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A knowledge-management model for clinical practice.

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Full Text

Healthcare professionals face information overload and they come across paradoxical information. They are overwhelmed by information but cannot find a particular piece of information when and where they need it.[1] This paper describes a model for knowledge-management (KM) specifically designed for use by healthcare professionals. Technologies have increased the dissemination of information, but worsened the problem of unwanted information. Freely available search engines such as PubMed, MEDLINE and other such searches within bmj.com, allow rapid access to a growing body of knowledge as never before.[2],[3] The skill required by the practitioner is to know how to sift and find information, rather than how to remember facts. In an attempt to control the volume of information and to ensure its relevance to the end-user, sites like the Primary Care National Electronic Library for Health (NeLH-PC) have been created.[4] It is designed to meet the needs of its target group. Instead of getting tens of thousands of hits, as would happen if a search term for a common condition is placed in MEDLINE, NeLH-PC is designed to take the user to a smaller number of more relevant hits. It is an example of how to access the information appropriately. However, access to the information by itself will not result in its use or raise the quality of service.

The knowledge-management model outlined in this paper goes beyond the need to manage information-overload. It sets out to ensure that learning about the best practice actually takes place and as a result, quality standards are actually implemented. However, this implementation is a complex process as real patients often do not fit neatly into simple evidence-based categories.

The proposed model differs from much of the existing knowledge-management literature in that it reconciles a fundamental challenge in medicine: The duty of clinical governance which requires clinicians to implement evidence-based practice across populations[5] whilst personalising the way they consult with individuals to meet their ideas, concerns and expectations.[6] There is consensus among a number of knowledge-management authors, drawn from both the commercial and health sector, that for a knowledge-management strategy to be successful, it must adopt either a "codification" or "personalisation" strategy.[7],[8],[9],[10] Codification means that the work can be reduced to frequently performed routine tasks – for which computerised decision-support can then be deployed. Personalisation is the production of customised solutions for an individual case. In clinical practice, an approach to knowledge-management that uses either personalisation or codification alone will prove inadequate. Even in the most scientific clinical setting, human interaction will affect the acceptance of therapeutic interventions. Medicine remains a human science, with a strong scientific basis; its consultations have such high levels of complexity that probably they can never be computerised and automated. This knowledge-management model suggests needs of clinicians that are within both the codification and personalisation domains and is therefore unique.

The knowledge-management model, presented in this paper, is derived from three sources of information: Firstly, a review of literature knowledge managment from both the medical and commercial contexts and secondly the learning from two programs of developmental work the authors have been involved in. The two sources of experiential learning are: the development of applications that provide easy access to evidence at the consulting room desk, the "Doctor's Desk"[11] and the "NeLH-PC",[12] and the design and development of educational programs to improve data quality and clinical care, the "Primary Care Data Quality (PCDQ) Program".[13]

:: The knowledge-management literature

The key terms: data, information, and knowledge need to be defined. Data forms the base of the hierarchy of meaning [Figure:1].[14] Data represents numbers or objects only when provided with context does it have any meaning. For example, "Cholesterol 5.4 mmol" is just a piece of data, however, it gains significance when contextualised by the additional information that this patient has heart disease, thus informing the clinician that this patient may benefit from a cholesterol lowering drug. Information may also be considered to be a flow of messages[15] for example, a series of cholesterol recordings may inform the clinician as to the effectiveness of diet or therapy. Passing data through a "sense-giving interpretative framework" to produce information is a further way of describing this process.[16] There are many epistemologies (theories) of knowledge. Most of these describe it as the flow of information that involves human thought. What differentiates knowledge from information is that knowledge is conditional on the existence of commitment and belief that something is right or true. Information is akin to data corroboration.

Explicit and tacit knowledge

Polyani described Knowledge as being of two types, "explicit" and "tacit".[17] Explicit knowledge can be "codified" and recorded in a structured way in journals and books. Evidence Based Medicine (EBM) is a highly formalised form of explicit knowledge.

Tacit knowledge is subdivided into our "mental models" of the world and a "technical element".[15] Both the mental model and technical element have a place within the practice of medicine. The mental models include our paradigms, perspectives and schemata. Understanding the paradigm within which a judgement is framed, or an individual's perspective, forms a large part of clinical practice when a patient's ideas and expectations are explored within a consultation.[18] Clinicians regularly use "schema", mental models, formed by images of a patient in a particular circumstance. NeLH-PC takes a different approach, by focusing on the "technical element" of tacit

knowledge. These are more concrete know-how, crafts and skills. The term "know-how" describes the technical elements of tacit knowledge, and is primarily about how to apply the EBM that forms the knowledge base.

The types of knowledge inevitably predict the type of learning that is required to learn them. There are some things that can be learnt from a book or lecture and others that can only be learnt from another person or through reflection and problem-solving. Taxonomies of knowledge and learning are summarised in [Table:1]. Their importance is that they provide a framework within which knowledge-transfer can take place. This is an essential element of knowledge-management.

Medical knowledge

Within medicine, emphasis has been placed on formalised explicit knowledge. Sackett's[19] and Eccles's[20] accounts of EBM provide tools for communicating the relative effectiveness of health interventions where quantitative data exists. These authors suggest how evidence can be graded and the strength of the recommendations that can be based upon it.

Many regard the evidence-base as not really telling the whole story. As early as the 1950s Balint encouraged doctors to see their interaction with patients as something therapeutic in its own right,[21] a theme that continues to be recognised.[22] Engel recognised that physicians can't manage their patients simply as biomedical models,[23] and that there is often another dimension to disease and patient- management. The failure to recognise the limitations of EBM leads to tension being created when it cannot be implemented.[24] Clinicians often lack a language with which to communicate important knowledge, for which there is no high-grade evidence base.[25] This is a shortcoming that this proposed model attempts to address.

:: Knowledge-management

The term knowledge-management is sometimes used by those selling intranets[26] and internet technology. This approach to knowledge-management is labelled "information-centred" - where access to information is the key provision. The other side of the knowledge-management literature is less technology and information focussed. It recognises the need for learning to take place. This is termed "learner-centred" knowledge management. It seeks to engage the participant in a learning process.

In the business world, competitiveness is felt by many to be based on an organisation's ability to acquire new knowledge. The faster an organisation can learn, the more successful it will be; hence the drive for businesses to become "learning organisations". Education and learning are felt to be appropriate models for change in professionally dominated organisations. Professional staff are more likely to be motivated to change as part of a quality initiative or as part of personal development. They are less likely to be influenced by managers attempting to impose change. If it is accepted that success is now measured in terms of an organisation's ability to adapt and use new knowledge, then there is a clear role for knowledge-management in accelerating its ability to learn and therefore change. This view is reinforced by Wyatt, who sees knowledge-management as about recognising knowledge's importance and getting it used.[7]

The educational interventions that accelerate learning in clinical practice are already well documented in the medical education literature. There is a lot of evidence about what does and does not work. This body of knowledge needs to be transferred into the KM arena. Clinical approaches to information and knowledge-management talk about the value of knowledge often without having an inbuilt implementation strategy.

"Commercial" knowledge-management literature seems to place a greater value on the tacit knowledge held by experienced individuals and to see the promotion of learning as a key activity. Information is needed, but learning

should have at least equal weight. Takeuchi and Nonaka[15] extended the epistemology developed by Polyani.[17] They described a knowledge-spiral that creates new knowledge. In particular, it models how tacit knowledge can be externalised and discussed, thereby making it explicit. This spiral consists of four stages: socialisation, externalisation, combination and internalisation. It stimulates questioning and creative thinking and values the externalisation of tacit knowledge in order to be able to implement change.

Another model within the theory of knowledge-management is the "communities of practice".[27] 'Communities of practice' are phenomena said to: "galvanise knowledge-sharing, knowledge and change". They are defined as: "groups of people bound together by shared experience and passion for joint enterprise".[28] This can be described as cross-functional teams – brought together to capture and spread ideas and know-how. The 'communities of practice' work predominantly with tacit knowledge, in a learner-centric way and have been suggested as a means by which the National Health Services (NHS) could achieve "Knowledge-Management for Health".[29] However, the downside of the 'communities of practice' model is its informal nature. The latter has resulted in these communities often failing to align themselves with the aim or objectives of their organisation and therefore contribute less tangibly towards its development or success.

:: Experiential learning from two programs of developmental work

The case studies provide examples of two different approaches to knowledge-management: information-centred and the learner-centred management. Information-centred knowledge management disseminates existing knowledge whilst the learner-centred aims to create opportunities to accelerate learning.

A case study of information-centred knowledge-management

NeLH-PC provides an example of an information-centred program designed primarily to disseminate evidence-based medicine. NeLH-PC promotes clinical governance, by making "explicit knowledge" available to primary care in a digestible form.

Every resource in the library has an electronic index card. The electronic indexing is designed to allow rapid searching of almost one thousand resources stored within the database. These index cards can be searched via the "Search NeLH-PC Directory" box in the top left hand corner of the home page. It can also be browsed alphabetically. The index cards are also cross-referenced by MeSH (Medical Subject Headings)[30] terms, so that it is possible to look at all the resources within the database which have the same heading applied. The site directory is the most commonly used part of NeLH-PC.

The "EBM search" engine, found in the top right hand corner of the home page, is designed to allow primary care professionals to find the right volume of high quality, but relevant evidence. The search engine produces results from multiple information sources and delivers its results in three tiers. The first tier contains guidelines. Users are presented with the five most relevant guidelines as the first tier of the search. They are able to read a condensed abstract from the page before choosing whether they wish to visit the host site. The search engine searches simultaneously across guidelines databases that include SIGN (Scottish Intercollegiate Guidelines Network),[31] and NeLH guidelines.[32] The second tier contains evidence-based medicine summaries; it is presented below the top five guidelines. This second tier contains distillates of information such as Cochrane,[33] Bandolier[34] and ACP (American College of Physicians) Journal Club[35] and Clinical Evidence,[36] Effectiveness Matters[37] and MeRec.[38] The third tier is the automatic transfer of the search term to the "Medline Clinical Queries" interface. This enables more detailed information to be found, should the user wish to search for information in more depth. The Medline Clinical Queries interface is the subset of randomised controlled trials in the PubMed database.[2]

NeLH-PC enables primary care professionals to find out what they need to know whilst helping to avoid the pitfalls

of information overload.[39] It is widely used with over 750 000 'hits' per month. However, there is no way of knowing whether it effectively answers clinicians' questions or changes practice.

A case study of learner-centred knowledge-management

An example of learner-centred knowledge-management is the Primary Care Data Quality Program (PCDQ).[13],[40] Using MIQUEST (Morbidity Information Query Export Syntax), the PCDQ Program extracts anonymous clinical information from the medical records of patients of participating Primary Care Organisations. The aim is to audit primary care services for the investigation and treatment of patients against specific standards, for example, the National Service Framework for Coronary Heart Disease or for Older People. It has provided a powerful impetus for experiential learning - clinicians are motivated by feedback of their clinical data to improve the quality of its recording as well as of their clinical care. This form of learning based on the clinicians' own patients in their own workplace may be the most effective way to achieve change.[41]

An educational intervention via the PCDQ was successful in the provision of an educational environment within which primary care organisations could improve secondary prevention in coronary heart disease.[42] Both the data quality standards and those of clinical care were raised.

Lessons from the case studies

NeLH-PC provides an example of how a limited range of "information-centric" knowledge-management tools are utilised when provided.[4] It is a first step in knowledge-management. Primary care professionals need the help of information professionals if a resource like this is to be utilised and start achieving its aims of promoting clinical governance and improving care through the use of its resources. Access to and ultimately use of, the NeLH-PC is as ubiquitous as that of the drug dictionaries: BNF (British National Formulary) and MIMS (Monthly Index of Medical Specialties), within the consulting room. Implicit in this are that technical resources are required to access the knowledge, there is a need for the resource itself and support for those learning to use it. The NeLH-PC provides the access to knowledge; the training needed to really make the best use of these resources rests currently with local initiatives.

The "learner-centred approach" of the PCDQ program is not centred on its technical adeptness, but instead in the creation of an environment in which what might work in the locality is discussed and reflected upon. Much of that knowledge is tacit and only shared when the appropriate opportunity presents itself. The program appears to be a successful intervention. Participation results in both improvement of clinical care, and in primary care professionals learning how to share their knowledge and expertise.

:: The knowledge-management model for clinicians

The proposed knowledge-management model seeks to balance, if not reconcile, the need for both explicit as well as tacit knowledge using both the information-centered and learner-centred styles. It has been suggested that a combined approach to knowledge-management is inappropriate.[9] Primary care has to deal with both individuals with their own health beliefs, ideas, concerns and expectations, whilst having to achieve health gains for populations.

The model [Figure:2], in it simplest form, is a two-by-two matrix of explicit and tacit knowledge on its x-axis, and information and learner centred activities on its y-axis. The model aims to encourage primary care professionals to have a portfolio of information-management tool, as well as to be participating in learning activities. The model also encourages connecting with and learning about tacit information, as well as explicit. Four prototypical activities or learning types for the model are proposed; however, this is not to say that prescriptively they have to be part of

each primary care professional's knowledge-management portfolio. They should be regarded as examples of how the set of knowledge activities might be made up, and what the place of information technology might be within the model.

The NeLH-PC, sits firmly within the information centred knowledge-management and explicit knowledge box. This part of the model forms the "EBM" box. The bottom left box is the intersection of the learner-centred knowledge-management and explicit knowledge, this is the domain of learning. The archetypal activity that sits here is that of the "clinical audit domain" (e.g. PCDQ). The intersection of information-centred knowledge-management and tacit knowledge is where technology based solutions to knowledge-management sit. This has been given the term "Intranets". Many practitioners find that even simple e-mail gives a route to externalise and socialise their tacit knowledge. The remaining box is the intersection of the learner-centred knowledge-management and tacit knowledge. Although it is increasingly possible to use technology to share and learn tacit knowledge, this box is predominantly one that can only be filled by person-to-person learning activities and therefore entitled the "Mentorship" box. Primary care professionals should have a portfolio that has elements in each of these boxes. The individual elements should be aligned with the strategy and aims of the health service.

:: Discussion

The principal attraction of this model is its provision of a simple framework that intends to address two key requirements of clinicians: firstly how to manage information overload and secondly how to address the quality agenda, and implement the best practice.

The aim of the model is to create an environment within which accelerated learning will take place. Clinicians or organisations implementing it, need to ensure that they are participating in learning activities in each of its domains. Its strength is that it is simple, but hopefully not simplistic, recognising that patients' individual circumstances are complex requiring the physician's skill to address.

There is support for this view from the educational literature: Davis has proposed that it is the complex educational intervention that provides the best form of knowledge translation, i.e., the integration of knowledge into practice.[43] A clinician with activities in each part of the model will, inevitably, be engaged in a complex educational intervention. Importantly, the model also reinforces the viewpoint that neither telling a clinician what to do through didactic teaching or in-consultation computerised decision support, is likely to accelerate learning in a way that improves quality. Studies have shown that the former does not work[44] and that systems for in-consultation use are relatively difficult to access[45] and may not change practice.[46] Learning activities that enhance participant-activity and provide the opportunity to practise skills are those most likely to result in the implementation of best practice; these must inevitably be engaged by a clinician or organisation implementing this model.[47]

The model of knowledge-management presented in this paper is a synthesis of concepts derived from a review of the literature and the experiential learning from two programs of developmental work within an academic primary care informatics group.

The potential shortcomings of this model are that it is built on an incorrect premise. The experience of many clinicians is that there is a need to reconcile this tension in many, if not all, clinical consultations.[48] Clinicians who feel that this tension does not exist are likely to find that they have entirely codified or personalised ways of working in every consultation.

Further research is needed; it is hoped that this model will be piloted as a piece of 'action research.' Its acceptability to health professionals, as well as its effectiveness needs to be evaluated.

:: Conclusions

In recent years, health care services have increasingly placed an emphasis on formalised explicit knowledge or evidence-based medicine. In the UK, this is reflected in the duty of Clinical Governance outlined in the "New NHS Plan".[49] National guidelines, National Service Frameworks and "individual learning accounts" for health care workers were introduced as a means to continuous improvement in health care services. Advances in information technologies also allow a rapid and almost bewildering range of access to a growing body of knowledge for the health care professionals.

The science of health services involves human interaction and tacit knowledge held by experienced individuals and need to be valued. The literature broadly classifies knowledge management as 'information-centred' or 'learner-centred'. The review of the literature and the experiential learning has led to the view that the key element of any knowledge-management initiative should result in accelerated learning.

From the literature review and experiential learning, a model for knowledge-management in clinical practice has been derived. It is designed to be implemented by individuals and clinical teams. It provides a framework for practising evidence-based care that is based on the medical literature. In addition, it promotes the development of clinical consulting skills that it sees largely being learnt from colleagues.

This is not to decry evidence-based medicine that is so highly valued within the medical literature. Evidence-based medicine is the cornerstone of the knowledge-management model proposed. However, it is only part of the story. The assertion within this paper is that a broader approach is needed when working in a clinical environment. This broader approach needs to take into account the less formalised forms of knowledge acquired through clinical practice and from working with experienced clinicians and it should also include elements that ensure that learning is taking place.

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