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DESIGNING A PROTOCOL TO AID DECISION MAKING IN A BILLION DOLLAR HEALTHCARE ORGANISATION: USING COLLABORATIVE RESEARCH

This paper describes a method to accomplish 'a pre-planned guided search of interesting and known knowledge and information sources for decision making in public health medicine', i.e. a search protocol. The protocol is based around a knowledge base of known information and knowledge sources. These sources have been useful in earlier public health studies. The database of sources is maintained and updated as a consequence of each new study on which the search protocol is used. The paper outlines how the protocol has been created, built and tested. The results of using the protocol on five different public health studies are presented and analysed.

1. INTRODUCTION

Over the last few decades, healthcare organisations, similar to other large businesses, have accumulated large amounts of information and data related to their business activities. Alongside these objects, professional experts have created documents that contain explicit knowledge, which outline and describe how these experts – knowledge workers – undertake and complete their professional work. In the 1990s, healthcare organisations and other businesses were perceived to be overflowing with information and knowledge. Knowledge management (KM) was seen as a method through which knowledge and information could be harnessed for the benefit of the host organisation, i.e. the healthcare organisation, and hence for the benefits of patients [8]. There is not space in this paper to explain KM, but table 1 provides definitions of some basic terminology. Comprehensive explanations can be found in the KM literature [4, 8, 14].

Table 1. Explanations of the terms data, information, knowledge and wisdom.

Category	Explanation
Data:	o A datum is the value of an observable and measurable attribute, i.e. raw observations and measurements. o Data have no meaning in themselves. o It is in the context of the data that gives the data structure. o An example of a datum is an individual health symptom present in an individual patient
Information:	o Information depends on an aggregation of data. o Information comes from data that are selected, analysed and processed. o Information, processed data, becomes useful to someone. Information, as the name implies, can be seen as a message – this in turn insinuates that there is (i) a recipient or listener and (ii) a purpose from the message. Information is data plus conceptual interpretations.
Knowledge:	o Knowledge is not simply accumulating &/or processing of data and information over time. o Knowledge is a complex and loose pattern with its parts connected in many and various ways. o Information or messages are passed through this structure – some pass through without any impact, while others 'stick' to (i) become part of the structure or (ii) cause a re-structuring [4].
Wisdom:	o Wisdom is the only one of the four categories that relates to the future. The other three concern the past. o Wisdom calls upon all previous categories. o Wisdom is an extrapolative non-deterministic process. o Wisdom attempts to give understanding where previously there had been no knowledge

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We are now in a situation where most large organisations, such as hospitals or larger healthcare organisations, have adopted knowledge management (KM) and consequently information and knowledge is continuously identified, codified, stored and managed [8]. The adoption of KM solves the problems of the 1990s but gives rise to new problems [2, 3, 11]. Among all this stored knowledge and information, is it straightforward to find what is needed related to the problems that we are asked to solve? Is it easy to find 'interesting' knowledge, or the most appropriate knowledge and information? Do professional decision-makers use suitable methods, if not the best method, when searching for relevant material? Do they find the most appropriate material? Are professional knowledge workers taking full advantage of the information and knowledge available to them?

2. RESEARCH METHOD

The paper seeks to answer the specific question 'Can we design procedures to help in the search for knowledge and information for decision making in public health medicine?' Within this context, the over-arching research question of this study is:

'Can better methods (e.g. a search protocol) be devised for the professional decision maker for the location, management and utilisation of information and knowledge?' If better methods can be devised then these methods should result in (1) improved evidence-based decision making, and (2) better, perhaps optimum, use of limited and valuable medical and financial resources [1].

To answer the above question, a search protocol was designed for the purpose of aiding experienced professional decision makers in public health medicine. The value of this protocol was tested and evaluated against current, traditional, methods in which the decision maker operated alone choosing their own preferred search methods. The comparison allowed the following questions to be answered.

- Can a search protocol be designed to help the decision maker?
- If a search protocol can be devised:
- Does its performance compare satisfactorily with the performance of a professional decision maker using his/her own preferred search approach?
- If an effective search protocol can be devised:
- Can the protocol be successfully exploited by decision makers in public health medicine?
- Can the search protocol – with appropriate adjustment for context – be successfully used in other similar organisations with public health decision makers? And with other professional disciplines in the same organisation?

The study took place in a large healthcare organisation, West Sussex Primary Care Trust (WS-PCT), with the assistance, support and cooperation of highly qualified and experienced public health practitioners. The aim of the study was to influence, and perhaps change, the search methods used by these experienced public health practitioners, i.e. it is an action research study. As the people with whom the researcher would work were experienced public health practitioners, it was thought that a collaborative research approach would be appropriate. Therefore the study is an action research investigation using a collaborative approach.

Collaborative research has a long history and while it can be perceived as a well-defined research methodology [10], it is more often viewed as an approach to research where the emphasis is on empowering local people and ensuring that their wishes determine the direction and outcomes of the research. Collaborative research requires the researcher to respect and understand the participants in the host organisation, and recognise that local people have knowledge and capabilities that, if used alongside the skills of the researchers, can improve analyses, solutions and outcomes. Collaborative research should be viewed not simply as something that should be done for ethical reasons [12], but as a way to improve the quality of research [13].

3. TYPICAL PROBLEMS IN PUBLIC HEALTH IN PRIMARY CARE TRUSTS

In the organisation where the study took place, i.e. West Sussex Primary Care Trust, there is a group of seven public health practitioners, who are asked to provide advice on a wide range of topics as described in sections 3.2 and 5. These topics come from a variety of people, including:

- National healthcare initiatives that request WS-PCT to investigate a specific problem and initiate a solution that is most appropriate for local circumstances in West Sussex.
- Specific problems identified by a national Public Health Practitioners Group - i.e. a CoP, a community of practice [8] – that appear relevant, interesting and worthy of investigation, and
- A local request from within the West Sussex area where an individual finds a treatment area that might be funded, i.e. an individual finding request.

Of the problems discussed below in section 3.2, two problems came from national initiatives, two problems from the CoP, and one from an individual finding request. These five problems are used to test and measure the potential of the search protocol, as illustrated in table 4.

3.1. WEST SUSSEX PRIMARY CARE TRUST (WS-PCT)

West Sussex PCT is the fourth largest PCT in England and is responsible for planning health services for a population of some 800,000, see table 2. These services include health centres, general practitioner services, clinics, community hospitals and community nursing to people in their homes

Table 2. West Sussex Primary Care Trust.

Population	800,000	*Staff*	Approx 3,000
Geographical Area	2,025 km^2	*Budget*	£1.2bn/annum

In an organisation like WS-PCT, the recent growth of amount of information, combined with the take-up of the Internet, has impacted heavily on the PCT despite large investments in KM. In addition, PCTS and similar government organisations, have been subject to continual change resulting in staff replacements and staff losses – changes which are costly. All these factors combine to create problems for knowledge workers, i.e. loss of information, knowledge, and know how; and problems of business continuity, consistent decision making, and maintaining corporate intelligence – in particular the problem of finding information and knowledge as the evidence-base for decision making for specific public health problems. In this context, a successful search protocol might be extremely valuable in overcoming some of the difficulties listed above.

3.2. ILLUSTRATIVE PUBLIC HEALTH PROBLEMS THAT OCCUR IN A PCT

Five typical problems which were presented to the public health team for analysis and advice are described below.

- How can a Primary Care Trust increase the take-up rate for Chlamydia screening? This was a national initiative where WS-PCT was required to analyse the problem and then to take decisions to address the problem that would be most suitable for the West Sussex circumstances.
- How can educational attainment of children in care be improved? This was another national initiative where the public health decision makers were asked to recommend and apply local actions that would help to improve the conditions.
- Should Proton Beam Therapy be funded locally as a cost effective treatment for liver or prostate cancer? This problem came from the national public health consultants group.
- Is Cyberknife Surgery an effective treatment for lung metastases? This question was raised locally, i.e. an individual finding request.
- Is Uterine Artery Embolisation a better treatment than Magnetic Guided Focussed Ultra-Sound for uterine fibroids in terms of cost, safety and effectiveness. This problem was essentially a national problem.

These five examples illustrate the wide range of problems that are presented to the decision makers, i.e. the public health practitioners in WS-PCT. Three problems are national problems, one came from the CoP, and one came locally. The results from each study provide a basis for deciding where and how to focus financial resources, and hence they can create significant changes within the PCT, changes that might have repercussions for a wider audience.
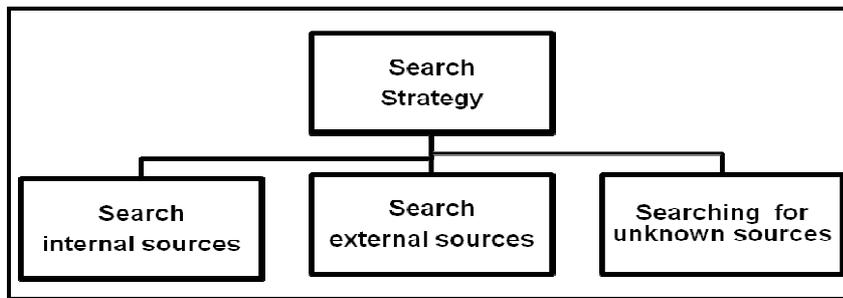
Fig. 1. An overview of the search strategy.

4. THE SEARCH PROTOCOL

The objective of the proposed search protocol is to promote evidence-based decision making in public health medicine by means of access to, and retrieval and utilisation of the most appropriate information and knowledge, available from within the organisation and external to it. This will lead to optimum public health interventions.

There are some Web sites that are archiving specific evidence that provide complete answers for specific questions [5]. These are extremely important and valuable Web sites. However the protocol - while recognising the value of these special centres - encourages the decision maker to take a holistic view, and during an investigation search for additional evidence to ensure the most robust proofs.

Table 3. The Search Protocol - Information and knowledge sources.

Source	Examples
Internal:-	Previous projects; internal specialists; Yellow Pages; CoPs; Intranet
External:-	Similar organisations; National Agencies, e.g. National Institute for Clinical Excellence journals; latest research
Wider:-	Contacts outside of healthcare; knowledgeable people; distant experts

The search protocol directs the user to all possible sources of potential information and knowledge and, in addition, to look outside these areas for the less known or the 'unknown', see figure 1. The search starts with searches within the organisation, then it moves externally looking nationally and globally, before finally encouraging the decision maker to look for less obvious sources, such as external experts who are known for their successful work but do not write about their achievements, i.e. they are virtually hidden. Typical sources are shown in table 3.

Decision makers can be tempted to cut the search strategy short when they believe they have found important material, with the consequence that critical evidence is not located. The protocol points the way to a comprehensive search, but the decision maker is in charge of the process. However, when the study is complete, the decision maker archives facts describing the searches that s/he has completed and the sources used. It is thought that this will encourage the decision maker to complete a wide-ranging search.

At the end of an investigation, the whole exercise is used to improve the search protocol. Details of the study are stored for possible future reference or use by later decision makers; and new knowledge and information sources, that have been found during the investigation, are added to the database of useful sources.

4.1. DEVELOPING AND BUILDING THE SEARCH PROTOCOL

Earlier studies completed by the authors indicated that professionals welcome the opportunity of using new technologies – such as a search protocol – in their professional work and their decision making [6, 7]. However, some experts when undertaking searches believe that (1) search engines, such as Google, satisfy all their needs, while other experts feel that (2) their own personal skills and wide experience are sufficient basis for them to address any problem.

Consequently, the search protocol must appeal to expert decision makers with different attitudes and different mind-sets within the public health domain. The protocol, using an algorithmic approach, must be neither deterministic nor a straight-jacket on the expert. It must (1) provide a comprehensive set of search results to help the decision maker, but (2) allow freedom to the creative thinker. The three main stages of building the search protocol are outlined in table 4.

Table 4. Building and testing the search protocol.

Stage of Development	Activity
1. Build basic protocol and test to prove usability.	o Discussion and agreement with stakeholders, to identify breadth and scope of searches and studies. o Develop trial search protocol (manual version) – see Chlamydia example in section 3.2 o The designer tests the trial protocol. o Further tests are made by an end user, a public health doctor – see the 2nd example in section 3.2 o Amendments and improvements are made and the search protocol is ready for wider use.
2. Initial protocol is fully operational – undergoes wider testing.	o Further tests are made on three important public health studies – see three examples in section 3.2 o The tests demonstrate the success and the effectiveness of the search protocol. o The protocol is ready for migration to other organisations – this requires a computer-based protocol.
3. A computer-based search protocol is built.	o This is a straightforward development of the protocol of stage 2 above. o It requires financial investment, and o Evidence that the investment will bring appropriate benefits.

5. DISCUSSION AND RESULTS FROM TESTING THE PROTOCOL

The results from the five test studies - outlined in section 3.2 above - are presented in tables 5 and 6. The results (1) prove the success, or lack of success, of the search protocol, and (2) provide a basis for answering the research questions formulated in the Research Method section above.

The initial tests showed that the search protocol worked and that it was a useful tool for both a lay person and a public health professional. Following the initial tests, amendments were made to the protocol and then the protocol was subjected to more rigorous testing, as shown in table 4.

Three tests were completed. In each test, the quality of the results obtained by the search protocol used by a lay person were compared with those obtained by WS-PCT's public health experts who used traditional search and review procedures, i.e. they did not use the search protocol. In each of the three tests, the lay person who used the search protocol was ignorant of the conclusions made by the public health professionals. In all three tests the lay person was able to (1) find all the critical evidence and (2) reach similar conclusions to those reached by the public health specialists.

Table 5. Initial testing of the search protocol.

Problem	Protocol User	Test Results
1. Can the PCT increase the take-up rate of Chlamydia screening?	Lay person – the protocol designer	o A comprehensive search was completed, similar to that done by the public health specialist o Details were found of successful screening programmes. o These formed basis of new screening programmes.
2. Can educational achievement of children in care be improved?	Public health doctor Lay person	o The tests compared the results of expert and lay person. o Both users found similar evidence sources; came to similar conclusions. o The tests showed that the protocol helped both expert and lay person.

However, there were slight differences in the search material found. In the Proton Beam study, one critical paper was not found by the search protocol approach; but this did not affect the conclusions of the investigation. In the Cyberknife study, a greater body of evidence was found by the search protocol approach, but again the conclusions were similar to the conclusions in the control group, the public health

professionals. In the final test, the Uterine Artery Embolisation investigation, the search protocol approach found similar bodies of evidence to those found in the review by the public health professionals. The same conclusions were drawn by the search protocol approach and the public health specialists concerning costs, safety and effectiveness.

Table 6. Testing of the search protocol of a more rigorous nature.

Problem	Evidence Review by Professional	Outline answer - Protocol Approach
Should Proton Beam Therapy be funded for treatment of liver or prostate cancer?	o It is effective o Further research needed to prove it is superior to current treatment methods.	o Insufficient evidence o More expensive. o Benefits not large enough to justify additional costs
Should Cyberknife treatment be used for lung metastases?	o Clinically effective. o Difficult to estimate (reliably) the clinical and cost effectiveness.	o An effective treatment. o Insufficient evidence to justify as standard treatment.
Is Uterine Artery Embolisation better treatment for uterine fibroids than Magnetic Guided Focussed Ultra Sound?	o UAE is more effective in terms of cost, safety and effectiveness. o MGfUS appears good, but insufficient body of evidence to justify.	o UAE is preferred treatment o Based on costs, safety and effectiveness.

From tables 5 and 6, it is apparent that the search protocol is effective as an aid to decision making in public health medicine. The search protocol allows a lay person to locate and use sources of knowledge; and hence to create a robust evidence-base for decision making in the PCT. It should be equally powerful, if not more powerful, if used by public health practitioners.

5.1. A COMPUTER-BASED SEARCH PROTOCOL

Whether or not the search protocol – a pre-planned guided search of interesting and known knowledge and information sources for decision making in public health medicine – would, after appropriate modification, be effective with (1) other knowledge workers in other disciplines in WS-PCT or (2) other PCT organisations is not proven. The existing search protocol – a manual method – could be amended to match the needs of different knowledge workers from other disciplines in WS-PCT; and there is no apparent reason why it should not be successful.

However, to transfer the search protocol to a different organisation or different PCT ideally requires that the current manual protocol be written to operate as an automated computer-based protocol, i.e. an e-protocol. This would ensure its ease of use in a different organisation. This work is currently in hand.

Features of the computer-based protocol are outlined in table 7. A computer-based search protocol would make the pre-planned search approach available to (1) a wider audience and (2) the public health practitioners in different PCTs. The automated search protocol is designed to guide the decision maker (1) through the search for evidence; (2) to store all files and evidence collected - e.g. Word documents, e-mails, images, content and other documents – in a relational database; and (3) to index all materials that might be needed in future projects. Many of the activities discussed above in this section, section 5.1, are areas for future research.

Table 7. Features of automated protocol.

STORAGE RELATED	SEARCH RELATED	COMMUNICATIONS
o Connection to external information services o Facility to store documentation & upload to protocol system. o Allow users to maintain personal information. o Capability to update knowledge sources and add additional sources	o Maintain record of relevant research o Capability to rank information & knowledge, and present by rank. o Ability to search stored documentation using wildcard characters & Boolean logic. o Facility to search personal information	o Internet and Intranet access & connections o Connection to external information services o Forums & online discussions. o Capability to define user roles & privileges. o Password protection capability
OTHERS		
o Users facility to tailor their homepage.	o Facility to implement workflow, i.e. to describe a sequence of operations to add to the protocol to improve it.	o Capability to prompt e-mail from Outlook account

An additional benefit of the e-protocol is its role in protecting the corporate memory (CM). The CM is a repository of information and explicit knowledge, which combined with tacit knowledge, provides a basis for delivering an organisation's strategic objectives. Loss of CM occurs because of business re-organisations and re-structuring, and/or staff changes. The e-protocol adds information and knowledge to the corporate repository, and updates the staff yellow pages. Since the CM is an 'electronic' CM, it is more stable. In summary, the e-protocol provides not only for evidence-based medicine, but it also maintains, updates and protects the corporate memory. This ensures that the CM is a dependable resource for strategic decision making in healthcare.

6. CONCLUSIONS

A number of questions were posed in the section entitled Research Method, i.e. section 2. These research questions are answered below.

- *Can better methods (e.g. a search protocol) be devised for the professional decision maker for the location, management and utilisation of information and knowledge?* The work described in this paper demonstrates that this is possible and has been achieved.
- *Can a search protocol be designed to help the decision maker?* Again the answer is 'Yes'.
- *Does its performance compare satisfactorily with the performance of a professional decision maker using his/her own preferred search approach?* Comparisons were made and the performances appear to be similar.
- *Can the protocol be successfully exploited by decision makers in public health medicine?* The test results presented in this paper show that this is correct.
- *Can the search protocol – with appropriate adjustment for context – be successfully used in other similar organisations with public health decision makers? And with other professional disciplines in the same organisation?* This was not proven in this paper. This is for future research.

Decision making is a common thinking activity in businesses. More importantly, it is one of the most critical processes in any business. Can computers and protocols ever be a substitute for a human being in complicated decision making? No! Not yet. However, the work presented in this paper shows that a search protocol can offer support to the decision maker.

Decision makers can be tempted to cut short a search strategy, when they believe that they have found important material, with the consequence that critical evidence is not located. The search protocol points the way to a comprehensive search, but the decision maker is in charge of the process. It is thought that if the decision maker has a documented and formal search protocol to follow, this will not only help but also encourage the decision maker to undertake a complete and wide-ranging search.

The protocol can bring benefits to staff in a healthcare organisation in their efforts to locate and use information and knowledge as the basis of robust evidence-based decision making. The search protocol, using an algorithmic approach, is neither deterministic nor a straight-jacket on the expert. It provides comprehensive results to help the decision maker, but it allows freedom to the creative thinker. The protocol allows decision makers to understand, manage and use knowledge and information – local, national and global – in order to make informed and evidence-based strategic decisions in public health.

BIBLIOGRAPHY

[1] AVALON J., HAYWARD P., LANE VP., SNAITH J., Are we losing our knowledge? Where to look for what we know, Editor: G. Ogunmokun (Editor) Proceedings of International Conference: Business, Marketing & Management Development, University of Oulu, Vol. 4, Finland 2010, pp. 107–111.

[2] BAO X., JONATHAN LH., THOMAS G.D., Fewer Clicks and Less Frustration: Reducing the Cost of Reaching the Right Folder. Proceedings: 11th International Conference on Intelligent User Interfaces, Sydney, Australia, ACM, January 2006, Available at: http://doi.acm.org/10.1145/1111449.1111490, Last accessed August 2010.

[3] BEALE R., Supporting serendipity: Using ambient intelligence to augment user exploration for data mining and web browsing, International Journal of Human–Computer Studies, Vol. 65, 2007, pp. 421–433.

[4] CHOO C., W. The knowing organization: How organizations use information to construct meaning, create knowledge, and make decisions, Oxford, Oxford University Press, 2006.

[5] DOBBINS M., DECORBY K., ROBESON P., HUSSON H., TIRILIS D., GRECO, L., A knowledge management tool for public health: health–evidence.ca, BMC Public Health, Vol. 10, 2010. Available at: http://www.biomedcentral.com/1471–2458/10/496. Last Accessed: August, 2010.

[6] LANE VP. Neural networks for decision making related to asthma diagnosis and other respiratory disorders,. In: B Richards et al (Editor) Current Perspectives in Healthcare Computing , Proceedings of HC'96, Harrogate International Conference Centre, BJHC, Weybridge 1996, pp. 85–93.

[7] LANE VP., HAYWARD P., The Impact of E–Business Technologies on Healthcare – New Horizons or False Dawns? Invited Paper. In: J. Piecha (Editor) Journal of Medical Informatics and Technologies, University of Silesia, Dept. of Electronics and Computer Systems, Vol. 3, 2002, pp. 15–24.

[8] LANE VP., J. SNAITH J., LANE DC., STEPHENSON K., Knowledge management in business: Purpose, principles and problems? Journal of Management and World Business Research, Vol. 4, 2009, pp. 11–18.

[9] MERSEY CARE NHS TRUST Knowledge management strategy: Liverpool: Mersey Care NHS Trust, 2004.

[10] MUMFORD E. Designing Human Systems for New Technology – The Ethics method, Manchester, Manchester Business School, 1983.

[11] PIRRÓ G., MASTROIANNI C., TALIA D., A framework for distributed knowledge management: Design and implementation, Future Generation Computer Systems, Vol. 26, 2010, pp. 38–49.

[12] PORRA J., HIRSCHHEIM R, A lifetime of theory and action on the ethical use of computers: A dialogue with Enid Mumford, Journal of the Association for Information Systems, Article 29, 2007.

[13] POWER J., KUHNLEIN H., Collaborative research: An 'indigenous lens' perspective, Ottawa, Kishk Anaquot Health Research Report: completed for Canadian Coalition for global health research, 2008.

[14] WILSON T. D., (2002) The nonsense of knowledge management. Information Research, Vol. 8, Paper No: 144, Available at http://InformationR.net/ir/8–1/paper144.html, Last accessed September 2009.

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