Hospital dentist 5)

At the same time, expert participants often find that meeting discussions about what appeared to be straightforward cases to them often actually turned into very interesting discussions, as Dentist 1 explains:

To me there isn't one case that isn't interesting enough. [...] I think that you can take the most typical case and you can always discuss it. (Hospital dentist 1; research background)

A related factor is the proportion of time spent in the clinic on common types of cases, as reflected on by Dentist 3:

But I think that it can be just as good to discuss regular, quite banal changes. Things that take a lot of time in the clinic, where you have many cases. 'Should we follow them, should we not follow them?' And try to form a common opinion about this. (Hospital dentist 3; research background)

Another effect of the varied expertise is that many participants do not speak at meetings. All of the interviewees find that encouraging participation from a wide variety of clinics and clinicians is important. One suggested that all meeting participants could be encouraged to talk by explicitly asking them what they think. Others brought up the role of the individual in this, in daring to speak even when others are more experienced.

The level of expertise of the clinician affects the extent to which participants learn from discussions, and a certain level of background knowledge in oral medicine was found to be needed to learn from the meetings. For somebody without this level of knowledge, the main learning opportunity comes from submitting a case. This is problematic, given that experts submit a majority of the cases.

4.3.2. Using external evidence in everyday work

While participating in SOMNet expose clinicians to more external evidence, it is unclear if this affects its use in their everyday work. When the interviewees were asked if participating in SOMNet had changed the way they seek knowledge, only one person explicitly responded that they were more active. The other respondents fall into two categories: those already using research literature on a regular basis and those that see themselves primarily as clinicians. For the latter category, it seems that searching for and reading research literature is something that the clinicians see as a natural part of the researchers' work, but not their own. Furthermore, interviewees who mainly see patients stated that they do not read literature as much as they would like due to a lack of time.

Another impediment to using external evidence is access. While interviewees at research institutions and some hospitals have access to online articles, smaller hospitals and general practitioners often lack such access. This stands in contrast the senior interviewee who reported that he had two "fantastic" librarians who often impressed him in what they could find. Knowledge about the availability of such resources, if they are available, should not be underestimated.

4.3.3. Handling the shortage of time

The interviewees often raised the issue of a lack of time, due to a heavy load of patients or teaching. This affected both their participation in SOMNet and their use of external evidence in their everyday work. When the interviewees were asked about the frequency of their participation in telephone conference meetings, all stated that they participate as often as possible. They are generally able to set aside time from their work. As indicated in Section 4.1.2, the lack of time limits the number of cases submitted.

One interviewee mentioned the differences he felt existed between his work place, where

oral medicine is only a small part of the overall activities and there is no research connection, and research institutions, which specialise in oral medicine. He found that it was not possible to set aside office hours to search for and read relevant literature. Interviewees who were not at a research institution, who reported that they read articles, often did so outside of work hours.

4.4. *Collaboration enablers*

4.4.1. Champion and facilitators

One person in SOMNet has taken on the role of champion, through initial chairing of meetings, organizational and technical development, and outreach to potential members. Though there was no specific interview question about the importance of the champion, the name of the champion came up in all interviews. One interviewee specifically presented this person as the main enabler of SOMNet. While this issue was not explicitly studied, there are indications that the champion is an important enabler of the collaboration's growth and development. Furthermore, it was the champion that initiated the development of the SOMWeb system.

Another important role is that of facilitating, or chairing, the meetings. Previously, the collaboration champion often also facilitated meetings. With the introduction of SOMWeb, a rotation of chairpersonship among core members began. Two of the interviewed members who had facilitated meetings expressed that they found value in preparing for meetings, in getting an occasion to look into the literature and to contribute to the case discussion. Two other interviewees, who had also facilitated meetings but were less experienced, expressed apprehension toward chairing meetings and what was expected of them. This led to the creation of guidelines for the chairperson, guide-

lines which are included in the SOMWeb system. Thus, while there is an indication that collaboration can become more robust by distributing the responsibility of preparing and chairing meetings over more members, this also creates a need for greater clarity around the facilitator's role.

4.4.2. Experts

Another enabler of SOMNet is the participation of oral medicine experts, who have both in depth clinical experience and are familiar with recent research findings. This was pointed out by most interviewees, either by referring to their appreciation of the expertise of a specific person or through statements that the collaboration includes some of Sweden's top experts of the discipline.

For the experts to take part in the collaboration, they also have to find participation valuable. This is very clear in the interview with Hospital Dentist 1, who values the possibility of staying up to date with new cases, having the chance to engage with the literature when he chairs meetings, and to maintain competency and enthusiasm.

4.4.3. Collaboration structure

As described in Section 4.1.1, SOMNet has a regular collaboration structure, with one-hour meetings about once a month. Several interviews allude to the format and focus of the collaboration as something that makes it practicable. For example, the length and frequency of meetings meant that they were usually able to set apart time for them. One interviewee found that by focusing only on cases, the collaboration was maintainable. Another interviewee thought that if meetings were held more often, then participation might drop.

In addition to participants, the collaboration needs cases to discuss. Prerequisites for this are that submitters take the time to submit a case and that they feel assured that

their effort will be met with suggestions. The meetings can be seen as providing a deadline for case submission, while also providing a guarantee that one's case will be addressed.

4.4.4. IT support: From PowerPoint to SOMWeb

Since its inception, SOMNet used different variants of IT to support their collaboration: In the beginning, a handful of participants e-mailed case presentations to one another, in the form of PowerPoint presentations. The number of participants grew, and case presentations were put in a Web-repository, and eventually the need for another solution arose.

The development of SOMWeb followed an iterative, user-centred design approach (cf. Norman and Draper 1986). This means that a selected group of users were involved in the design process already from the start. These users took active part in the establishment of initial requirements, and have continuously provided feedback on developed prototypes.

The SOMWeb system (see Figure 1) includes such functionality as case-entry, case browsing, and meeting support. In SOMWeb, cases are entered using a community-defined case-entry form.

An evaluation of SOMWeb is included in Anonymous (2008), where improvements included making it easier and faster to enter cases, a more consistent data collection and that relevant information is available at the time of the meeting, as well as bringing more structure to SOMNet's activities in general.

5. Discussion

5.1. Identity, expertise and participation

The common purpose for participating in SOMNet is better patient care, achieved through access to external expertise and the continuing education that are provided

through the collaboration. However, depending on the level of expertise of the participant, there may be more focus on teaching or on learning. The relationships formed through SOMNet's extended collaboration can be seen as a way of building trust and identity in the profession.

Minvielle *et al.* (2010) point out that coordination depends on many qualitative factors: trust, experience in working together, level of uncertainty, and professional differences. In SOMNet, professional differences are clearly seen with respect to engagement in research. While many healthcare organisations have policies for making decisions more evidence-based, a clear division can be seen in SOMNet between clinicians and researchers. Several interviewees see themselves primarily as clinicians and, as expressed in Section 4.3.2, this leads to a view that research articles are less of a concern for them. Gosling *et al.* (2003) find that social and cultural factors affect variations in use of external evidence, and we can see that these factors play a large role in inhibiting the use of external sources by oral medicine practitioners. This points to collaborations such as SOMNet being able to play an important role in increasing the use of external evidence.

According to Wenger *et al.* (2002), to be successful, a CoP should encourage different levels of participation, where the participants of a CoP can often be divided into three groups: core, active, and peripheral. The core group consists of members that take on leadership roles and set the agenda for the group. The active group's members are regular participants in the community's events and sometimes participate in discussions, but without the intensity or regularity of the core group. A large portion of the participants often belongs to the group of peripheral users, who mostly observe interactions between core and active members. Reasons for not participating may be that they do not believe their comments are valuable enough or that they do not have enough time. Wenger *et al.* (2002) hold that these peripheral members are a very important part of the CoP,

and that they are not as passive as they might seem. They take in what is said, and may bring it up in private conversations. The different levels of member participation are clearly discernible in SOMNet. The core members chair meetings, contribute most cases, and are very involved in the discussions. The active members participate in most meetings, sometimes contribute comments and provide some cases. Finally, there is a large group of peripheral members, who do not submitted cases and rarely or never make comments. Further investigation into levels of participation could identify work processes and technical support that raise the effectiveness and inclusiveness regardless of whether the clinician is a core or peripheral member.

Another collaboration aspect is that of leadership and meeting chairs, which we find are very important to ensure that the meeting is relevant to all participants, which is in line with the findings of Brown *et al.* (2009), Kuziemy *et al.* (2009), Swanson Jaecks (2009) and Walsh *et al.* (2010).

5.2. *Regularity and structure*

Wenger *et al.* (2002) suggest that successful CoPs have a rhythm, consisting of regular meetings, informal conversations, Web site activity, and so on. In the case of SOMNet, the most prevalent rhythm is the monthly telephone conferences. These affect when cases are entered and when members log in to the system. A system where members submit cases with a request for advice and other members could reply at any time would probably not work in this situation. This conclusion is supported by the observations made in Moehr *et al.* (2006).

The lack of time experienced by SOMNet's participants (see Section 4.3.3) is a common problem in clinical collaborations (e.g. Dawes and Sampson 2003, Swanson Jaecks 2009, Walsh *et al.* 2010). The presence of a clearly defined meeting time can be a way of

alleviating this problem.

Brown *et al.* (2009) also emphasise the importance regular team meetings, along with a structuring tasks to be accomplished before, during, and after team meetings, e.g., creating an agenda before the meeting with team members assigned to specific agenda items, taking minutes, and agreeing on suitable actions during the meeting for follow-ups. The structure of SOMNet's meetings bears similarity to the multidisciplinary medical team meetings described by Kane and Luz (2006) in that members meet regularly to review patient cases, establish a diagnosis, and decide on the most appropriate treatment plan for the patient. Since its inception, SOMNet has evolved into having a clear set of work practices and, as seen in Section 4.1.1, a SOMNet meeting contains the same set of processes, though the recording of outcomes was not done before the SOMWeb system and is still problematic after its introduction. It would be interesting to see how the MDTM structure could aid in the design of future versions of SOMWeb, adding possibilities for cueing chairpersons and participants in the discussions and securing that decisions are being made, supported by relevant external evidence.

5.3. *IT support for distributed clinical CoPs*

A CoP needs an evolution of IT support (Wenger *et al.* 2002). This principle emerges from the fact that they often begin as pre-existing personal networks, and that the level of designed support will grow and change as the community grows and changes. In the matter of SOMNet, this is very much the case, as described in Section 4.4.4. That is, SOMNet began with a simple technical solution, which has successively become more advanced and adjusted to the work processes of its members. One can also argue that it was necessary for the users to get used to the system functionality before they identified the need for new features, which is in line with results in Moehr *et al.* (2006).

The SOMWeb system illustrates relevant collaboration and knowledge sharing functions to be supported for a CoP of SOMNet's type, as well as exemplifies how this has been accomplished using a user-centred design approach. A commonly used approach in other systems supporting CoPs is using discussion forums and mailing lists. However, by using abstractions central to SOMNet's collaboration, a clearer focus on important, clinically motivated, concepts is gained. This also indicates that the identification of a community's core artefacts is a priority and that these artefacts should be reinforced in the system. The corresponding development of the SOMWeb system mirrors the increasing interest in using techniques from the Semantic Web in the implementation of distributed CoPs (Zhang *et al.* 2008), as these techniques sanction computations based on the *meanings* of entities.

Connected with the cases, the images have been found to be central to the information shared among the oral medicine clinicians, and similar conclusions have been reached by Groth *et al.* (2008).

As the membership grows, it is possible that adjustments will have to be made to the system. One aspect of this growth can be to focus on social aspects of the collaboration, to, for example, bridge the differences between different kinds of members. This is in line with the suggestion of Li *et al.* (2008) that "improved technologies should not only focus on solving problems in the communication, but also accommodate the social-emotional space related to the awareness and coordination issues such as informal discussion and interaction between the team members."

5.4. *Limitations*

Limitations of this research include that the number of interviews is relatively small and were carried out by a person with no medical or dental training. It is possible that there

is bias with respect to the interviewer being involved in the development of the SOMWeb system and in the kind of participants that responded to the call for interviewees and questionnaire respondents. Furthermore, three weaknesses in the selection of interviewees are that no interviews have been carried out with general practitioner dentists, whose membership has increased since the SOMWeb system's introduction, as well as that no interviews were done with those who had joined very recently nor those who have been dentists for a shorter time period. Another limitation is that we did not explicitly set out to collect data on enablers of and challenges to the collaboration.

6. Conclusions and future directions

Modern medicine's needs for knowledge sharing, continuous learning, and bridging the research-practice-gap implies new forms of collaboration. These collaborations pass over geographical and organisational borders, while providing a clinical and social context to new research findings. To support the collaborations, both organisationally and technically, we need to expand our understanding of distributed clinical CoPs where members have a large variation in clinical expertise and research experience. Through a case study of the SOMNet collaboration, this paper has explored the collaboration processes, outcomes, challenges, and enablers of such a CoP. This increases our understanding of the role and impact of CoPs in the clinical KT process by describing the results of the longitudinal development of a clinical CoP aimed at knowledge sharing. New knowledge about the defining characteristics of CoPs operating within the healthcare domain is obtained by a focus on the collaboration between researchers and practitioners. Thereby, sought-after insights into the design of dental information systems aimed at incorporating clinical evidence in practice have been gained (Song *et al.* 2010). In addition, the

presented research complements other recent initiatives for implementing KA within the healthcare domain (e.g. Conklin *et al.* 2011) by its focus on clinically motivated concepts supported by Semantic Web techniques.

In line with Wenger *et al.* (2002), we suggest that such CoP needs the rhythm provided through regular meetings focused on case discussions. However, appropriate meeting intervals probably vary, and the factors that affect this need in distributed CoP should be further explored. A distinguishing factor in the studied CoP is the inclusion of both researchers and clinicians, and the participation of experts was identified as an enabler of the studied CoP. While the results indicate that CoPs can provide opportunities for learning and case suggestions for varied levels of expertise, the subject matter knowledge and collaboration involvement affects the benefits to the participant. Furthermore, there is a challenge associated with accommodating varying levels of expertise. Here the meeting facilitator can be an enabling factor by encouraging active participation from those less experienced as well as ensuring that the experts find participation meaningful. Further investigation of the needs of participants of varying expertise and collaboration activity is needed to provide organisational and technical support to alleviate this tension.

A related topic, which was not part of this study, is the evolution of distributed clinical CoPs over time. Such research could include investigating how the forms of collaboration and the use of IT change over time, for example with changes in the diversity or the number of members. This can lead to an understanding of the lifecycles of distributed CoPs and variations in needs for organisational and technical support at different stages. The processes, enablers, and challenges presented in this paper exemplify factors that constitute a long-running clinical CoP, to be complemented with characteristics found in other CoPs of similar longevity, as well as emerging or declining collaborations.

References

- Anonymous, 2008. SOMWeb: A Semantic Web-Based System for Supporting Collaboration of Distributed Medical Communities of Practice. *J Med Internet Res*, 10 (3), e25.
- Anonymous, 2010. Impacts of a Web-based System on the Collaboration of a Distributed Clinical Community of Practice. *In: Proc. E-health 2010*.
- Barwick, M.A., Peters, J., and Boydell, K., 2009. Getting to Uptake: Do Communities of Practice Support the Implementation of Evidence-based Practice. *J Can Acad Child Adolesc Psychiatry*, 18 (1), 16–29.
- Boeddicker, A., 2006. European telehealth networks for oncology case discussions and stroke units. *J Telemedicine and Telecare*, 12, 17–20.
- Brown, J.B., *et al.*, 2009. Mechanisms for communicating within primary health care teams. *Canadian Family Physician*, 55, 1216–1222.
- Conklin, J., *et al.*, 2011. Knowledge-to-action processes in SHRTN collaborative communities of practice: A study protocol. *Implementation Science*, 6 (12), 1–11.
- Dawes, M. and Sampson, U., 2003. Knowledge management in clinical practice: a systematic review of information seeking behavior in physicians. *Int J Med Info*, 71 (1), 9–15.
- Gosling, A.S., Westbrook, J.I., and Coiera, E.W., 2003. Variation in the use of online clinical evidence: a qualitative analysis. *Int J Med Info*, 69, 1–16.
- Groth, K., *et al.*, 2008. The role of technology in video-mediated consensus meetings. *Journal of Telemedicine and Telecare*, 14 (7), 349–353.
- Haynes, R.B., Devereaux, P.J., and Guyatt, G.H., 2002. Clinical expertise in the era of evidence-based medicine and patient choice. *Evidence-Based Medicine*, 7, 36–38.

- Kane, B. and Luz, S., 2006. Multidisciplinary Medical Team Meetings: An Analysis of Collaborative Working with Special Attention to Timing and Teleconferencing. *Computer supported cooperative work*, 15 (5), 501–535.
- Kane, B. and Luz, S., 2009. Achieving Diagnosis by Consensus. *Computer Supported Cooperative Work*, 18 (4), 357—392.
- Kitson, A., Harvey, G., and McCormack, B., 1998. Enabling the implementation of evidence based practice: a conceptual framework. *Quality in Health Care*, 7, 149–158.
- Kitson, A.L., *et al.*, 2008. Evaluating the successful implementation of evidence into practice using the PARIHS framework: theoretical and practical challenges. *Implementation Science*, 3 (1), 1–12.
- Kuziemsky, C.E., *et al.*, 2009. An interdisciplinary team communication framework and its application to healthcare ‘e-teams systems design. *BMC Medical Informatics and Decision Making*, 9 (43).
- Li, J., Mansfield, T., and Hansen, S., 2008. Supporting Enhanced Collaboration in Distributed Multidisciplinary Care Team Meetings. *In: S. Puuronen, M. Pechenizkiy, A. Tsymbal and D.J. Lee, eds. Proc. 21st IEEE Int. Symposium on Computer-Based Medical Systems* IEEE Computer Society, 482–487.
- Li, L.C., *et al.*, 2009. Use of communities of practice in business and health care sectors: A systematic review. *Implementation Science*, 4 (27), 1–9.
- Lundvoll Nilsen, L. and Moen, A., 2008. Teleconsultation – collaborative work and opportunities for learning across organizational boundaries. *J Telemedicine and Telecare*, 14, 377–380.
- McDonald, P.W. and Viehbeck, S., 2007. From Evidence-Based Practice Making to Practice-Based Evidence Making: Creating Communities of (Research) and Practice. *Health Promotion Practice*, 8 (2), 140–144.

- Minvielle, E., *et al.*, 2010. Suitability of three indicators measuring the quality of coordination within hospitals. *BMC Health Services Research*, 10 (93).
- Moehr, J., *et al.*, 2006. Success factors for telehealth—a case study. *Int. J. Med. Inform.*, 75 (10–11), 755–763.
- Mullen, E.J. and Streiner, D.L., 2004. The Evidence For and Against Evidence-Based Practice. *Brief Treatment and Crisis Intervention*, 4 (2).
- Norman, D.A. and Draper, S.W., 1986. *User Centered System Design: New Perspectives on Human-Computer Interaction*. Erlbaum.
- Parboosingh, J.T., 2002. Physician communities of practice: where learning and practice are inseparable. *J Contin Educ Health Prof*, 22 (4), 230–236.
- Patton, M.Q., 1990. *Qualitative Evaluation and Research Methods*. 2nd edition SAGE Publications.
- Russell, J., *et al.*, 2004. Soft networks for bridging the gap between research and practice: illuminative evaluation of CHAIN. *BMJ*, 328, 1–6.
- Rycroft-Malone, J., *et al.*, 2004. An exploration of the factors that influence the implementation of evidence into practice. *Journal of Clinical Nursing*, 13, 913–924.
- Schleyer, T. and Spallek, H., 2001. Dental Informatics: A Cornerstone of Dental Practice. *J. Am. Dent. Assoc.*, 132, 605–613.
- Song, M., *et al.*, 2010. How information systems should support the information needs of general dentists in clinical settings: suggestions from a qualitative study. *BMC Medical Informatics & Decision Making*, 10 (7).
- Straus, S.E., Tetroe, J., and Graham, I., 2010. Defining knowledge translation. *Canadian Medical Association Journal*, 181 (3–4), 165–168.
- Swanson Jaecks, K.M., 2009. Current perceptions of the role of dental hygienists in interdisciplinary collaboration. *Journal of Dental Hygiene*, 83 (2), 84–91.

Walsh, J., *et al.*, 2010. What are the current barriers to effective cancer care coordination?

A qualitative study. *BMC Health Services Research*, 10 (132).

Wenger, E., McDermott, R., and Snyder, W., 2002. *Cultivating Communities of Practice*.

Boston, MA: Harvard Business School Press.

Zhang, Z., Cheung, K.H., and Townsend, J.P., 2008. Bringing Web 2.0 to bioinformatics.

Briefings in Bioinformatics, 10 (1), 1–10.

Table 1. Summary of figures for the data gathering methods.

Method	Data	Time period
Questionnaire	24 respondents	April 2007
Interviews	9 members	Nov 2007 – March 2008
Observations	10 meetings at 5 clinics	Feb 2007 – April 2008

Table 2. Summary of results relating to process and outcomes.

Process (Section 4.1)
<ul style="list-style-type: none">• Meeting structure<ul style="list-style-type: none">• monthly one hour telephone conference meetings• about six cases discussed• lead by facilitator• Case submission<ul style="list-style-type: none">• reasons for submitting cases: seeking advice regarding diagnosis or treatment, wanting to raise a general issue for discussion, educating, and building reputation• reasons for not submitting cases: missing images and data, lack of time, or that the case felt too banal• Meeting preparations<ul style="list-style-type: none">• preparation by reviewing case description and images before meetings• performed to aid learning and as a community obligation
Outcomes (Section 4.2)
<ul style="list-style-type: none">• Professional development impacts:<ul style="list-style-type: none">• case-based learning and knowledge sharing• building identity and maintaining enthusiasm• introducing external evidence to clinical practice• Clinical impacts:<ul style="list-style-type: none">• resolving individual cases• alignment of treatment models

Table 3. Summary of results relating to enablers and challenges.

Challenges (Section 4.3)
<ul style="list-style-type: none"> • Accommodating varying expertise levels – fear of revealing knowledge gaps means: <ul style="list-style-type: none"> • cases are submitted mainly by specialist clinics • most speakers at meetings are experts • Using external evidence in everyday work <ul style="list-style-type: none"> • identity as clinician leads to less use of evidence • limited access to journals • Handling shortage of time <ul style="list-style-type: none"> • possible to set aside time for meeting participation • case submission limited by lack of time • use of external evidence limited by lack of time
Enablers (Section 4.4)
<ul style="list-style-type: none"> • Champion and facilitators <ul style="list-style-type: none"> • the collaboration’s founder has acted as a champion • meeting facilitation rotates among core members • Participation of experts <ul style="list-style-type: none"> • the collaboration includes several oral medicine experts • the expert’s participation is highly valued by other members • the experts value participating • Collaboration structure <ul style="list-style-type: none"> • the length and frequency of meetings is manageable for participants • the meetings provide a deadline for case submission • the meetings give the case submitter a guarantee of feedback • IT-support <ul style="list-style-type: none"> • evolved with the CoP’s needs • SOMWeb was based on central artefacts, e.g., the case

Figure 1. The figure shows screenshots of some key parts of the SOMWeb system: part of an examination data entry form (A), case presentation with several consultations (B), the image browser for showing enlarged images (C), and a meeting page (D).