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The role of virtual communities of practice in overcoming isolation and improving knowledge sharing in general practice training in Australia

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**The Role of Virtual Communities of Practice in Overcoming Isolation and
Improving Knowledge Sharing in General Practice Training in Australia**

Dr Stephen Robert Barnett BMed DCH(Lond) MRCGP FRACGP

This thesis is presented in fulfilment of the requirement for the

Award of the Degree of Doctor of Philosophy

of the

University of Wollongong

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Thesis Certification

CERTIFICATION

I, Stephen Robert Barnett, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Social Sciences, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution

Stephen Robert Barnett

04.06.2014

Declaration of co-authors' contribution to the work

Chapter 2: General Practice Training and Virtual Communities of Practice – A Review of the Literature

Barnett SR , Jones SC, Bennett S, Iverson D and Bonney A . General Practice Training and Virtual Communities of Practice – A Review of the Literature. BMC Family Practice 2012, 13:87

A/Prof Bennett provided advice on Communities of Practice and along with Prof Jones, Prof Iverson and Prof Bonney assisted with the structure of the study and provided critical review of the manuscript.

Chapter 3: Perceptions of family physician trainees and trainers regarding the usefulness of a virtual community of practice.

Barnett S, Jones SC, Bennett S, Iverson D and Bonney A. Perceptions of Family Physician Trainees Regarding the Usefulness of a Virtual Community of Practice. J Med Internet Res 2013; 15(5):e92

Professor Bonney assisted with construction of the survey and provided statistical advice, Prof Iverson, Prof Jones and A/Prof Bennett all contributed to the survey development, structure of the study and critically appraised the manuscript.

Chapter 4: Usefulness of a virtual community of practice and Web 2.0 tools for general practice training: experiences and expectations of general practitioner registrars and supervisors

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Professor Bonney contributed to the development of the interview guide and critically reviewed the manuscript. Prof Jones, A/Prof Bennett and Prof Iverson advised on the structure of the study, contributed to the interview guide and provided critical review of the manuscript.

Chapter 5: A Virtual Community of Practice for General Practice Training: a pre-implementation survey using the Health VCoP Framework

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Prof Jones assisted with survey design, analysis and reviews and amendments to the paper and final approval. A/Prof Bennett assisted with survey design and drafts of the paper. Prof Iverson assisted with survey design, analysis and amendments to the paper. Ms Robinson did initial data analysis and was involved in drafting the manuscript. All authors reviewed and approved the final manuscript.

Chapter 6: Implementing a Virtual Community of Practice for Family Physician Training: A Case Study

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Dr Caton contributed to the design and implementation of the study. Ms Robinson did some initial data analysis and was involved in drafting the manuscript. Prof Jones, A/Prof Bennett and Prof Iverson assisted with the overall study structure, case study methodology advice and provided a critical review of the manuscript.

I have read and agreed to the above descriptions of co-authors' contributions to this work:

..... **Date:****04.06.2014**.....

Professor Sandra Jones

Primary Supervisor

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LIST OF ABBREVIATIONS

ACCRM: Australian College of Rural and Remote Medicine

CCCGPT: Coast City Country GP Training

ConnectGPR: Coast City Country Online Network for an Education Community of Training for
General Practice Registrars

CoP: Community of Practice

GP: General practitioner

GPT: GP Term

GPET: General Practice Education and Training

GPR: GP Registrar

RTP: Regional Training Provider

VCoP: Virtual Community of Practice

ABSTRACT

The role of virtual communities of practice in overcoming isolation and improving knowledge sharing in General Practice training

Introduction

General Practice training can be isolating. This isolation can lead doctors to choose to work decreased hours and have a lower intention to work in rural areas, with retention of GP registrars in rural areas an ongoing problem. Professional isolation can occur due to barriers to knowledge sharing, such as the structure of general practice in which registrars are alone in a room with a patient, and geographic barriers imposed by the large distances between registrars in rural and regional training programs.

Virtual Communities of Practice are a method of improving knowledge sharing and overcoming isolation that have shown clear benefit in the business literature and are also widely used in education. VCoPs have a more limited literature base in healthcare.

The aims of this research were to: review the international literature on VCoPs for GP training; ascertain whether VCoPs for GP training are acceptable to GP registrars and supervisors; explore how a VCoP for GP training would be designed and implemented; and ultimately discover whether a VCoP for GP training has benefits for registrars and supervisors in overcoming professional isolation and improving knowledge sharing.

Methods

This series of studies adopted a mixed-methods design in three phases. Phase 1 consisted of a search of the relevant international literature. Phase 2 comprised a survey and interview study. The literature informed the development of the survey - a quantitative survey study of registrars and supervisors in a regional GP training provider. Data were analysed using t-test,

chi-square, factor analysis and generalised linear regression. The survey results, and the literature reviewed provided relevant information for the ensuing qualitative study. This was a telephone interview study of 10 high internet using GP registrars and supervisors, with results produced through thematic analysis. In Phase 3, a further quantitative survey study was undertaken with registrars and supervisors in the same GP training provider. Data were analysed using t-test, chi-square, factor analysis and generalised linear regression. Finally, Phase 4 consisted of a mixed-methods case study was performed involving the implementation of a VCoP for GP training. Data collected included pre- and post surveys on knowledge and isolation, site usage statistics and postings and post study interviews. These were analysed in a case study format.

Results

Phase 1: What is the international literature?

There was no literature identified in the Phase 1 search on VCoPs for GP training. However, guidelines from the business sector were compared with the health literature to develop a proposed “Health VCoP Implementation Framework”. This was a seven-step guide on the important factors needed to implement a successful VCoP and included 1) organising facilitation; 2) engaging stakeholders; 3) establishing clear goals; 4) involving a broad church of participants; 5) creating a supportive environment; 6) including measurement, benchmarking and feedback on the design; and 7) technology and community factors such as users self selecting and having a mixture of online and face-to-face engagement.

Phase 2: Is a VCoP acceptable to GP registrars and supervisors?

In Phase 2, the survey study indicated that GP registrars, and to a lesser extent their supervisors, have the ability, interest and necessary internet access to use a VCoP for GP training. Using a multivariate generalised linear regression model, it was found that perceived

usefulness and training stage were positively predictive of intention to use a private VCoP for training, whilst concerns about privacy and time were negatively predictive. The Phase 2 interview study of 10 high internet using registrars and supervisors found themes of professional isolation and the potential of social media tools to improve peer support and knowledge sharing, along with potential barriers to use including time, skills and access. In the

Phase 3: How would such a VCoP be designed and implemented?

In the phase 3 survey study, the 7 steps of the Health VCoP Framework were supported by the respondents. Factor analysis showed that the single goal for registrars was 'usefulness', rather than, for example, a single aspect such as passing exams, and using a multivariate generalised linear regression, 'usefulness' independently predicted intention to actively use a VCoP (0.01).

Phase 4: Does a VCoP for GP training overcome isolation and improve knowledge sharing?

Finally, in the Phase 4 VCoP case study, of eligible GP Term 1 (GPT1) registrars, 28/34 (82%) enrolled. The 7 step framework was found to be useful for implementing the VCoP, but the case study identified that a broader 'church' of users was needed (only GPT1s were enrolled) and trust was built online rather than face-to-face. Isolation was a common theme amongst interview respondents and (13/14, 92.9%) of ConnectGPR user respondents felt more supported in general practice using the VCoP.

Discussion

Isolation and barriers to knowledge sharing were themes throughout these studies. This isolation resulted from disruption to the communities of practice that comprise medical training, due to structural issues such as being alone in a consulting room, or being geographically removed from peers. VCoPs were perceived as a potential facilitator to knowledge sharing and peer support, leavened by concerns about privacy and time. The main driver in terms of taking up active VCoP membership was the perceived usefulness of the

VCoP. When a VCoP was implemented, whilst pre and post knowledge and isolation scales were unchanged, and there was only a core of active users, there was qualitative feedback that the VCoP was valued as a facilitator of knowledge sharing and that it helped overcome professional isolation. More research is needed to quantify these potential benefits.

Conclusion

VCoPs have a potential role in general practice training in improving knowledge sharing and overcoming professional isolation. This may inform training of GP registrars across Australia, and possibly the training of other medical specialties. Where similar training programs exist around the world, there may be the potential for VCoPs such as ConnectGPR to improve knowledge sharing and professional connectedness, and assist with rural and regional retention internationally.

Chapter One: Introduction and overview of the thesis research

The importance of primary care and general practice

An effective primary healthcare system is the cornerstone of an effective healthcare system [1]. As a model, primary care was first mentioned by Lord Dawson in his report to the UK Ministry of Health in 1920. In this report he recommended that, due to the complexity and cost of medicine, curative and preventive treatments should be brought within the sphere of the general practitioner working in a primary care centre, supported by efficient nurses and visiting consultants [2]. Since then, robust international evidence has shown that health is better amongst those who receive care from primary care physicians [1] and that areas with more primary care physicians have better health outcome measures, including reduced stroke mortality, infant mortality, low birth weight and all-cause mortality [1, 3, 4]. This impact is evident even in less well funded health systems, for example Thailand, where the reduction in under-5-year-old mortality has been largely attributed to the establishment of an effective primary care system [5]. Primary care systems are more cost-effective and equitable, delivering better health outcomes at lower cost in first world and developing countries and minimising socio-economic impact on illness-related mortality [6]. For example, in a comparison study of breast cancer survival in the USA (which does not have a universal primary care system) and Canada (which does), the socio-economic gradient was strong in the USA, but not in Canada, demonstrating the effect of primary care systems on improving equity [7].

General Practice Origins

The World Organisation of Family Doctors states that “High quality primary health care depends on the availability of well-trained general practitioners or family physicians as members of health care teams in the community” [8]. The term ‘general practitioner’, those

generalist doctors to whom Lord Dawson referred, arose in Great Britain in the early 1800s. Prior to that, in the sixteenth century, medical practitioners first began to differentiate into physician members of the Royal College of Physicians (founded in 1518), surgeons who were members of the Company of Barber Surgeons (founded in 1540), and apothecaries who dispensed 'physic' and were members of the Society of Apothecaries (founded in 1617). In 1815, this latter group was recognised by the Apothecaries Act which legislated minimum requirements for the licencing of generalist doctors, forming the basis for the first 'general practitioners' [9].

General Practice in Australia

Australia's first doctors arrived with the First Fleet in 1788, followed thereafter by a mixture of convict doctors, ships' surgeons and official appointments [10]. For example William Redfern, arguably the first general practitioner in private practice, arrived as a convict and rapidly rose to become a prominent citizen and personal physician to the NSW Governor [10]. The Australian colonies established firm medical licencing standards early in their history, enabling general practice in Australia to flourish. Australian general practitioners became superb generalists - covering medicine, surgery, obstetrics and anaesthetics - partly in response to the wide geography and isolation with which they had to contend [9, 10].

During the Second World War, many doctors were recruited and trained as specialists, and after the war general practice lost the skills of those trained in specialties [9]. In the UK, similar forces led to serious concerns about standards of primary care provision, resulting in the damning findings of the Collings report in which general practice was described as "bad and deteriorating" [11]. This report led to the formation of the Royal College of General Practitioners in 1952, followed by the Royal Australian College of General Practitioners

(RACGP) in 1958 [9], which established and maintained appropriate standards for general practice.

General Practice Training

Medical training is based on an apprenticeship model. For centuries, doctors in training have attached themselves to more senior doctors to learn their craft [12]. In Australia, general practice training has long followed tradition, with newly qualified or 'novice' doctors working alongside an experienced or 'master' general practitioner before working independently [9]. This model continues today. However, to maintain the standards to which the RACGP aspired, a formal training program was implemented. The Family Medicine Program (FMP) commenced in 1974, offering members fellowship of the Royal Australian College of General Practitioners on completion of the College exam [13, 14]. Initially, this program and its exam were optional, with the examination more a demonstration of mastery than a requirement of entry into the workforce as a general practitioner [15].

Over time, the program became more structured and, after a government review in 1982, master and apprentice arrangements were formally entrenched with trainees spending a minimum of six months during the four year training program in a supervised and subsidised general practice [15]. The outcomes of training also became more closely observed, with a gradual move from a 'Certification of Satisfactory Completion of Training in General Practice' in the early days of the FMP, to a College position in the late 1980s that the Fellowship exam become the endpoint of training [13]. However, it was not until 1996 that a Fellowship of the College became a compulsory entry qualification to the general practice workforce. Prior to that, doctors could still practice as 'non-vocationally registered' primary care practitioners [15].

During the mid 1990s, GP trainees first began to be referred to as 'registrars' [13], with the RACGP remaining responsible for both standards of general practice and general practice training until 2001, after which training was moved to a new group. In 1997 there was a ministerial review in response to concerns about the urban focus of general practice training, and rural workforce shortages [14, 16]. In response to this report, the Federal Government established a new GP training body in 2001, General Practice Education and Training (GPET), which led to the formation of 22 regional training providers. Each training provider was responsible for providing training matched to the needs of its local population and each trainee was required to spend at least six months in a rural area. This change partly addressed rural workforce shortages, with the number of rural and regional registrars doubling from 618 to 1237 in this period [14]. By 2010, the total general practice training program consisted of over 2500 registrars [17].

Throughout this period of legislative changes, the overall general practice training program has remained an apprenticeship model of training. During the three to four year program of GP training, registrars rotate through a variety of hospital terms attached to a consultant. They then spend a minimum of 18 months in supervised general practice training posts, usually in at least two general practices, including six months in a rural or regional post, although this is not compulsory in all RTPs [18]. The training standards are overseen by either the RACGP or the Australian College of Rural and Remote Medicine (ACRRM) which offers a separate examination pathway for those planning a career in rural medicine [15]. During their training time, registrars are encouraged to form study groups and work as adult learners - keeping a log of learning needs, working their way through modular training materials in print and online, as well as attending face-to-face training workshops. This interaction between registrars, their peers and their supervisors enhances the single master and apprentice model, extending a registrar's 'community of practice'.

Communities of Practice

Communities of practice (CoPs) are “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” [19]. General practice registrars and supervisors form natural communities of practice, sharing knowledge about medicine and interacting regularly to improve their practice of medicine. However, there can be barriers to effective knowledge sharing in these communities of practice, particularly in general practice placements. During hospital rotations, registrars are part of a hospital team, often with a number of consultants and other levels of trainee and medical students. Education sessions are run within the hospital for the whole team. During general practice rotations, registrars are part of a much smaller community of practice within their general practice, which can pose challenges to knowledge sharing. These challenges include the structure of general practice, in which a registrar is consulting alone in a room much of the time; the location of the practice, for example in a small rural town; and the geography of the training program in which registrars may be spread across very wide regions [20]. These barriers to knowledge sharing can result in professional isolation, a reduced intention to work in rural areas and/or an intention to work fewer hours [20-22]. In the context of Australia’s low population density outside major cities this is important, as professional isolation plays a part in poor rural workforce retention [23]. To overcome professional isolation, solutions to improve professional networks and knowledge sharing need to be found.

The internet and knowledge sharing

The internet has given people the ability to connect and share knowledge regardless of geography, and to share knowledge both synchronously and asynchronously on a massive scale. The social networking site Facebook, for example, has over a billion monthly active users [24] and professional networking site LinkedIn has over 277 million users [25]. Alongside these

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sites, medical knowledge sharing communities have developed. Sermo, a physician only site in the US has over 200,000 active physicians across 68 specialties [26], and doctors.net.uk in Britain also has a similar number of doctors on its site [27]. These kinds of collaborative online technologies can be used to form knowledge sharing communities known as Virtual Communities of Practice.

Virtual Communities of Practice

Virtual Communities of Practice (VCoPs), also known as online or electronic communities of practice, use internet knowledge sharing tools to connect members of CoPs, thus overcoming the barriers of time and geography [28]. They have been widely used in the commercial world in businesses, such as Caterpillar [29]; in education, for example for training teachers and educators in New Zealand [30]; and in healthcare, for example amongst aged care nurses in Scotland [31]. One example of their potential can be seen in the redesign of a stroke service in the UK using CoP theory, which resulted in the creation of a nationally lauded service [32].

Research Questions

This thesis examines the potential role of Virtual Communities of Practice in General Practice training in reducing professional isolation and improving knowledge sharing. In particular, it addresses four main research questions.

Research Question 1: What evidence exists in the academic literature for VCoPs in GP training?

Research Question 2: Are VCoPs for GP training acceptable to GP registrars and supervisors?

Research Question 3: How would a VCoP for GP training be designed and implemented?

Research Question 4: Does a VCoP for GP training have benefits for registrars and supervisors in overcoming professional isolation and improving knowledge sharing?

Presentation of thesis

This thesis is presented in the Style 2 format. The body of the thesis comprises five chapters (Chapters 2-6) with each chapter consisting of a single journal article in the style of the journal to which the article was submitted. Each article therefore contains an introduction, overview or background, along with its own results, discussions and conclusions. Due to the nature of this series of articles, with each article building on the next and resting on a similar literature base, and with each article published as an individual piece of research that needed to be understood by the audience on its own merits, there is a necessary repetition of some themes throughout the chapters. Due to journal styles, there are also slight some variations between chapters in presentation of the references. As a result of space limitations in each article, the limitations section in some articles is brief. The final chapter (Chapter 7) includes an expanded review of the limitations of each article, along with a discussion of the findings of this thesis and their impact on ongoing GP training projects and the wider healthcare training literature.

Research structure and methodology

The preliminary review of the literature revealed no studies on VCoPs in GP training. However, a number of useful studies from healthcare and business were identified, some with useful lessons about CoP and VCoP construction [28, 31, 33]. This informed the formal literature review, which aimed not only to identify and examine current, relevant literature, but to identify evidence-based principles for designing and implementing a VCoP for GP training. The thesis research was then conducted in three phases, with each phase informing the next, culminating in an implementation case study. The research was conducted in a GP Regional

Training Provider in New South Wales, Australia, servicing an area of 160,000 square kilometres and including rural, regional and metropolitan practices. The phases are outlined below.

Phase 1 (Chapter 2)

Phase 1 (Chapter) consisted of a comprehensive review of the international health literature.

This literature review was published in BMC Family Practice, cited as follows:

Barnett S, Jones SC, Bennett S, Iverson D, Bonney A: General practice training and virtual communities of practice - a review of the literature. BMC Family Practice 2012, 13.

The review found that there was no literature on VCoPs for GP training and that the health literature on VCoPs was limited and largely qualitative. To inform the development of VCoPs for GP training, evidence based approaches outside the health literature were sought. Probst and Borzillo's review article "Communities of Practice: Why they succeed and why they fail"[32] which examined 57 business CoPs and VCoPs internationally, in large companies such as Siemens and IBM was identified as a informative guide. Probst and Borzillo's framework for CoP implementation was then used in the Chapter 2 literature review to guide the analysis of the health CoP literature, resulting in the development of a Health VCoP Framework.

Phase 2 (Chapters 3 and 4)

Following the results of the literature review, in particular in light of the lack of evidence for VCoPs in GP training, two studies were performed to investigate the experiences and expectations of GP registrars and supervisors of a VCoP. The Chapter 3 survey study and Chapter 4 interview study were published in the Journal of Medical Internet Research and the Australian Journal of Primary Health respectively:

Barnett S, Jones CS, Bennett S, Iverson D, Bonney A: Perceptions of Family Physician Trainees and Trainers Regarding the Usefulness of a Virtual Community of Practice. J Med Internet Res 2013, 15(5):e92.

Barnett S, Jones SC, Bennett S, Iverson D, Bonney A: Usefulness of a virtual community of practice and Web 2.0 tools for general practice training: experiences and expectations of general practitioner registrars and supervisors. Australian Journal of Primary Health 2013, 19(4):292-296.

Chapter 3 was a cross-sectional survey study to determine the baseline characteristics of the study population of GP registrars and supervisors in the regional training provider, including access, interest, and ability to use a VCoP. This was followed by the Chapter 4 qualitative study in which telephone interviews were conducted with volunteer respondents drawn from the survey respondents. The aim of this study was to further explore these experiences and expectations, in particular seeking to understand the current barriers to knowledge sharing, facilitators and problems with using technology to overcome these barriers, and what benefits a VCoP may have for registrars and supervisors.

Phase 3 (Chapter 5)

The phase 3 study presented as Chapter 5 was another cross sectional survey of the registrars and supervisors. This study has been submitted to BMC Family Practice and is under review with the following provisional title:

Barnett S, Jones SC, Bennett S, Iverson D, Robinson L: A Virtual Community of Practice for General Practice Training: a pre-implementation survey using the Health VCoP Framework.

This survey study built on the findings of the previous two phases. The literature review in Phase 1 proposed a Health VCoP Framework for implementing a VCoP. The studies from Phase 2 demonstrated that registrars and supervisors had sufficient ability, interest and access to use a VCoP and provided some useful insights about potential technologies and benefits of knowledge sharing and overcoming isolation. The phase 3 study combined these elements to develop a survey to inform development of an implementation plan for a VCoP for GP training and to assess the applicability of the Health Framework for VCoPs to this implementation.

Phase 4 (Chapter 6)

The final study in this thesis was a case study of the implementation of a VCoP, “ConnectGPR: the Coastcitycountry Online Network for an Educational Community of Training for GP Registrars”. It was published as follows:

Barnett S, Jones SC, Caton T, Iverson D, Bennett S, Robinson L Implementing a Virtual Community of Practice for Family Physician Training: A Mixed-Methods Case Study J Med Internet Res 2014;16(3):e83

This mixed methods case study built on the findings of the previous three phases, in particular the findings of Phase 3, which had indicated that the Health VCoP Framework was a useful approach for implementation. The case study details the implementation of ConnectGPR, presenting data gathered from site statistics, online postings, pre and post implementation surveys and post implementation interviews. The data are presented under the seven steps of the Health VCoP Framework, enabling review of the usefulness of this framework in implementing a VCoP for GP training, as well as evaluating the usefulness of the resulting VCoP for facilitating knowledge sharing and reducing professional isolation.

Chapter 7: Discussion and Implications of the Research

In the final chapter, each of the research questions of the thesis are addressed in turn. This includes a discussion of what has been learnt from the international literature on VCoPs and GP training; the acceptability of a VCoP amongst registrars and supervisors; how such a VCoPs should be designed and implemented; and what, if any, benefits there are in terms of knowledge sharing and overcoming professional isolation. These studies are reviewed as a body of work, with a review of each step of the Health Framework developed from the literature review and its efficacy as a guide for VCoP implementation. Given the word limits imposed by journals, the brief discussions of limitations that are mentioned in each paper are expanded upon in this chapter. Finally, future directions for practice and research are reviewed, including the role of ConnectGPR as it continues as a project for GP training, and the research questions that have been raised by this thesis that could be explored in further studies.

In summary, this thesis provides preliminary evidence that VCoPs have a potential role in general practice training in improving knowledge sharing and overcoming professional isolation. This has the potential to inform GP training in Australia, and in other countries with similar training programs. There may also be a role for this research to influence other training programs, including specialist and allied health training, both in Australia and overseas. In particular, by improving knowledge sharing and overcoming isolation, VCoPs may improve workforce retention in rural and regional areas, thus addressing some of the inequities of workforce distribution and healthcare access that have been a feature of the Australian health system.

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Chapter 2: General Practice Training and Virtual Communities of Practice – A Review of the Literature

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Background

General Practice is the cornerstone of an effective health system [1]. The Royal Australian College of General Practitioners defines General Practice as providing “person centred, continuing, comprehensive and coordinated whole person health care to individuals and families in their communities” [2]. High quality training is imperative to support this indispensable workforce, but in countries with low population densities, there are some inherent problems of professional and personal isolation for trainees in rural and regional areas. In Australia, the General Practice Training program involves multiple small training sites across a wide geographic area, which can be isolating for trainees [3]. To meet the ongoing needs of General Practice training and workforce, innovative solutions to overcome isolation need to be considered.

The provision of General Practice training and services in Australia is under pressure [4]. One of the causes of problems during General Practice training is isolation [3]. In the general medical population, isolation can lead doctors to reduce hours and move away from rural

practice [5]. However, General Practice registrars may be under even greater stress than the general population of doctors, due to their clinical and training demands [6]. Online communities offer a means to reduce isolation [7]. In particular, virtual communities of practice are a type of online learning community that have been shown to be highly effective in large companies, improving knowledge sharing and thus overcoming professional and structural isolation [8,9]. Given the promise of online communities, this literature review will critically review the current evidence relevant to virtual communities of practice in General Practice training, identify evidence-based principles that might guide their construction and suggest further avenues for research.

Isolation can be subdivided into professional, structural and social isolation, although all three are often experienced concurrently [3]. Social isolation is more marked amongst rural General Practice placements, as trainees are away from their usual support network of friends and family. Professional isolation is also more common in rural areas, as trainees can be concerned about limited supervision and clinical back-up. Structural isolation, however, is common across all training placements. Structural isolation can result from consulting alone in a consultation room, as opposed to the team environment of the hospital. Social isolation can be described as a form of loneliness [10]. However, professional isolation is linked to a lack of knowledge sharing activities such as networking, tacit knowledge sharing and mentoring [11]. The result of these barriers to knowledge sharing can be 'terrifying', when there are serious health decisions to be made, as the following trainee describes.

In an interview study of General Practice trainees conducted in Australia in 1999, one trainee said "I found it unbelievably stressful starting in General Practice ... country GP [was] always what I wanted to do. Got there—and I was shocked to find that I found it terrifying, isolating, extremely isolating...Just to have gone from a setting where you were working with colleagues constantly ... so GP work is a big change. Sitting in one room." [3].

Isolation has implications for the health system, as well as being a negative experience for the trainee. In Australia in 2008, GP registrars comprised 11% of the rural and remote workforce. However retention of registrars in rural areas continues to be a problem, with only 27% of previous Rural Pathway registrars (trainees committed to extra rural training) still working in rural practice in 2008 [12]. These problems are not confined purely to rural registrars or to Australia. In the US, a survey of 1700 physicians illustrated that stress and mental health issues, of which isolation is a component, can lead to physicians considering reduction in work hours, change of job or reduction in patient contact [5]. Effective means of overcoming isolation are urgently required to meet the needs of trainees and the health system.

Increasingly, people are using social networking tools to overcome personal and professional isolation by building relationships. Facebook alone now has over 845 million active users^a while LinkedIn has 150 million^b. A study of US college students found that usage of Facebook correlated with increased 'social capital' [7]- a term that broadly describes social relations that have productive benefits [13]. Not only was there a strong association between Facebook use and the formation and maintenance of social networks at a time when young people are often moving away from home and into a new phase of their lives, the findings also suggest that the benefits may be highest amongst students with low self-esteem and low life satisfaction. This suggests that social networking might be beneficial to General Practice trainees, a similarly mobile group that must frequently relocate during training [3], and may be even more valuable to those most vulnerable to low self-esteem and low life satisfaction that can be associated with isolation.

This mobile group of General Practice trainees can be thought of as a 'Community of Practice'. 'Communities of practice' are "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" [14]. The theory underpinning the idea describes master-apprentice learning, in which novices work alongside

experts, gradually developing their understanding with explicit and implicit guidance from others in the community according to the norms of the group. In this interaction, those with greater expertise also gain knowledge. This form of learning community also incrementally builds a stock of knowledge resources for the community over time [15,16]. Although the research underpinning the theory of communities of practice was conducted in Yucatan midwives, US naval quartermasters and apprentice butchers, its appeal has spread.

The widespread growth of the internet in the late 1990s led to considerable interest in combining online tools with communities of practice theory to create 'virtual communities of practice'. The main driver for these virtual communities of practice has been to connect people not located in the same place at the same time, thereby creating networks of people with common interests who are geographically dispersed. Virtual communities of practice have been successfully adopted by business, with significant interest from the education sector as well [17,18].

In the education sector, there is a wealth of literature on online and virtual communities of practice but little systematic review evidence [18,19]. Single study evidence is plentiful. For example a recent outcome study of an Internet-Based Master in Educational Technology demonstrates the efficacy of an online community of practice mixed with face-to-face teaching. The iMET program in Illinois graduated 85% of their 243 student within 3 years, compared with rates of 30% for other online Masters and 60% for some face-to-face Masters courses [20].

In business, there is significant outcome data on the effectiveness of online communities of practice. In a systematic review of 43 studies, many with a mix of face-to-face and online support, communities were shown to decrease cost and increase innovation by allowing workers to effectively collaborate and share knowledge [21].

In business, as in health, experts play a significant role in developing the knowledge and skills of novices. Large volumes of information must be managed, employees in large companies can be spread over multiple sites and professional isolation must be overcome to improve knowledge sharing. Companies such as HP, Xerox and Caterpillar have implemented virtual communities of practice in which employees share knowledge online, sometimes mixed with face-to-face interaction [17].

In the health sector, communities of practice also show promise, but systematic reviews so far are inconclusive [21]. Since the most recent review [21], however, there have been some positive examples of communities of practice. For example, a UK Stroke service was redeveloped using a face-to-face community of practice model to set up a stroke unit and implement best practice. As a result, the service moved from the bottom 5% to the top scoring service in four years [22]. This potential has been recognised by other researchers, for example by the Montreal Stroke Network, which is planning a series of trials around an e-collaborative platform using Communities of Practice theory for knowledge sharing on best practice in stroke care. Despite these positive indications, there are still significant questions about the potential for virtual communities of practice to help build a healthy and effective General Practice workforce by overcoming isolation in training.

This paper provides a critical review of current research literature to determine what, if any, evidence there is for virtual communities of practice in General Practice training. In addition, this review identifies evidence-based guidelines for developing virtual communities of practice from the wider research literature which could inform implementation in General Practice training.

Methods

A comprehensive literature search of the databases *Scopus*, *Psychlit* and *Pubmed* was

conducted using the terms “Community of Practice” (CoP) AND (Online OR Virtual OR Electronic) AND (health OR healthcare OR medicine OR “Allied Health”). Only peer-reviewed journal articles in English were selected. There was no date range limitation applied due to the need to identify all potentially relevant studies from a small body of literature. The further inclusion criteria required that journal articles include primary research and involve virtual communities of practice and human clinical healthcare. Exclusion criteria eliminated opinion pieces, conference papers and unpublished theses. Studies with patients as participants were excluded as this literature review focuses on professional education, not patient management. Articles involving the higher education teaching or research sectors were also excluded, as these are distinct from clinical healthcare. Each article was then read in full to confirm compliance with the inclusion criteria. References were searched to identify additional relevant studies.

The search returned 97 articles. Duplicates were removed, leaving 76 articles. References were searched, returning one extra article. Of the 77 articles, 22 articles met the inclusion criteria. The 55 articles excluded were conference papers/theses, ‘community’ or ‘community of practice’ but not ‘virtual community of practice’, articles from outside human clinical healthcare education, including university students, research, veterinary science and business, studies involving patients, opinion pieces, IT semantic articles, unrelated articles, and a study proposal with no data.

None of the 22 relevant articles were specific to General Practice training. Most articles had small sample sizes and a variety of methodologies, with a number of descriptive studies. Because of this limited empirical base, this literature review is descriptive, although a formal count of each theme’s appearance in each paper was also performed.

There is a wealth of business related literature on CoPs and VCoPs. The strength of the business literature is the concrete outcomes that have been demonstrated as a result of using

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the CoP theory within a business. These outcomes include lower costs, lower lead time to market and saving of labour hours/year. For this reason the authors looked at the recent business literature for a potential CoP or VCoP model that might be applicable to the health sector. In a recent literature review, Agarawal and Joshi [9] cite Probst and Borzillo's model [8]. The model, presented in their article "Communities of Practice- Why they succeed and why they fail" was noted by the candidate to be well structured, well supported, simple and yet comprehensive. It summarised, in a useful way, the themes that the candidate had noticed emerging from the health literature. Many of the CoPs were also VCoPs, although a subset analysis was not done. A final strength of the model was the large amount of empirical data, in reputable companies, on which it was based; 57 CoPs in companies including Oracle, Siemens and IBM were reviewed.

The Probst and Borzillo model has been used to analyse the literature to determine whether similar themes are present in the health literature and to identify evidence in support of virtual communities of practice for General Practice training.

Results and Discussion

Probst and Borzillo propose 'ten commandments' for effective communities of practice and suggests five key reasons for failure [8]. The researchers identify six key themes important to the establishment and maintenance of successful communities of practice: Leadership, Sponsorship, Objectives, Boundary Spanning, Risk-free environment and Measurements. These themes are explained and expanded upon as each theme is explored in relation to the literature identified for this review.

It must be noted that most of these studies are qualitative and there is varied statistical analysis and methodology reporting (Table 1). These papers have been read extensively and, where comments or discussions or conclusions from data, or from the project being discussed,

are made, then these items are matched against the themes in Probst and Borzillo's framework (Table 2). This is not an assertion that these themes have been formally studied as outcomes for each study. The additional themes of 'Technology' and 'Community' barriers and enablers have been included to cover a number of similar themes in these studies.

Table 1. Study summary

Table 2. Theme count

Table 1
Study summary

Author	Approach	Brief description	Data Collection
Andrew 2009 Booth 2007	Informal case study Action research-mixed methods	Nursing academics online support site iCoP Constructing evidence-based nursing care guidance for gerontological nurses using CoP and Virtual College	Analysis of weblog posts Focus groups, telephone interviews, analysis of online archives and documentary outputs
Brooks 2006	Case study organizational research	Study of midwives as knowledge workers using online forum (subset of AEC project)	Interviews, focus groups and analysis of online forum postings
Brooks 2006	Qualitative study	Assisted Electronic Communication (AEC) project for nurses, using an online forums	15 interviews and analysis of online forum postings
Curran and Murphy Falkman 2008*	Mixed methods	VCoP of Emergency clinicians in Canada	Online posting analysis and 'post' survey
Falkman 2008**	Mixed methods	SOMWeb, an online CoP for oral surgeons in Sweden	Interview, online message review, meeting observation and survey.
Hara 2007	Mixed method case study	Another paper on SOMWeb – an online CoP for oral surgeons	Online questionnaire and interviews
Ho 2010	Project description	Listserve for nurses in USA	Analysis of online postings and interviews
Li 2009	Systematic review	Electronic detailing project on diabetes (TEAD)	Description of electronic detailing project, mentions surveys and data collection.
Nagy 2006	Case report	Review of effectiveness of business and healthcare CoPs	Electronic database search
Penn 2005	Project description	An online PACS (radiology system administrator) community	Description of successful project
Perotta 2006	Qualitative	An online suicide prevention site for mental health workers	Description of design and background and some initial findings of ACROSSNet
Poissant 2010	Research protocol	An online psychology community in Italy	Analysis of online postings
Poole 2008	Action research	The development of an e-collaborative platform for the Montreal Stroke Network	Not applicable
Rolls 2008	Quantitative	Women's Health VCoPs in British Colombia	Outcomes of webinars and description of resulting presentations and materials
Russell 2004	Qualitative	Intensive Care Unit clinician network in Australia	Survey study
Sharma 2006	Qualitative	CHAIN an email based evidence service in the NHS, UK	Posting analysis, feedback both active and unsolicited, interviews
Thomas 2010	Case study	Study of an online incident reporting system for anaesthetists in UK	Interviews
Tolson 2005	Qualitative	GAPS project on sharing family planning information for WHO	Moderated discussions analysed as part of case study
Tolson 2008	Mixed methods	Nurses used an online forum (Virtual College) for gerontological nursing	Interview study
Valaitis 2011	Q methodology	Review of effect of a Virtual College and CoP on implementation of Best Practice Statements	Focus groups, pre and post intervention audits
		Explored views of nurses using online CoP to support practice in homeless populations.	Online survey and focus groups

Brooks 2006* = Nursing and Health Management and Policy
Brooks 2006** = International Journal of Nursing Studies.
Falkman 2008* = Journal of Medical Internet Research.
Falkman 2008** = Studies in Health Technology and Informatics.
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Key: L = Leadership, O = Objectives, S = Sponsorship, B = Boundary Spanning, R = Risk-free environment, M = Measurements, T = Technology, C=Community

Table 2
Theme count
Probst and Borzillo
Theme

Theme	Theme description	Comments supportive of theme	Comments non-supportive of theme	Supportive count
Leadership	The organisation can designate leadership roles to motivate community members to collaborate	Andrew 2009, Booth 2007, Tolson 2005, Tolson 2008, Brooks 2006**, Brooks 2006*, Curran 2009, Falkman 2008**, Falkman 2008*, Hara 2007, Ho 2010, Li 2009, Nagy 2006, Penn 2008, Russell 2004, Poissant 2010, Poole 2008, Thomas 2010	Booth 2007, Sharma 2006, Valaitis 2011, Rolls 2007	18
Objectives	Clear objectives provide members with responsibilities and motivates them to contribute more actively	Andrew 2009, Booth 2007, Falkman 2008**, Falkman 2008*, Hara 2007, Ho 2010, Li 2009, Penn 2005, Russell 2004, Poissant 2010, Poole 2008, Thomas 2010, Rolls 2007, Perotta 2006, Tolson 2005, Tolson 2008	Brooks 2006*, Nagy 2006 Penn 2005	15
Sponsorship	Senior executives need to provide sponsorship to help communities reach their full potential	Andrew 2009, Booth 2007, Tolson 2008, Brooks 2006**, Brooks 2006*, Russell 2004, Poissant 2010, Poole 2008, Sharma 2006, Thomas 2010, Tolson 2005, Rolls 2007		12
Boundary Spanning	Boundary spanning enables members to engage in internal and external benchmarking practices	Andrew 2009, Booth 2007, Falkman 2008*, Tolson 2008, Tolson 2005, Curran 2009, Ho 2010, Penn 2008, Russell 2004, Poole 2008, Poissant 2010, Rolls 2007, Thomas 2010 Tolson 2005, Tolson 2008, Brooks 2006*, Hara 2007, Nagy 2006, Penn 2008, Sharma 2006	Andrew 2009, Perrotta 2006, Valaitis 2011	12
Risk-free environment	COPs should be used as an especially valuable opportunity to express and test ideas in an informal and risk-free environment, thus requiring a strong degree of safety and intimacy between members		Penn 2008, Valaitis 2011	6
Measurements	Empirical evidence suggests the use of measurements to assess the value of communities of practice	Andrew 2009, Booth 2007, Tolson 2008, Brooks 2006*, Curran 2009, Hara 2007		6
Technology ***	Technology enablers (points supportive of this theme) and barriers (points against this theme)	Andrew 2009, Falkman 2008**, Falkman 2008*, Booth 2007, Tolson 2005, Tolson 2008, Brooks 2006**, Brooks 2006*, Hara 2007, Ho 2010, Nagy 2006, Penn 2008, Russell 2004, Poole 2008, Sharma 2006, Valaitis 2011, Rolls 2007, Poissant 2010, Booth 2007, Poissant 2010, Thomas 2010, Falkman 2008*, Brooks 2006**, Brooks 2006*, Poissant 2010, Rolls 2007, Curran 2009, Hara 2007, Ho 2010, Li 2009, Nagy 2006, Penn 2008, Russell 2004, Thomas 2010, Perotta 2006, Poole 2008, Tolson 2005, Tolson 2008	Andrew 2009, Brooks 2006**, Brooks 2006*, Curran 2009, Sharma 2006, Tolson 2005, Valaitis 2011	16
Community ***	Points which build community (supportive) and reduce community (against)		Hara 2007, Sharma 2006	19

Brooks 2006* = Nursing and Health Management and Policy.

Brooks 2006** = International Journal of Nursing Studies.

Falkman 2008* = Journal of Medical Internet Research.

Falkman 2008** = Studies in Health Technology and Informatics.

*** = Technology and Community are two extra themes added by the authors of this literature review and do not appear in Probst and Borzillo's model (See Table 3).

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Theme 1: Leadership

Probst: The organisation can designate leadership roles to motivate community members to collaborate

Almost every study in this review commented on leadership, facilitation or moderation [21,23-38]. Previous studies have commented on the lack of clarity around these terms in virtual communities of practice [21]. In this review, it appears that these roles, whilst overlapping, are different.

Facilitators/Moderators

The most common role described in the studies was of the facilitator or moderator. This role may arise in several ways. The originator of the group may end up being the initial leader and facilitator [23]. The facilitator may be appointed by the originators of the group [24-26] or the facilitators of the group may arise spontaneously [24].

If they arise spontaneously, then these moderators or facilitators tend to be part of the 'core group' which also characterises these virtual communities [23]. The 'core group' consists of a minority of active users, whilst often the majority is passive [25,26]. Despite this passivity, these users are still seen as benefiting from the network as 'legitimate peripheral participants'. As one GP put it, I have not used CHAIN much but it is a security blanket!" [26].

The tasks of the facilitator and moderator are, as Probst described, to improve collaboration [27,28], but can also include making sure the rules of engagement are clear, keeping discussions focussed and processing memberships [23,26,27,29].

There is some controversy about ongoing facilitation. One researcher believed that these networks can be self-sustaining [23], one found that it was definitely not [30], however most simply used facilitators, or had facilitators emerge, throughout the projects.

Leadership

In one study without formal facilitators, 'leaders' emerged. This 'emergence' demonstrated the opportunity for horizontal leadership to occur in VCoPs, in which marginalised or junior members of staff have the chance to emerge into leadership roles, potentially taking forward actions that arise from discussions [27].

In the same online midwifery forum, more senior nurses used their postings to praise other contributors and to validate the use of the forum, successfully encouraging usage. However, praise online actually fits better with the role of a moderator and from the perspective of Probst's thematic analysis, the 'leadership' shown in validating the use of the forum by the organisation may fit better under 'sponsorship' [24].

Probst tells us that the role of the leader is in promoting collaboration [8]. However the definition of leadership in the articles reviewed is controversial. Li's systematic review highlights the fact that the role of leader and facilitator may be separated or performed by the same person [21]. In terms of roles, in the articles reviewed it appears that it is actually the facilitator and moderator who promote collaboration. Leadership, when implying validation by the organisation, can actually be seen as equivalent to Probst's 'Sponsorship' or the display of executive approval for the network. The main importance of the leader found in this review is in the initiation of the community. In many of these studies that role was actually performed by the study organisers [30,31,39]. In studies in which the study organisers are not the leaders, then this concept of leadership and initiation merge with Probst's concept of sponsorship.

Theme 2: Sponsorship

Senior executives need to provide sponsorship to help communities reach their full potential

In business, Probst's finding was that effective CoPs had a sponsor, or senior executive, who sanctioned the CoP. There was then a leader that drove the community [8].

The findings in the current literature review were that, in fact, in health the agenda is usually driven by the organisation attempting to start the community and/or the researchers founding the community. It is then the moderators and active group that continue to stimulate and promote knowledge sharing.

Sponsorship, initiation, vision or leadership was evidenced in many of the studies, as the groups were collaborations between stakeholders that were forming a network to solve a problem. Ultimately, someone had to start the network, then continue to support its activities. For example, the CHAIN network of evidence in the UK is part of the NHS Research and Evaluation network, ICUConnect is part of the ICU Monitoring Unit and the proposed e-collaborative platform for the Montreal Stroke Network is formed from a number of state and national stakeholders [26,29,32].

Once created, ongoing organisational support was essential to the success of projects. This was demonstrated well in a group of gerontological nurses that needed ongoing support from high-level nurses to legitimise work-based learning, before the use of the online environment was accepted [39].

Whilst sponsorship describes the process of the corporate world well, in the health context there are some differences. Mostly, the networks have an initial purpose of knowledge sharing that supports the organisation, or the researchers' study, and thus are a collaboration of multiple stakeholders such as a health service, the researchers and clinicians, rather than the domain of a single company.

Theme 3: Objectives

Clear objectives provide members with responsibilities and motivate them to contribute more actively

Each VCoP studied had an objective, however these objectives ranged from clear and specific

to broad. The success of networks with specific objectives initially appears to support this statement [24,25,31,34,39]. For example, the development of evidence-based 'best practice' statements for gerontological nurses in Scotland led to the better uptake of evidence-based practice, using a Virtual College and CoP. However, a number of networks had broad objectives within a specialised group of practitioners and were also successful [23,24,34]. For example, Nagy's network for PACS online radiology systems had a broad objective to "facilitate and accelerate PACS through education and communication". Within that framework, users developed their own goals and content through posted queries and responses. A similar pattern was found in Brooks' midwifery forum [27].

However, when a busy psychologists' network was reviewed for the outcome of 'professional identity creation', there was less success. The network had not been set up for this, and perhaps its broad goal of providing a 'meeting place where ..professionals...can establish valuable relations; sharing experiences information and practices...' contributed to the lack of specific identity formation [35]. Also, a network of nursing academics experienced some problems with lack of focus [30].

Probst describes clear objectives and sub-objectives for CoPs. For example, a car manufacturer may have a broad objective of improving engine

performance, with sub-objectives around building and exchanging technical knowledge around each of the engine parts (valves or internal combustion for example). The findings from this review are that specific objectives are helpful although, particularly in a specialised area such as midwifery or radiology systems, some networks succeed without a high degree of clarity around their goals.

Theme 4: Boundary spanning

Boundary spanning enables members to engage in internal and external benchmarking practices

Most groups in this review benefited from a heterogeneous make-up, although there were some problems. In almost every study, there were either a variety of practitioner types, or a variety of organisations participating. Booth found that linking CoPs in different sites via the virtual college accelerated their guideline development process for nurses [31] and Curran's rural emergency departments benefited from their city cousins sharing expert knowledge and from the use of knowledge experts [40]. The evidence-based CHAIN network in the UK described the effective knowledge sharing between groups as a demonstration of strong and weak tie theory [26]. In this instance, strong ties are between users that know each other best, but weak ties between users only distantly acquainted or introduced via the network led to the greatest knowledge sharing.

However, if the group is too heterogeneous, there can be problems, as there is either not enough overlap for effective communication or antagonistic viewpoints between competing groups [30,35].

Probst describes members of CoPs either being fed with external expertise, or making use of other CoPs either within, or from without, the CoPs company. This view differs from the health experience in that often these networks do not originate within a single 'company' or stakeholder. The boundary spanning occurs through the interaction between either different professional groups or different organisations, or both, whilst some used external experts.

Theme 5: Risk-free environment

COPs should be used as an especially valuable opportunity to express and test ideas in an informal and risk-free environment, thus requiring a strong degree of safety and intimacy between members

A risk-free environment came through as important in this review. Moderators were encouraged to enforce rules of no offensive language and 'model citizen behaviour' [23,27]

and protocols were developed about how users are to behave online with expectations of themselves and each other [34].

In addition to lack of risk, positive reinforcement was also important, along with a non-hierarchical atmosphere. One nurse said “I think if you keep encouraging people they will think and be creative” [39], whilst another commented that “It’s (the online environment), you know, a free atmosphere; to be able to do it without any comeback” [36].

A demonstration of the risks that users fear was the fact that Penn’s Suicide Prevention network had still not progressed to its original goal of online psychiatry advice due to legal concerns [34]. In addition, in an online anaesthetic network reporting on critical incidents, it was felt that some of the lack of reporting was due to the general culture of low reporting of incidents. This network also commented that users requested anonymity as an option, likely for the same reason [41]. Probst’s review demonstrates that a risk free environment is important in business to encourage growth. In health, although an environment must be risk free, it should also be positive and encouraging. This type of environment builds trust and thus improved communication.

Theme 6: Measurements

Empirical evidence suggests the use of measurements to assess the value of communities of practice

There was very little formal measurement identified in this review. One study found that regular feedback provided to participants assisted them in decision-making [31]. However, several studies commented on the value of informal ‘benchmarking’ or ‘validation’ of their own practice against that of other users and organisations [27,39,40], while other participants generated their own ‘closing the loop’ of actions resulting from the online discussions [24].

Measurement, benchmarking and feedback

The VCoPs in Probst's review had more measurable goals, such as cost reduction or product improvement. However, he still notes that members posting online 'stories' of how their experiences have led to positive change motivates other members. In the health context, these measurements may be more likely to be member-generated, including benchmarking of practice or having feedback about organisational changes that have been triggered as a result of the discussion, rather than formal manufacturing targets.

Technology and community features

Whilst not specifically addressed by Probst and Borzillo, a number of other themes were found in this literature review, which have been grouped under the headings Technology and Community Features.

Technology

Making the technology easy was commonly cited as highly important. The concept of 'easy' included ease of use, ease of access and flexibility of options for communication [24,27,28,30,34,37,41].

Communication options in most studies included an asynchronous method, either by email or discussion boards [23,24,26,28,34,37,39,42], while some studies used these with a mix of features including chat, content sharing and synchronous web-meetings [23,34,35,39]. Email reminders were also suggested to be useful [26,37,41].

Whilst the previous features were more uniform, a number of areas were controversial. Some studies used passwords [28,42] though lost passwords and online delivery created barriers for others [37,39,40]. The online environment was of real benefit to most [24,27,35], though one study found that the culture of face-to-face interaction amongst nurses was a barrier to use of

online environments [30]. Lastly, training was mentioned as necessary by some [39] whilst others aimed to avoid training through simplicity of design [24].

Ease of use is paramount in any online community. Communities should offer asynchronous communication methods such as email and discussion boards and may consider other options such as chat and content repositories. When setting up a community, consideration needs to be given to the pros and cons of passwords, access, identification and training.

Community features

Effective communities of practice result in knowledge sharing [15]. This knowledge sharing can be encouraged by voluntary involvement, as self-selection appears to encourage users that are willing to share knowledge to participate [27,28]. A particular feature of the CHAIN network of evidence in the UK is the reciprocity of members, that is the generosity of members when responding to queries from others [26]. However, whilst this active membership is essential, passive users can still be seen as Lave and Wenger's 'legitimate peripheral participants', gaining support from watching the 'expert' users [25,26]. The validation of each others' practice and a desire to understand current knowledge are other factors that help sustain an online CoP [24,27,40].

Whilst online membership is helpful in overcoming barriers of geography and time [24,27,30], bonds can be strengthened through face-to-face meetings [31,32]. In fact, one network started online, with physical chapters developing as a result [23].

Communities can help professionals overcome isolation through connecting with colleagues and sharing knowledge [27,38]. One nurse said "I feel fairly isolated [because] I don't have many peers (advanced practice nurses) in my organisation. The listserv helps give me ideas when I have no-one else to bounce ideas with in my hospital".

In addition to the features mentioned by Probst and Borzillo, self selection, a desire to

knowledge share and the blending of face-to-face and online involvement are desirable. It is worth noting that it is not just the active users that benefit from membership in such communities.

Implications

From this review it can be seen that there may be a role for VCoPs in general practice training, although a planned approach to research is needed. A VCoP for general practice training may decrease the social, structural and professional isolation aspects of training, thus improving trainees' sense of connectedness and improve their knowledge sharing opportunities. The benefits of these outcomes could include higher general practitioner trainee satisfaction and knowledge, particularly whilst in rural placements, with implications for possibly helping to overcome workforce shortages and quality health care delivery in these areas.

Another potential benefit of a VCoPs for general practice training is that VCoPs can offer the potential to make invisible work visible. This might enable areas of practice that have traditionally occupied lower status in general practice to gain significance as members communicate their experiences. An example of a VCoP for general practice trainees could include online expert medical moderators facilitating case discussions, answering questions and helping to build a shared knowledge resource for trainees. During this process, under-represented or marginalised areas such as workers' compensation related illness or youth mental health may be highlighted in discussion, thus raising their profile as well as providing practical tips for trainees with little exposure to these difficult areas.

Limitations

There are a number of limitations to this study. Firstly, the initial model is drawn from the business literature, with business outcomes in mind. In health, CoPs often involve several organisations, rather than one business. They may also be non-profit and the outcomes being

measured may be more related to clinical care delivery or knowledge sharing and overcoming professional isolation. It was also unclear in the Probst and Borzillo model how many of the CoPs were in fact VCoPs and there was no subset analysis on this differentiator, which is noted in the Probst and Borzillo paper.

Secondly, the overall data quality of many of these papers is limited and in particular there is very little rigorous outcome data. Future studies must include an examination of efficacy in addition to qualitative review.

Finally, the themes that have been generated from each paper are not formal themes that have been evaluated in each paper. In many cases they are drawn from descriptions of the project or interpretations of the data by the candidate, but with variable data quality (see Table 2).

Conclusions

Good General Practice is core to good care delivery and needs to be maintained by a high quality training of new general practitioners. However, General Practice registrars face a number of pressures, including professional, structural and geographical isolation.

Virtual communities of practice in business have been shown to improve knowledge sharing and overcome geographical boundaries, essentially overcoming professional and structural isolation. There are some promising signs in the health literature that VCoPs may help to overcome isolation, but studies are few and there is no systematic review evidence.

This review shows that a highly cited framework for VCoP development in the business literature could be applied to the current health literature, with some amendments (see Table 3). As a result, further research is needed to validate whether this framework is an effective method of health VCoP development, whether such a VCoP is effective in overcoming isolation

in General Practice training and, if so, whether VCoPs could be a tool for improving General Practice training and retention, particularly in rural areas.

Table 3: Proposed Health VCoP Framework

Probst's Business CoP Framework	Proposed Health VCoP Framework
Leadership: The organisation can designate leadership roles to motivate community members to collaborate	Facilitation: Facilitators promote engagement and maintain community standards
Sponsorship: Senior executives need to provide sponsorship to help communities reach their full potential	Champion and Support: The network needs to have an initial stakeholder champion, with stakeholder support
Objectives and Goals: Clear objectives provide members with responsibilities and motivates them to contribute more actively	Objectives and Goals: Clear objectives provide members with responsibilities and motivates them to contribute more actively
Boundary Spanning: Boundary spanning enables members to engage in internal and external benchmarking practices	A Broad Church: Consider involving different, overlapping but not competing, professional groups, different organisations and external experts. However make sure the church is not too broad.....
Risk-free environment: CoPs should be used as an especially valuable opportunity to express and test ideas in an informal and risk-free environment, thus requiring a strong degree of safety and intimacy between members	Supportive environment: Health VCOPs should promote a supportive and positive culture that is both safe for members, and encouraging of participation
Measurements: Empirical evidence suggests the use of measurements to assess the value of communities of practice	Measurement, Benchmarking and Feedback: Health VCoPs should consider measurement as a factor in their design, including benchmarking and feedback
	<p>Technology and Community: Online CoPs should ensure ease of use and access, along with asynchronous communication. Other options including chat and meetings can also be considered, along with the need for training.</p> <p>Communities are more likely to share knowledge when there is a mixture of online and face-to-face meetings, members self select, and both passive and active users are encouraged.</p>

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Chapter 3: Perceptions of family physician trainees and trainers regarding the usefulness of a virtual community of practice.

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Introduction

Training for general practice, or family medicine, in Australia is a postgraduate specialty program. After graduation from medical school, doctors spend a minimum of 1 year in the hospital system. To become a general practitioner, they must join a 3-year general practice training program, run by one of 17 regional training providers across Australia. This program consists of 1 hospital year and 2 supervised general practice years. During these 3 years,

trainees are required to work in a number of different rural and urban general practice locations, with at least 6 months located in a rural area. These locations are often small practices with a limited number of medical colleagues onsite, in contrast to the large hospitals with many colleagues that characterise early medical training.

As a result of these features, general practice training can be isolating [1], resulting in decreased knowledge sharing [2] and can affect career choices [3], including lowering intention to work in rural areas [1]. This has implications for the quality of training, standard of the primary care workforce and retention of a rural general practice workforce.

The types of isolation experienced can be categorised as structural, personal and professional [1]. Structural isolation refers to smaller practices with closed consulting rooms and occurs across urban and rural sites [1]. Social isolation, which can be described as a kind of loneliness [4], is more common in rural placements [1,5]. Professional isolation results from a lack of clinical support and is also potentially a greater problem in rural areas [1]. Professional isolation is linked to barriers to knowledge sharing, with reduced tacit knowledge exchange and networking opportunities [2]. Problems with training, including all 3 types of isolation, are associated with a decreased intention to work in rural or regional areas [1].

The general practice workforce in Australia is under pressure [6], particularly in rural areas [7]. Given that isolation can lead to a lower intention to practice in rural and regional areas, it is important to try to overcome isolation in order to maintain a sustainable general practice workforce.

A recent literature review proposed a role for virtual communities of practice (VCoPs) in overcoming isolation, particularly professional isolation, through improved knowledge sharing [8]. The literature review built on an accepted business VCoP framework [9], proposing a framework for VCoPs in health. Communities of practice (CoPs) are “groups of people who

share a concern or a passion for something they do and learn how to do it better as they interact regularly” [10]. These groups build shared resources that maintain ways of working, standards, and values within the community [11,12]. As technology has progressed, collaboration is being facilitated by social media tools [13-15] resulting in a blending of face-to-face and virtual communities of practice [16, 17]. This differs from a simple virtual community that is fluid and without formal boundaries or membership [18] and, most importantly, may be purely around a shared interest such as movie trivia rather than a shared practice. Probst and Borzillo [9] have developed a framework for CoPs implementation based on 57 face-to-face and virtual CoPs in large companies such as IBM and Siemens. Barnett et al [8] have refined this for the health sector after a comprehensive review of the health literature and suggested a role for VCoPs, in the form of online private networks, in overcoming isolation through improved interaction with colleagues and knowledge sharing [8].

This study explored whether Australian GP registrars and their supervisors would be able to use, and would be interested in using, a VCoP of this type for work and training purposes. It also sought to understand the facilitators and barriers to intention to use such as community, and considered whether any of these factors could be modified.

Methods

Participants

The sampling frame for the current study included all general practice registrars and supervisors in a large regional training provider in Australia in May 2010. In ascending order, the training levels are basic registrar, advanced registrar, subsequent registrar, supervisor and educator. The training provider, Coast City Country General Practice Training (CCCGPT), provides general practice training across a wide geographic area including the urban centres of Canberra in the Australian Capital Territory and Wollongong in New South Wales, alongside large regional and small rural centres spread across approximately 160,000 square kilometres.

Surveys were sent to all trainers and trainees on the CCCGPT database via an email link to Survey Monkey [19], a Web-based survey creation tool. A participant information sheet was provided. Surveys were sent to the total sampling frame of 363, which included 139 registrars and 224 supervisors. A total of 146 completed surveys were returned (40.2%); 15 participants were removed for reasons such as not completing at least half of the survey (n=10), not completing demographic data (n=3) and not ticking the consent box on the survey (n=2). This left 131 (36.1%) for analysis.

Ethics approval was obtained from the University Human Research Ethics Committee.

Questionnaire

There is a lack of literature on VCoPs in general practice training [8]; therefore the survey was developed by the authors to assess computer, Internet and social media access and usage, confidence, perceived usefulness, intentions to use and barriers to use for training purposes.

The instrument was piloted among a group of general practitioners, general practice trainees and health researchers. Afterwards, a group discussion amongst pilot participants led to the amendment of wording and several response options alterations, to improve clarity and better reflect GP work.

The final survey consisted of 26 questions, including categorical and Likert response items (see Table 1). Specifically, the questions covered demographics (questions 1-5), computer and Internet access and usage (questions 6-9), computer and social media confidence (questions 10 and 11), social networking usage (questions 12-21), social media usefulness (questions 22 and 27), barriers to use (questions 23 and 24) and intention to use social media for training purposes (25 and 26).

Table 1: Survey content and question type.

Question Content	Question Type	Question Number (Categorical options or Likert items)
Demographic	Categorical	1 (2), 2 (2),3 (1),4 (2),5 (2)
Access and usage	Categorical	6 (2),7 (2),8 (6),9 (7), ,
Confidence	Lickert items	10 (4), 11 (7)
Social networking usage	Categorical	12 (2),13 (9),14 (11), 15 (2),16 (9),17 (2),18 (1),19 (2), 20 (5), 21 (8)
Usefulness	Likert items	22 (14)
Usefulness	Categorical	27 (6)
Barriers	Categorical	23 (8), 24 (8)
Intention to Use	Likert items	25 (2), 26 (2)

Statistical Analysis

Data were analysed using SPSS version 19 (IBM Corporation, Armonk, NY,USA). Respondents were categorised as registrar or supervisor for comparisons between groups. The t-test and chi-square tests were used to determine differences between responses based on rurality, gender, age and training level. Paired-samples t-tests were used to compare means of scale data, such as intention to use a private social network for work purposes and intention to use an open social network for work purposes. Independent-sample t-tests were used to compare categorical and scale data, such as computer confidence and for the analysis involving all categories of training level. The chi-square test was used to compare differences between categorical data, such as rurality and training level. All statistical comparisons were 2-tailed and statistical significance was set at .05.

Factor analysis using varimax rotation was used to determine which Likert items grouped naturally in questions with multiple Likert items, for constructs such as computer confidence (questions 10 and 11) and usefulness (question 22). Factors were included if their eigenvalues were > 1.0 . The Cronbach alpha test for reliability was used to determine the degree of agreement between the Likert items. Cronbach alpha was > 0.8 for both items, higher than the recommended threshold of 0.70.

A confidence scale was constructed using all items from questions 10 and 11; the summated data were used as an independent variable in further analysis. The Pearson product moment correlation (r) was used to determine agreement between variables such as confidence, and intention to use a private network for training purposes. The multivariate associations of independent variables such as confidence and training level, with the dependent variable of intention to use a private network for training purposes were examined using multivariate general linear regression modelling.

Results

Characteristics of the Survey Population

Of the 131 respondents, gender was evenly split (males 66/131, 50.4%; females 65/131, 49.6%). Registrars accounted for 61.8% (81/131) of respondents and the remainder were supervisors. The response rate amongst trainees was higher than supervisors (registrar 81/139, 58%, supervisor 50/224, 22%). The mean age of the sample was 41.5 years (range 23-66 years, SD 10.369), with a significant difference between ages of trainees and supervisors (35.9 and 51.0 respectively, SD 10.369), with a significant difference between ages of trainees and supervisors (trainees: mean 35.9, SD 7.21; supervisors mean 51.0, SD 7.21, .001)

Over half (75/131) of respondents were from rural settings, whilst the remainder worked in a general (nonrural) setting, with no significant differences between training stage and rurality or age and rurality.

Access and usage

Almost all general practice trainees and supervisors had access to the broadband Internet at home (125/131=95.4%) and at work (130/131=99.2%). However, usage was found to be significantly different between registrars and supervisors, with 20% (n=10/50) of supervisors compared with 33.3% (n=27/81) of registrars spending more than 2 hours per day on the Internet ($p=0.03$). Internet usage of greater or less than 2 hours per day was not significantly associated with age ($p=0.17$).

Registrars were significantly more likely to use social networking sites for non-work purposes (registrars: 41/81, 50.6%; supervisors: 14/50, 28%, $p=0.01$) and higher usage was associated with lower age (.001). Both registrars and supervisors were unlikely to use social networking sites for work purposes (registrars: 13/81, 16.0%; supervisors: 4/50, 8.0% respectively) and there was no statistically significant difference between the groups.

Out of all online social media activities, registrars and supervisors were most likely to watch online videos (registrars: 63/81, 77.8%; supervisors: 27/50, 54.0%), followed by reading discussions (registrars: 53/81, 65.4%; supervisors: 25/50, 50.0%). They were least likely to construct a wiki (registrars: 3/81, 3.7%; supervisors: 0/50, 0.0%). Video watching was significantly correlated with age, with younger users using more video ($p=0.001$) and registrars watching more video than supervisors ($p=.004$). Reading online discussions was not significantly different between registrars and supervisors and was not associated with age.

Confidence

Factor analysis was performed on the 4 general computer confidence items, revealing only 1 factor, which was labelled *computer confidence*. The factor analysis was reliable (Cronbach alpha= 0.82) and valid (eigenvalue= 2.66). Overall confidence was high (n=131 mean 3.93, SD=0.63) and confidence was negatively associated with age ($r = -0.18$, $p = .04$) but not significantly associated with being a registrar or a supervisor.

Confidence using discussion boards, wikis, blogs, online communities, chat, online video and Twitter, was assessed on a 5-point Likert scale for each of the 7 items. Confidence among supervisors was low to moderate, from a mean of 2.32 (SD 0.91) to a mean of 2.98 (SD 1.29) and was significantly lower than among registrars for all applications except Twitter, which was low for both groups (see Table 2).

Factor analysis was performed on the 7 social media confidence items, revealing only 1 factor, which was labelled *social media confidence*. The factor analysis was reliable (Cronbach alpha= 0.93) and valid (eigenvalue= 5.0). Social media tool confidence overall was moderate (n=131, mean=3.03, SD 0.99) and was negatively associated with age ($r = -0.38$, $p < .01$) and training level (.01), with younger respondents and registrars more likely to be confident with social media tools.

Cronbach alpha for the items in the confidence scale including all 11 items was 0.92. The inter-item correlations ranged between 0.21 and 0.78 indicating that there were no redundant items.

Table 2: Means and standard deviations for confidence using internet based applications and services

Item	Group	n	Mean	St Dev.	t	df	95% CI	
							LL	UL
Discussion forums	Registrars	81	3.40	1.02	2.05**	129	0.01	0.82
	Supervisors	50	2.98	1.29				
Wikis	Registrars	81	3.22	1.07	4.21*	129	0.44	1.21
	Supervisors	50	2.60	1.11				
Blogs	Registrars	81	3.12	1.02	2.68*	129	0.14	0.91
	Supervisors	50	2.60	1.20				
Online communities e.g. Facebook	Registrars	81	3.48	1.22	4.17*	129	0.46	1.30
	Supervisors	50	2.60	1.23				
Online chat/instant messaging	Registrars	81	3.46	1.22	3.98*	129	0.40	1.27
	Supervisors	50	2.62	1.24				
Online video	Registrars	81	3.69	1.01	3.60*	129	0.34	1.13
	Supervisors	50	2.96	1.26				
Twitter	Registrars	81	2.56	1.04	1.32	129	-0.12	0.59
	Supervisors	50	2.32	.91				

Nb. 5- point Likert scale: 1 – Strongly disagree, 2 – Disagree, 3 – Neither Agree nor disagree, 4 – Agree, 5 – Strongly agree. Nb. * p

< .01, ** p < .05

Usefulness

Using a 5-point Likert scale, 13 items were asked regarding perceived usefulness of social networks, regardless of whether the respondent currently used social networks, for aspects such as training purposes, keeping in touch with other trainees, job networking and social support (Table 3).

Table 3: Means and standard deviations group's responses to usefulness of social networks

Item	Group	n	Mean	Std Dev.
Training purposes	Registrars	80	3.60	1.01
	Supervisors	49	3.43	0.82
Keeping in touch with other registrars	Registrars	80	4.11	0.83
	Supervisors	48	3.69	0.55
An extra way of interacting with current supervisors	Registrars	79	3.37	1.12
	Supervisors	49	3.61	0.76
A way of interacting with previous supervisors/other clinical mentors	Registrars	79	3.61	0.93
	Supervisors	49	3.63	0.57
Job networking	Registrars	80	3.61	0.95
	Supervisors	49	3.59	0.65
Staying in touch with people	Registrars	79	3.96	0.86
	Supervisors	49	3.78	0.65
Social support from peers	Registrars	80	3.60	0.99
	Supervisors	49	3.63	0.67
Professional support from peers	Registrars	80	3.60	0.99
	Supervisors	49	3.63	0.10
Professional support from supervisors	Registrars	80	3.40	1.06
	Supervisors	49	3.63	0.71
A knowledge resource for solving clinical problems with the help of other clinicians	Registrars	79	3.58	1.01
	Supervisors	49	3.47	0.82
A way of sharing useful resources with colleagues	Registrars	80	3.81	0.94
	Supervisors	49	3.63	0.67
A forum for expressing or hearing opinions on clinical and political topics	Registrars	80	3.64	0.98
	Supervisors	49	3.65	0.72
A resource of useful learning tools e.g. video tutorials	Registrars	80	3.86	0.92
	Supervisors	48	3.65	0.76
Other	Registrars	24	3.13	0.68
	Supervisors	14	3.50	0.76

Nb. 5- point Likert scale: 1 – Strongly disagree, 2 – Disagree, 3 – Neither Agree nor disagree, 4 – Agree, 5 – Strongly disagree

The question “keeping in touch with other registrars” was the only item to show a significant difference between registrars and supervisors ($p=.002$). On review of the result it was decided that the question was confusing as supervisors were being asked to value the usefulness of keeping in touch with other registrars, for which they have little need, as opposed to keeping in touch with other supervisors. Because of the confusing nature of the question it was discarded from the subsequent factor analysis. Factor analysis of the remaining 12 items revealed a single factor (Cronbach alpha=0.96, eigenvalue= 8.3) labelled *usefulness*. Overall usefulness was scored positively ($n=123$, mean 3.63, SD 0.74), and was not significantly associated with age or training level. Usefulness was not significantly correlated with computer confidence, but was significantly correlated with social media tool confidence ($r= 0.27$, $p=.02$).

Barriers to use

A number of barriers to using social networks for work were described. The main concerns were worries about privacy (registrar: 61/81, 75.3%; supervisor: 30/50, 60.0%) and insufficient time (registrar: 41/81, 50.6%; supervisor: 36/50, 72.0%; see Table 4). Factor analysis was not performed as these barriers were categorical questions.

Table 4: Perceived difficulties in using online social networks for professional purposes

Difficulty - Professional	GPRs (n)	Supervisors (n)
Worried about privacy	75.3 (61)	60.0 (30)
Insufficient time	50.6 (41)	72.0 (36)
Worried about security	48.1 (39)	38.0 (19)
Not sure how to use them	27.2 (22)	40.0 (20)
Not interested	14.8 (12)	34.0 (17)
Technical Issues	28.4 (23)	18.0 (9)
Lack of other colleagues known to use them	33.3 (27)	44.0 (22)
Other	4.9 (4)	8.0 (4)

Intention to use

An important aim of the survey was to assess whether doctors would use a social network for training purposes. Respondents were asked whether they would use a private network, or an open network such as Facebook, for work purposes or social purposes.

Respondents differed in their intentions to use private as compared with open networks. All respondents were significantly more likely to use a private network for work purposes compared with using an open network for work purposes (.001). On subgroup analysis, both registrars and supervisors were more likely to use a private network for work purposes than an open network (.001), but registrars were more likely to use a private network for work purposes than supervisors (.001). Both registrars and supervisors were equally likely to use an open or private network for social purposes (Table 5).

Table 5: Private vs. open network usage amongst GPRs and Supervisors

Item	Group	Open: Mean (SD)	Private: Mean (SD)	P
Work	All	2.09(0.97)	3.57 (0.93)*	<0.001
	Registrars	2.2(0.99)	3.85 (0.77)*	<0.001
	Supervisors	1.9(0.90)	3.16 (0.97)*	<0.001
Social Purposes	Registrars	3.21(1.30)	3.19 (1.10)	0.85
	Supervisors	2.40 (1.35)	2.62 (1.05)	0.25

To investigate which factors had an independently predictive value for the outcome “I would use a private network for work and training purposes”, a multivariate generalised linear regression model was developed using private network as the dependent variable. To inform this model, multiple correlations and t-tests were performed to identify individual factors that correlated with the intention to use a private network for work and training purposes (Table 6). These factors were then entered into the regression model as independent factors.

Table 6: Factors correlated with the intention to use a private network for work or training purposes

Factor	Significance (P)
Training level: GP or Registrar	<0.01
Rural versus Urban	0.42
Age	0.01
Confidence (computer + social)	0.03
Usefulness	0.03
Concern about privacy	0.11
Concern about time	0.004
Concern about security	0.82
Not sure how to use	0.61
Uses Facebook	0.24
Gender	0.07

In the initial model, age was not independently predictive, whereas training level was predictive. Given that training level is related to age, the subcategories of training status were analysed in the model.

The final model was significant ($R^2=.365$). In the final model, controlling for other factors, training level was an independently significant predictor of intention to use a private network for work and training. The beta coefficient fell as training level rose, showing the most significant predictor was early training stage, declining as registrars progressed through training. Concerns about privacy and time were negatively predictive, whereas security concerns were non-significant. Usefulness was independently predictive of use of a private network for work and training purposes. Confidence was not statistically significant ($p=.06$; see Table 7)

Table 7: Intention to use a Private Network for Work Purposes

Parameter	Beta	Std. Error	t ₁	p	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Privacy	-.382	.166	2.296	.02	-0.711	.052	.046
Time	.561	.149	3.765	<.001	.266	.856	.115
Confidence:SocialandComputer	.211	.111	1.901	.06	-.009	.431	.032
Age	.008	.010	.763	.45	-.012	.028	.005
Usefulness	.318	.095	3.327	.001	.128	.507	.092
Basic Registrar	1.371	.346	3.963	<.001	.685	2.056	.126
Advanced Registrar	.998	.390	2.558	.01	.225	1.771	.057
Subsequent Registrar	.884	.346	2.550	.01	.197	1.570	.056
Supervisor	.693	.298	2.321	.02	.101	1.284	.047
Medical Educator	0 ^a

Discussion

Principal Findings

The purpose of this study was to assess whether general practice registrars and supervisors in Australia would use a VCoP in the form of a private online network for training purposes and what factors are important in this decision. The results demonstrate that doctors in this sample have the access and interest needed to use a VCoP. High levels of access to computers and the Internet were coupled with overall high computer confidence. Although computer confidence was high, confidence using social media tools was lower and varied significantly between registrars and supervisors, and between applications. Confidence was also found to be related to training stage and age, but given that training stage and age are related, it was interesting to see in the regression that training stage became significant but age did not. This is in-line with previous findings that age is not a significant predictor of physicians' use of social media [20]. Therefore the most receptive group of doctors may be those at a more junior training stage, rather than those who are the youngest.

Confidence was found to correlate with intention to use an online community, but did not reach significance in the generalised linear regression. This may be because confidence overlaps with training stage and, thus, it is the training stage that is the greatest predictor, with confidence of secondary importance. However, confidence may still be worth considering when in the implementation of a virtual community. A study from the United Kingdom showed high levels of interest in social media amongst British doctors, but low levels of usage, with the authors concluding training as a potential gap [21]. This suggests that a lack of training or exposure results in a lack of confidence.

In spite of good levels of access and confidence, overall use of social media for work purposes was low. This is in contrast to a recent study in the United States, that showed a high uptake of social media tools, in particular physician-only communities, with 52% of respondents using online communities such as Sermo or Ozmosis [20]. This contrast may reflect a more mature market in the United States with a longer history of online communities. In the United States, the largest online community launched in 2006 and now has over 125,000 members, whereas in Australia serious online medical communities only began to appear in 2010.

Perceived usefulness is another important predictor of use of an online community in this study. Initially it was thought that respondents' levels of perceived usefulness and intention to use an online community could be covariate, but this was not the case and usefulness was an independent predictor of intention to use an online community. This is in keeping with findings of 2 studies of use and intention to use social media among health care professionals, and previous studies on technology acceptance [20,22,23]. The Technology Acceptance Model was developed to describe the most significant predictors of technology use in the general community. The most significant was perceived usefulness of the technology [23]. In a US study of physician social media usage, physicians with a higher perception of usefulness of technology overcame their barriers to use [20], and in Canada, participants in a stroke

knowledge transfer planning study expressed high levels of perceived usefulness of social media tools for stroke knowledge exchange [22]. The authors of the Canadian stroke study perceived a higher level of usefulness for rural users, but respondents in their study did not support this – consistent with the finding in the current study that rurality was nonsignificant. It may be that rural users are seen as the beneficiaries of online knowledge sharing tools, and this has been the case in other studies, for example, knowledge sharing among emergency medicine workers in Canada [23]. One reason for the difference may be that general practice registrars can experience structural isolation as a result of working in small practices with less professional contact than hospital workers, in urban as well as rural environments [1]; conversely, as in the Canadian stroke study, respondents may already have strong established local networks [22]. Perceived usefulness is also important as it is potentially modifiable through training and promotion of the potential benefits of an online community to its users.

Finally, barriers are important to address. In this study, time and concerns about privacy were important negative predictors of use, but concerns about security were not significant. This may have been because of a lack of understanding of the difference between privacy and security, or a lack of concern about security, or a higher value being placed on personal or patient confidentiality than computer security. In contrast to these possible concerns, in the Canadian stroke study, participants did not express particular concern regarding patient confidentiality in online exchanges [22]. Once again, this may be due to a more evolved North American market with more experience in online exchanges, as the participants were said to be “fully aware that written communication within a Web platform must ensure confidentiality and respect ethics rules” [22]. Time as a barrier correlates with the findings of the recent Canadian stroke study [22], and a number of previous studies on health professional use of VCoPs [24,25]. It is a difficult factor to modify. However the US physician Web 2.0 study found that in spite of a high perception of barriers, if usefulness and ease of use are taken into

account, usage is still high [20]. Thus the barrier of time needs to be recognised and addressed with training and promotion on potential usefulness.

Ease of use of a network is another important consideration [23]. The preference amongst doctors for a private network compared with an open network for work and training purposes was significant and most likely related to privacy concerns. This is supported by their lack of preference for a private network when using an online network for social purposes, in which patient confidentiality is not an issue. Importantly, previous work has expressed concern that private networks may have an effect on decreasing ease of use by introducing the need for passwords [22]. Given the importance among respondents of a private network, ease of use may be able to be addressed through technical and training avenues, such as the use of a current password (i.e. integrating the network with a current training platform), the ability to “remember me” and easy retrieval of lost passwords.

The findings from this study can be looked at in terms of the proposed Health VCoP Framework presented in the recent literature review of VCoPs in general practice training [8]. In that framework, elements of Probst and Borzillo’s [9] recognised business VCoP Framework were modified for the health sector, based on the current literature. The framework consists of 7 factors (Table 8), including facilitation, champion and support, objectives and goals, a broad church, a supportive environment, measurement benchmarking and feedback, technology, and community. In the current study, in the broad church category, it seems that not only does a network need to engage users with varying abilities, (eg, registrars and supervisors), registrars may actually be more likely to engage than general practice supervisors. In the technology and community category, training is an important factor when implementing a VCoP. As well as focusing on technical training, training could include promoting usefulness and confidence in using the online network, as well as addressing the barriers of time and privacy. This is consistent with findings from a US physician study in which

barriers were perceived, but they were overcome if usefulness was perceived to be high [20].

This promotion of usefulness may also be a role for the facilitator. Facilitators can make sure that users are engaged, are realising the potential of the site, that feedback is responded to and that necessary changes are made to the site in response to feedback and usage. A facilitator can also grow the community by monitoring and ensuring the usefulness of the site for both active and passive users, as the health framework proposes that both groups are valuable to the community. Finally, if a general practice training network were to be considered, concerns about privacy would need to be addressed through design, (eg, password authentication). The resulting usage barrier would need to be offset by appropriate design to ensure through ease of access on the password-protected site.

Table 8: Barnett et al Health VCoP Framework
Facilitation: Facilitators promote engagement and maintain community standards
Champion and Support: The network needs to have an initial stakeholder champion, with stakeholder support
Objectives and Goals: Clear objectives provide members with responsibilities and motivates them to contribute more actively
A Broad Church: Consider involving different, overlapping but not competing, professional groups, different organisations and external experts. However make sure the church is not too broad.....
Supportive environment: Health VCoPs should promote a supportive and positive culture that is both safe for members, and encouraging of participation
Measurement, Benchmarking and Feedback: Health VCoPs should consider measurement as a factor in their design, including benchmarking and feedback
Technology and Community: Online CoPs should ensure ease of use and access, along with asynchronous communication. Other options including chat and meetings can also be considered, along with the need for training. Communities are more likely to share knowledge when there is a mixture of online and face-to-face meetings, members self-select, and both passive and active users are encouraged.

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Chapter 4: Usefulness of a virtual community of practice and Web 2.0 tools for general practice training: experiences and expectations of general practitioner registrars and supervisors

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Introduction

Australian general practice training can be isolating [1]. During training, registrars move from a large urban hospital environment, with many colleagues in open ward rounds, to small training practices in urban and rural areas with fewer colleagues and much time spent alone in a private consulting room. Geographic barriers can result in professional isolation through decreased knowledge sharing [2] and can affect career choices among doctors and other health workers [3, 4], including lower intentions to work in rural practice [1]. Registrars also experience social isolation, a form of loneliness [5], particularly in rural terms [1, 6]. At a time when the Australian general practice workforce is under pressure [7], especially in rural areas [8], isolation must be addressed.

Peer-group tutorial models within Norwegian rural general practice training overcome professional isolation, leading to higher rural workforce retention [9]. These peer group

tutorials are essentially Communities of Practice. ‘Communities of practice’ are “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” [10]. Ways of working, standards and values within the community are shared and become a resource for the whole community [11, 12]. These Communities of Practice facilitate knowledge sharing [13], thus overcoming professional isolation.

General Practice training in Australia is also a Community of Practice, with learners at different stages interacting with experts and peers to gain knowledge. However, these Communities of Practice suffer from barriers to knowledge sharing, in particular the large distances that training programs cover.

Knowledge sharing can be facilitated by social media tools and Web 2.0, resulting in Virtual Communities of Practice [14, 15, 16, 17]. A recent survey study [18] showed that registrars and supervisors within a GP regional training provider had the requisite interest, ability and access to use a VCoP, such as an online community for GP training. Most importantly, it showed that their intention to use such a community was associated with their perception of its usefulness.

This study examined the perceptions of a small group of high internet users, focussing on the concept of usefulness, including the particular role of an online network, its features, and barriers to usage. These insights will help guide further studies on the development of online GP training communities.

Methods

Data and sample selection

A qualitative study, using semi-structured individual telephone interviews was conducted with 10 general practice registrars and supervisors in one of Australia’s 17 regional general practice training providers.

The 10 participants were selected from a previous online survey study. 34 participants agreed to be contacted for an interview. The criterion for selection for an interview was that participants spent more than one hour per day on the Internet. The intention was to choose interviewees who were confident using the Internet and social media tools and thus were able to give an informed opinion on their use and usefulness. There were 18 participants who met the selection criterion. From these, seven registrars and three supervisors were randomly chosen to participate in the interviews. All invitees agreed to participate.

Of the ten interviewees, ages 27 to 54 years [mean age: 38.2], there were 4 males and 6 females. Average length of interview was 18 minutes. Participants were allocated a unique identifier and data were de-identified to maintain confidentiality. The university human research ethics committee granted ethics approval for this research.

Measures

The semi-structured interviews were designed to explore the concept of usefulness. Interviewees were asked to describe their general training experience, any particular problems they had, and how social media tools might be useful, if at all. The interview guide was developed by the candidate and trialled amongst a small group of registrars and supervisors. The interviews were performed by the candidate and recorded and transcribed by research assistants. Thematic analysis was undertaken with two researchers coding the transcripts independently of each other. Data saturation was reached at 10 interviews. The discussion guide was used to develop provisional themes; both researchers discussed their findings with one another until agreement had been reached on the appropriate themes.

Results

A number of themes emerged from the interviews. These included professional isolation; the potential of social media tools to provide peer support and improve knowledge sharing; and barriers to usage including time, access and skills.

Professional Isolation

Respondents felt that the training program was generally supportive, however some registrars identified that the transition from hospital to general practice training can be isolating. This isolation seemed to stem from the distances between the registrar and training opportunities, particularly in rural areas. It was also due to the nature of working in a small general practice compared with a large hospital with many colleagues. Supervisors could also be professionally isolated due to distance.

I think I really struggled when I first started GP training. I came out of the hospital which is a very social environment and into GP which is really isolating, and I found that very difficult. (GP registrar 7)

We are quite spread out, it is quite difficult to keep in contact with people.....what trends are and what's happening. (GP Supervisor 9)

Whilst distance was commented on as a barrier by some, one registrar felt more supported in the rural placement than in the urban placement, due to the higher amount of webinar communication in the rural term.

[In the urban term].....because we only see each other, you know, once a month....but in the countryside we just have the meetings (webinars) every week....(GP registrar 3)

Knowledge sharing and support

Interviewees were asked about the potential benefits of an online network using social media tools. The main benefit of online tools was described as their ability to facilitate increased interactions and collaboration with others. These facilitated interactions were described in several different scenarios. For example, some registrars felt the need for support from off-site clinicians, particularly when working in remote areas or when the skills were not available on-site due to clinical experience or time pressures. Others felt that more contact with peers would assist the initial isolation that they felt.

When I am working alone, or when I am working remotely, so having a network would be very helpful...to discuss the clinical conditions, especially when you don't have a specialist around. (GP registrar 2)

Some sort of forum.....in the first few weeks, to say, all look this is what problem I'm having...that would be quite useful....it's always good to get other people's opinions in relation to questions from people who are in your similar situation. (GP registrar 8)

Other potentially useful facilitated interactions suggested were around general sharing of resources. Registrars and supervisors felt that sharing resources that other doctors had developed or found useful or interesting would be valuable.

To actually have a.....maybe an online collaboration of what people have found very useful for particular things I think would be really, really helpful. (GP registrar 8)

This morning is our presentation morning.....it would be good if you could end up with a few presentations that you could almost take out and share... (GP supervisor 9)

In addition to general resource sharing and to supervisor discussions, registrars noted specific areas of clinical support that would be useful, including exam preparation and particular topics such as mental health, dermatology and procedures.

Social media tools

Respondents commented on the benefits and limitations of several social networking tools. For example, live chat was seen to be useful as a means of social interaction between peers, a way of accessing instant clinical support and improving confidence in a consultation. The main limitation was that other users needed to be online at the same time. One user said that this limitation might be overcome by having lots of users, thus making it more likely that someone would be available.

In work hours so if somebody is there online you feel very confident. (GP registrar 2)

Some of us use it during our practice time, like if you've got a problem and need a quick result. [we use] chat either from Hotmail or from Facebook. (GP registrar 1)

Forums were mentioned by eight of the ten respondents. The main benefits of forums were once again to promote collaboration and to be able to compare different points of view. They were seen to be useful as they allowed for flexibility of communication at a time that suited the user and gave the user the ability to see a conversation over time. Overall, respondents preferred forums to chat, whilst acknowledging their different advantages.

I'd prefer [to] just post it online with waiting for the response [from chat]. (GP registrar 5)

You've got time to have a look at what the general conversation is over time, so something that is more longitudinal rather than I've got to be online at this time. (GP supervisor 6)

Webinars and video resources were seen as particularly beneficial for providing visual demonstration not available through other media. The examples given included demonstrating procedures, participating in lectures and live collaboration across different sites. A number of respondents were active users of these applications.

It is online meeting, one person does the presentation and the other registrar and supervisors are doing the comments.....I believe that's a very good chance of, you know, communicating and learning [with] each other. (GP registrar 3)

Barriers to usage

Participants mentioned several barriers, including privacy, access, training and time. These barriers were, however, not universal; for example, in the case of time, several participants noted that they felt they would get good value for their time online.

I've had webinar invites, but I haven't actually looked at them....it's just time as usual. (GP supervisor 9)

One hour a week wouldn't be much. (GP registrar 3)

You'd get good value for your time with things like that [chat, forum, shared repository]. (GP registrar 8)

Access to an adequate online experience was seen as a barrier by one participant in particular. They commented on dropped lines, particularly in the country, differing levels of equipment and access at different sites. For example one workplace had banned a number of sites, including social networking sites. Another participant had troubles with download speeds for video.

If you gotta watch a video, you have to arrange where to do it. (GP supervisor 9)

Public hospitals banned those websites, so the AMS has got no access [to] social networking sites....so the way I got around it was to use Hotmail [email]. (GP registrar 1)

One participant was cautious about privacy, wanting to make sure that they knew to whom they were talking so that patient information was not misused. A number of other participants were not concerned about privacy, as long as information was de-identified and people were 'careful'.

I want to be sure to whom I am sending a patient's details. (GP registrar 2)

Obviously you don't put a name on anything. (GP supervisor 9)

Some users were confident that their skills would be sufficient, particularly if the site was easy to use, but others identified that some training would be helpful, even though they could see they would like to use it. One supervisor also said that there may be a skill gap between supervisors and registrars, as registrars are more technically adept.

An easy interface is important.....if you have to log in to multiple things it becomes less appealing. (GP registrar 7)

Dermatology. Take a picture and post it online- but I don't know how to do that. (GP registrar 5)

I think the registrars would find it useful because they're even more savvy on it [computers] than we are, so they are going to take to it very easily. (GP supervisor 9)

Discussion

This study population of frequent internet using GP registrars and supervisors perceived social media tools as part of an online community to be useful for training purposes. The main aspect of that usefulness was perceived to be in facilitating interactions with other doctors, thus overcoming professional isolation through improved peer support and knowledge sharing. Barriers were noted, but there was a perception that these were something to be acknowledged and overcome, and that despite the barriers, the value of the online interaction would be worthwhile.

This concept of usefulness is in keeping with the literature, particularly the Technology Acceptance Model [19], in which usefulness is the primary predictor of use of an online network; and barriers, whilst acknowledged, are overcome by users if their perception of usefulness is high enough. In the USA, physicians recognised barriers to the use of social media for professional collaboration [20], but those physicians who perceived the technology as useful overcame the barriers and had the highest usage.

Several small studies internationally have demonstrated the benefits of knowledge sharing in VCoPs [21, 16, 22]. There is also an international trend towards the use of online medical communities (Table 1), with 50% of respondents in a US study using one [20]. In Australia, respondents to a survey of GP registrars and supervisors within a regional training provider also perceived an online community as useful, whilst recognising barriers including time and privacy. [18]. In that study, whilst intention to use was predicted by a perception of usefulness, computer confidence was not associated with intention to use.

The present study is a small, qualitative study of frequent internet users, with presumably high computer confidence. However, it is in the context of a larger survey study in the same sample population, and its findings are in line with other, international studies. Therefore, although it has limitations, the present study provides some insights around perceived usefulness and

specific social media features that could be used to guide larger, quantitative research on the design and implementation of a VCoP for GP Training.

Table 1: Online Communities for doctors

Network Name	Country	Users at 13/2/2013	Source: company website
www.sermo.com	USA	125000	Sermo
www.doctors.net.uk	UK	197891	Doctors.Net.uk
www.e-healthspace.com.au	Australia	10786	E-healthspace

Finally, because usefulness is a highly important predictor of use of online communities, training and promotion may be effective ways of encouraging usage. This position is supported by the proposed model for implementation of Virtual Communities of Practice in Health (Table 2; adapted from [18]). Effective training could concentrate on demystifying any technology issues and on promoting the usefulness and the particular benefits of use to the target user group. From the present study, this could include promotion of benefits such as clinical and peer support with specific examples, including case based online discussions and exam preparation support.

Limitations

The present study was a small qualitative study involving one regional training provider in Australia. The participants self-selected for interview and then were further intentionally sampled based on frequent Internet usage.

Conclusion

An online community to support knowledge sharing in the general practice training community is perceived as useful by higher internet users in an Australian regional training provider. The

most useful features were forums, shared content, webinars and possibly chat. Barriers of time and usability were also noted. The potential benefits of usage include overcoming professional isolation through improved knowledge sharing, resulting in better training and improved rural workforce retention. Further study is needed to ascertain whether these findings are applicable to the broader general practice training community.

Table 2: Barnett et al Health VCoP Framework
Facilitation: Facilitators promote engagement and maintain community standards
Champion and Support: The network needs to have an initial stakeholder champion, with stakeholder support
Objectives and Goals: Clear objectives provide members with responsibilities and motivates them to contribute more actively
A Broad Church: Consider involving different, overlapping but not competing, professional groups, different organisations and external experts. However make sure the church is not too broad.....
Supportive environment: Health VCOPs should promote a supportive and positive culture that is both safe for members, and encouraging of participation
Measurement, Benchmarking and Feedback: Health VCOPs should consider measurement as a factor in their design, including benchmarking and feedback
<p>Technology and Community: Online CoPs should ensure ease of use and access, along with asynchronous communication. Other options including chat and meetings can also be considered, along with the need for training.</p> <p>Communities are more likely to share knowledge when there is a mixture of online and face-to-face meetings, members self-select, and both passive and active users are encouraged.</p>

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Chapter 5: A Virtual Community of Practice for General Practice

Training: a pre-implementation survey using the Health VCoP

Framework

This paper has been submitted to BMC Family Practice and is under review.

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Background

Professional isolation is an important factor in low rural health workforce retention [1]. Isolation can lead to decreased knowledge sharing [2] and can affect the career choices of doctors, including intending to work reduced hours and moving away from rural areas [3-5]. Training for doctors in general practice in Australia can be particularly isolating [3, 4] with trainees, or registrars, spread across large geographic areas, moving between different practices in urban and regional placements, and usually being alone in their consulting room with a patient. These factors of geography and structure are barriers to knowledge sharing, impeding the natural communities of practice that form in medical training.

Communities of practice (CoPs) are “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” [6]. CoPs reflect the master and apprentice knowledge sharing that occurs with between senior doctors and those in training. In knowledge management terms, there are two types of knowledge being shared in this type of master and apprentice learning. Firstly, explicit knowledge [7] sharing occurs around a topic; for example the details of which drugs are appropriate for a clinical condition. This can be referred to as the ‘know what’. Secondly, and most importantly, CoPs help participants share tacit knowledge [7]. This is the ‘know how’ of putting that knowledge into practice. For example, how to ensure a clinical condition is identified from a primary care database, that the patient is recalled, that they are encouraged to take medications, and how

