Knowledge Management Applications in Medicine

Knowledge is a critical resource in the provision of health care. Access to the latest medical research knowledge can mean the difference between life and death, an accurate or erroneous diagnosis, early intervention or a prolonged and costly stay in hospital (Ayres and Clinton, 1997).

Healthcare KM

2 Healthcare Knowledge Management

Healthcare Knowledge Management (HKM) can be characterized as the *systematic creation, modeling, sharing, operationalization and translation of healthcare knowledge to improve the quality of patient care*. The goal of HKM is to promote and provide optimal, timely, effective and pragmatic healthcare knowledge to healthcare professionals (and even to patients and individuals) where and when they need it to help them make high quality, well-informed and cost-effective patient care decisions. In practice, HKM is

2 Healthcare Knowledge Management

workflow. Functionally, the HKM portfolio addresses the following `activities:

(a) capture, represent, model, organize and synthesize the different modalities of healthcare knowledge to realize comprehensive, validated and accessible health-care knowledge resources.
(b) access, share and disseminate current and case-specific knowledge to healthcare stakeholders in a usable format.
(c) operationalize and utilize healthcare knowledge, within clinical workflows, to provide pragmatic patient care services, such as decision-support and care-planning, at the point-of-care and point-of-need.

Types & Modalities

3 The Nature of Healthcare Knowledge: Its Types and Modalities

Healthcare knowledge is complex both in form and function [7]. In this section we deal with the form of healthcare knowledge and identify the different *types* of healthcare knowledge, and the various *modalities* of healthcare knowledge. Here, it is important to

Healthcare Knowledge Types

(a) *Patient knowledge* entails a clear description of the health status of the patient. Patient knowledge encapsulates medical relationships between the various observations of the patient and the inferences drawn by physicians, both captured and recoded in the medical record, to provide a complete picture of the patient.

(b) *Practitioner knowledge* is practice-related tacit knowledge withheld by a practitioner and exercised whilst discharging patient care [7]. Practitioner knowledge is acquired through active learning, internship, observations and experiences.

(c) *Medical knowledge* is the core domain knowledge describing the theories about health and healthcare, healthcare delivery models and processes.

(d) *Resource knowledge* is the quantification of the care delivery resources and infrastructure available within a healthcare setting. It is important for practitioners to have an up-to-date resource knowledge so that they are aware of what resources—such as medical diagnostic devices and tools, drugs, support staff, nurses, hospital beds, surgical facilities and so on—are available when they are making decisions about diagnostic and treatment interventions.

(e) *Process knowledge* concerns institution-specific care pathways (or workflows) that determine the stipulated discourse of care for specific medical conditions within a healthcare setting. Process knowledge stipulates the standardized way to treat a patient, whilst addressing pragmatic considerations such as the resources needed to treat the patient as per the care pathway.

(f) *Organizational knowledge* represents the organizational structure and policies exercised by a healthcare institution. Organizational knowledge entails the information and knowledge flows within the organization—i.e. how does information flow from one source to another, who is required to report to whom, what is the decision-making hierarchy, what is the composition of care teams, what are the roles and responsibilities of different healthcare team members, and how to make and respond to information requests. Organizational knowledge is particularly important when deploying HKM solutions because their successful deployment needs to be congruent with the organizational and process knowledge.

Knowledge Modalities

We have identified the following healthcare knowledge modalities:

(1) *Tacit knowledge* of practitioners manifested in terms of their problem-solving skills, judgement and intuition.
(2) *Explicit knowledge* in terms of evidence-based medical literature, reviews, case studies, clinical practice guidelines and so on.
(3) *Clinical experiences* (both recorded and observed) and lessons learnt.
(4) *Collaborative problem-solving discussions* between practitioners.
(5) *Operational policies* eliciting clinical protocols and care pathways.
(6) *Educational resources* in terms of medical education content for practitioners and health education content for patients.
(7) *Decision support (symbolic) rules* obtained from domain experts and/or decision models induced from data, and stored in knowledge-bases.
(8) *Social knowledge* in terms of a community of practice and their communication patterns, interests and expertise of individual community members.
(9) *Data-induced observations* derived from clinical observations, diagnostic tests and therapeutic treatments recorded in medical records.

4 Spectrum of Healthcare Knowledge Management Services

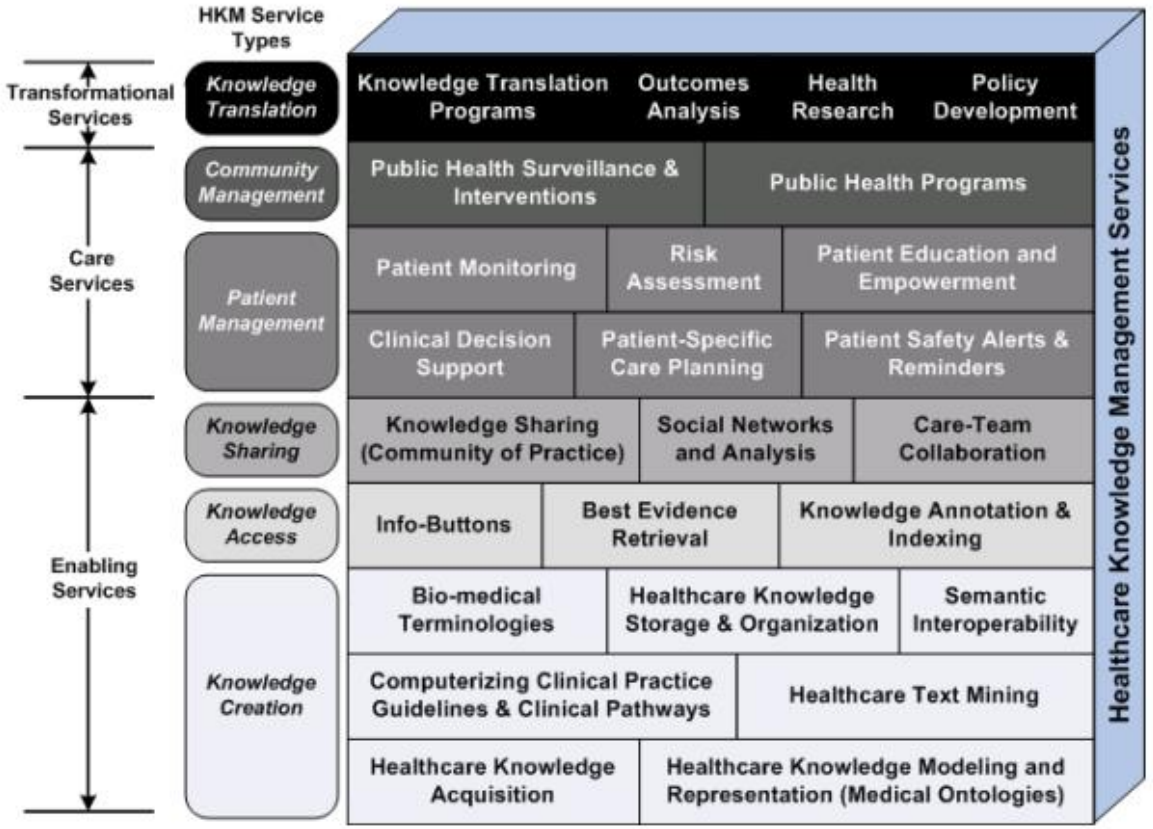
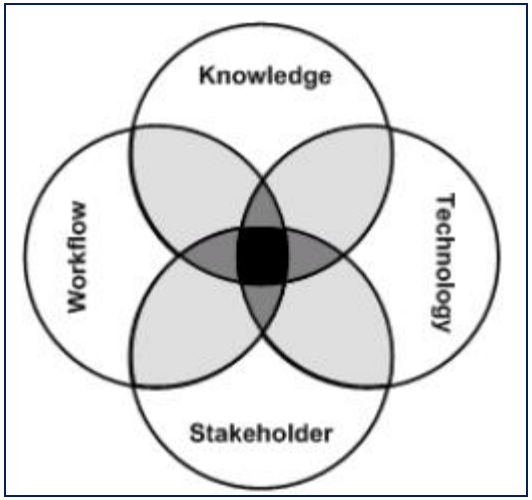


Fig. 1. A hierarchical organization of a spectrum of HKM services

We suggest that the design of effective HKM services need to incorporate four interacting dimensions (as shown in figure 2), namely comprehensive and pragmatically sound *healthcare knowledge*, state-of-the art healthcare knowledge management *technology*, alignment with institutional clinical *workflows*, and *stakeholder* specifications for service needs and usage preferences. The richness of the overlap between these dimensions will determine the functional sophistication of the HKM service.



Healthcare Knowledge Management

There is a growing demand by healthcare stakeholders for pragmatic, proactive, multi-faceted and comprehensive healthcare knowledge to be available at the point-of-care. This demand by health stakeholders, though reasonable and valid, is not achievable unless we are ready to uptake HKM principles and practices within clinical workflows, and develop the necessary capacity amongst healthcare professionals to manage the knowledge. Indeed, there is a general lack of understanding about the potential of HKM that is resulting in the prevalence of operational barriers towards the flow and use of knowledge within the healthcare system. However, it is our contention that recent advancements in HKM applications will effectively bring down these barriers, because these applications will practically demonstrate how they can effectively help to achieve high levels of patient safety, care quality, team-care, patient centeredness, and cost-effectiveness. Nevertheless, if we want to sustain the

Road to KM

Road to Knowledge Management

- Concerns that analysts were duplicating each other's work by re-creating code or re-running the same reports
- Investing too much time & resources replicating processes
- Challenges with **information organization & classification** across systems and across silos
- More consistent organization of information via an improved taxonomy?

Common symptoms of KM challenges

"Need to work together better"
"Duplicating efforts"
"Reinventing the wheel"
"Inconsistent across silos"
"Can't find what we're looking for"

KM - Defn

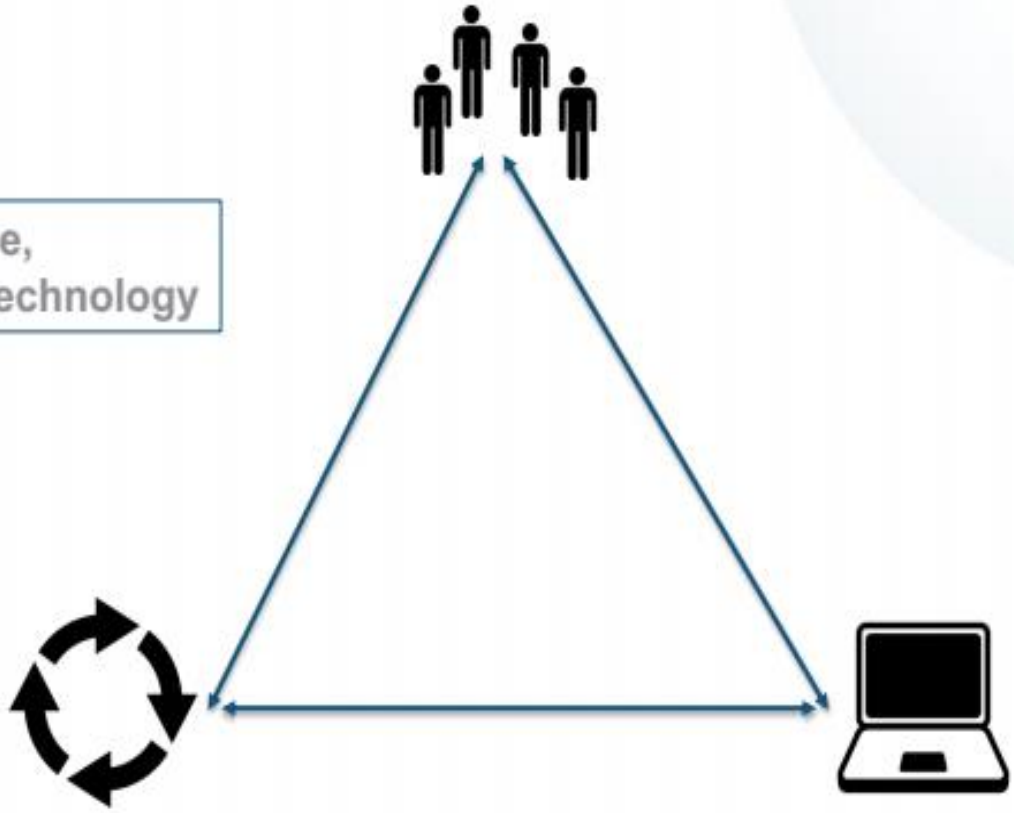
What is Knowledge Management?

- Range of practices, processes, and activities that together encompasses how an organization approaches knowledge
- Levels and approaches to KM: top down vs. bottom-up, organizational vs. departmental
- Elements of KM are tied to:
  - Organizational structure
  - Organizational culture
  - Operational processes
  - Technology adoption
  - Information management
  - Organizational learning and professional development

Knowledge Management

Framework for systematically and consistently capturing and sharing organizational knowledge to achieve operational excellence.

People,
Processes &Technology



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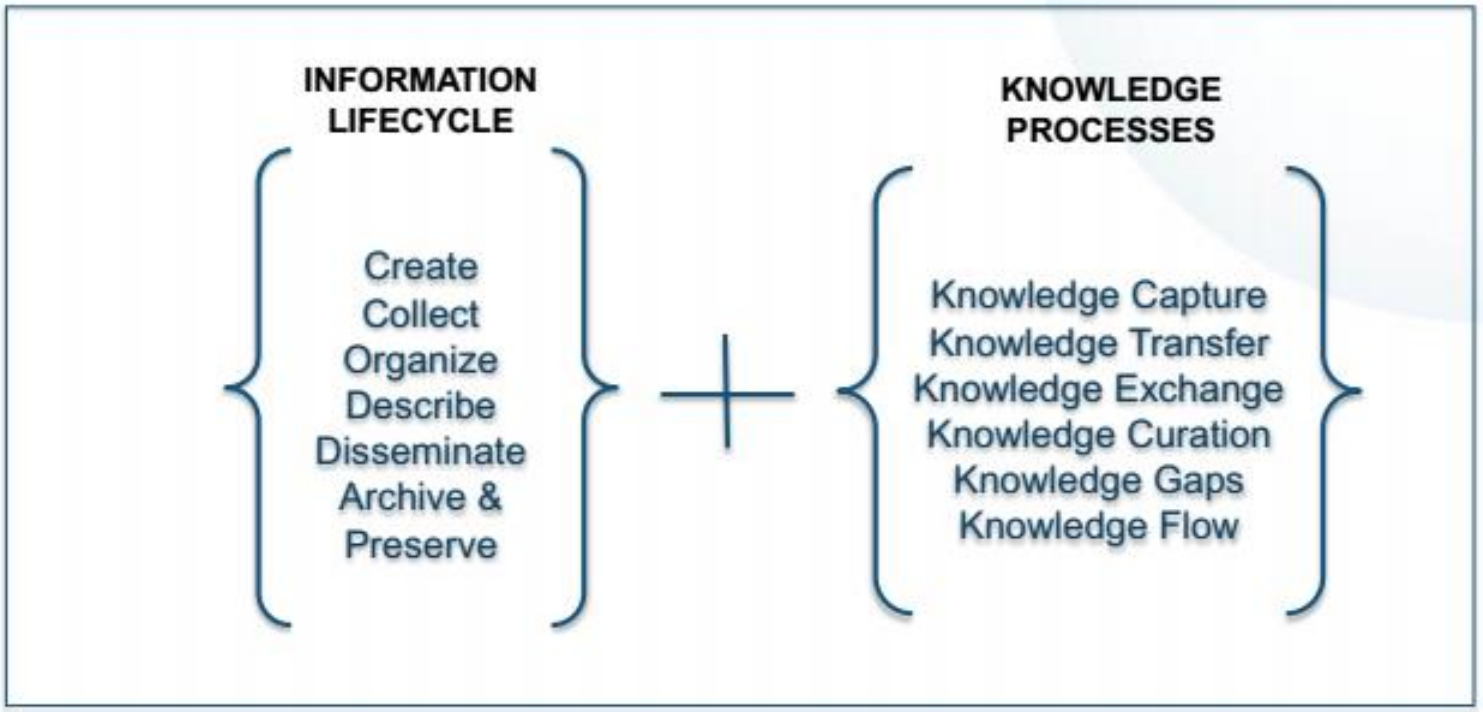
Knowledge Management:

FIND or DISCOVER Information & Knowledge:
to promote the re-use, uptake, adoption, adaptation of organizational knowledge

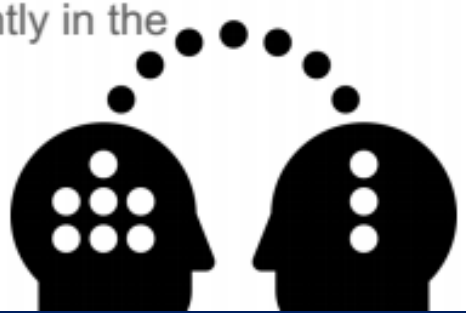


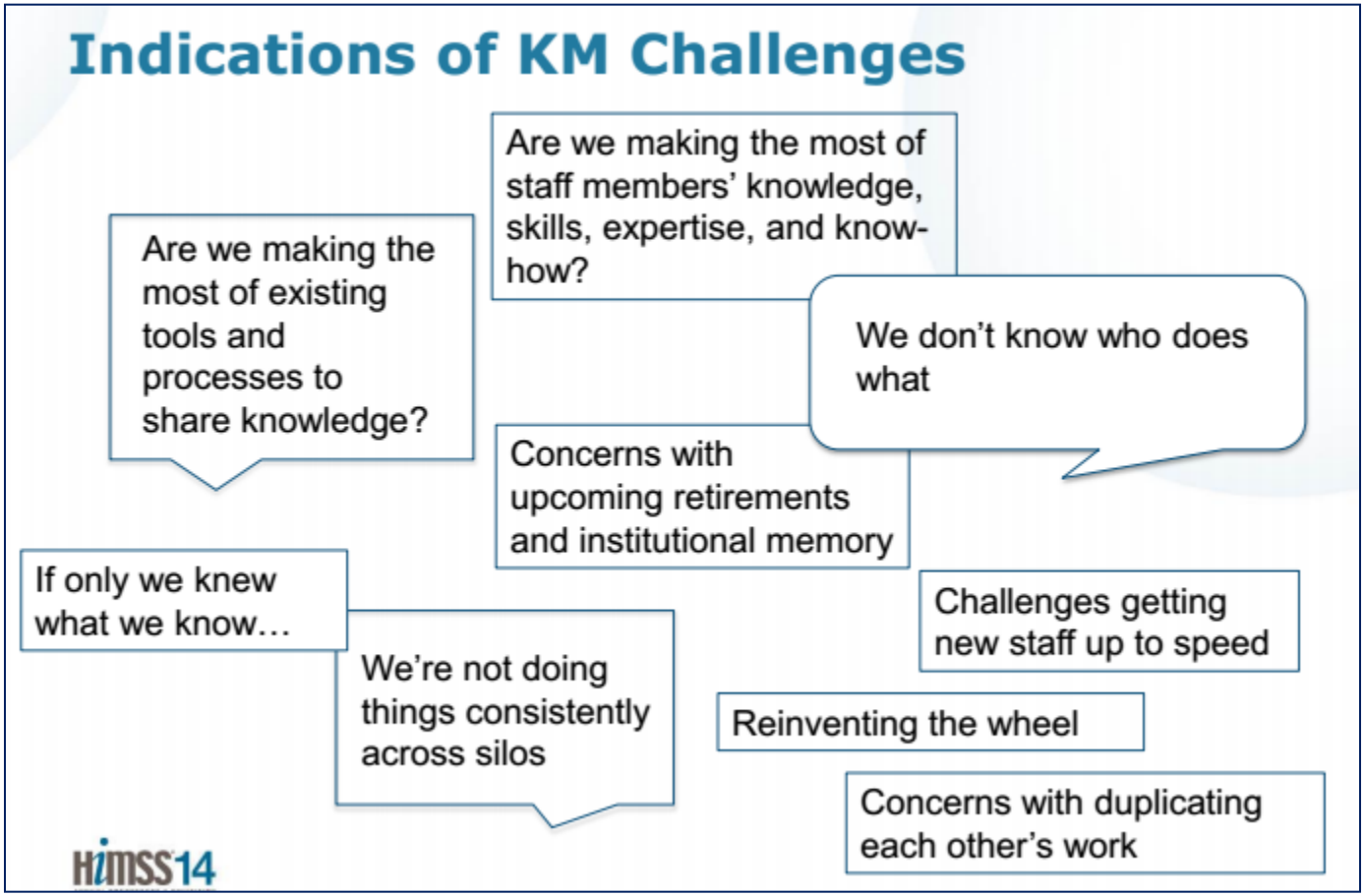
Knowledge Exchange & Transfer

- Converting from tacit knowledge (in people's heads) to explicit knowledge (articulated and captured, stored in a knowledge asset)
- Staff turnover – exiting staff, retirements, onboarding new staff

Areas to target:

- Organizational ways of working: typical or standard methods, practices for conducting everyday work
- Institutional memory: when and why key decisions were made, processes put in place, organizational changes
- What worked, what didn't? What could be done differently in the future?




Indications of KM Challenges
Are we making the most of staff members' knowledge, skills, expertise, and know-how?
Are we making the most of existing tools and processes to share knowledge?
We don't know who does what
Concerns with upcoming retirements and institutional memory
If only we knew what we know…
We're not doing things consistently across silos
Challenges getting new staff up to speed
Reinventing the wheel
Concerns with duplicating each other's work
HIMSS14

What is Medline?

- MEDLINE is the premier bibliographic database for biomedicine supported by the National Library of Medicine
- MEDLINE contains approximately 18 million references, most of which have abstracts.
- MEDLINE covers over
  4800 journals, in
  over 30 languages
- MEDLINE citations

MEDLINE

- A biomedical database
- Covering years since 1966
- Indexing journals only
- ± 4800 journals indexed
- International coverage

MESH

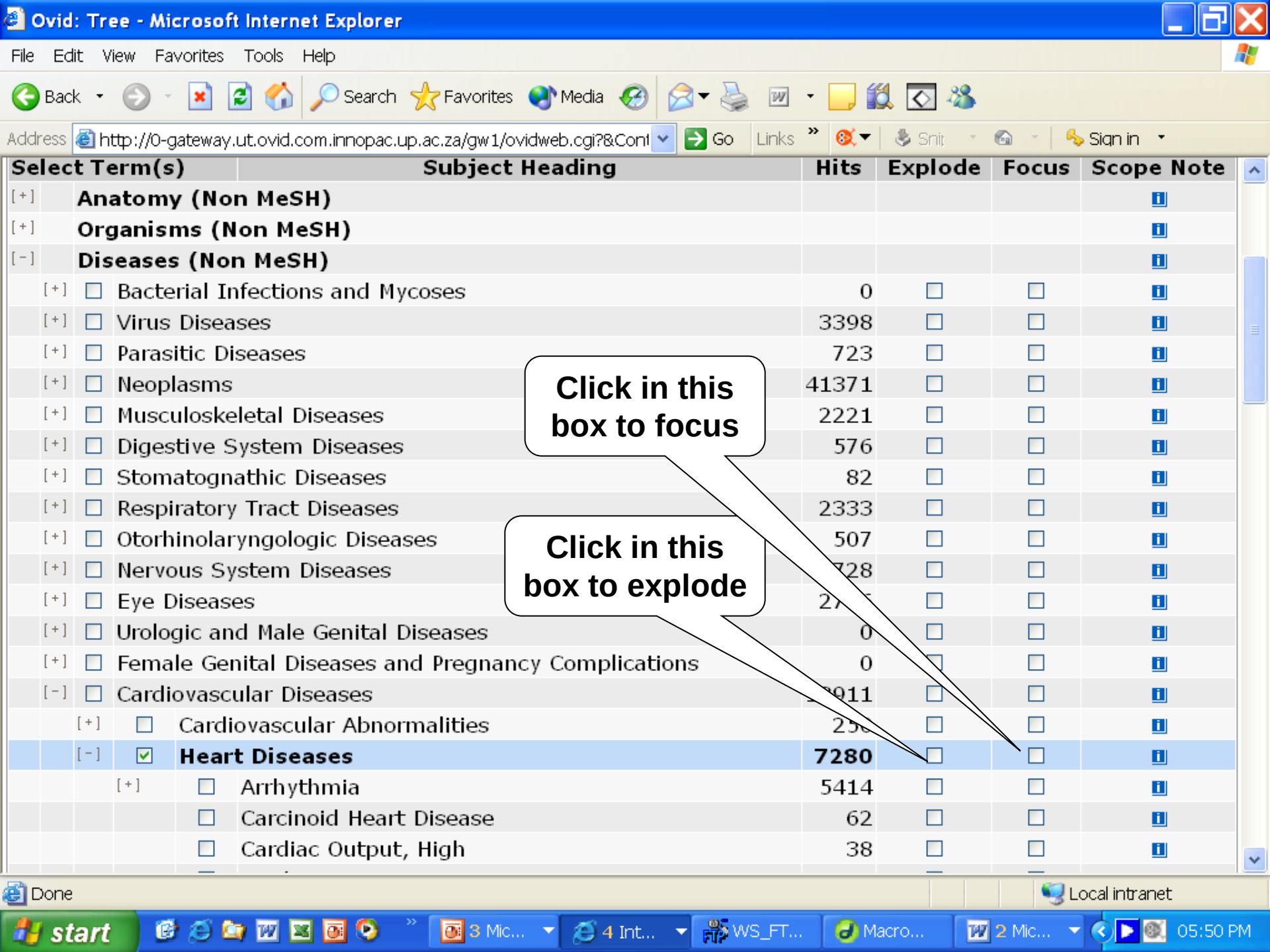
- Medical Subject Headings
- An alphabetical list of medical terms
- MESH makes efficient searching easy for everyone

Advantages of MESH

- Automatic cross-referencing from non-MESH to MESH terms
- Cover British/American spelling
- Include singular/plural terms
- Include synonyms
- MESH terms link to subheadings
- MESH terms will take you step-by-step through database searching on OVID

EXPLODE

- MESH terms are organised into tree structures
- The TREE structure arranges MESH terms into broader and narrower terms
- Medline has an EXPLODE function which enable you to use a broader term while simultaneously include all its narrower terms
- Enable the EXPLODE function by clicking on the EXPLODE block at the right side of your MESH term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File Edit View Favorites Tools Help
Back Search Favorites Media
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Go Links Snit Sign in
Select Term(s) Subject Heading Hits Explode Focus Scope Note
[+] Anatomy (Non MeSH)
[+] Organisms (Non MeSH)
[-] Diseases (Non MeSH)
[+] Bacterial Infections and Mycoses 0
[+] Virus Diseases 3398
[+] Parasitic Diseases 723
[+] Neoplasms 41371
[+] Musculoskeletal Diseases 2221
[+] Digestive System Diseases 576
[+] Stomatognathic Diseases 82
[+] Respiratory Tract Diseases 2333
[+] Otorhinolaryngologic Diseases 507
[+] Nervous System Diseases
[+] Eye Diseases
[+] Urologic and Male Genital Diseases 0
[+] Female Genital Diseases and Pregnancy Complications 0
[-] Cardiovascular Diseases
[+] Cardiovascular Abnormalities
[-] Heart Diseases 7280
[+] Arrhythmia 5414
Carcinoid Heart Disease 62
Cardiac Output, High 38
Click in this box to focus
Click in this box to explode
Done
Local intranet
start
3 Mic...
4 Int...
WS_FT...
Macro...
2 Mic...
05:50 PM

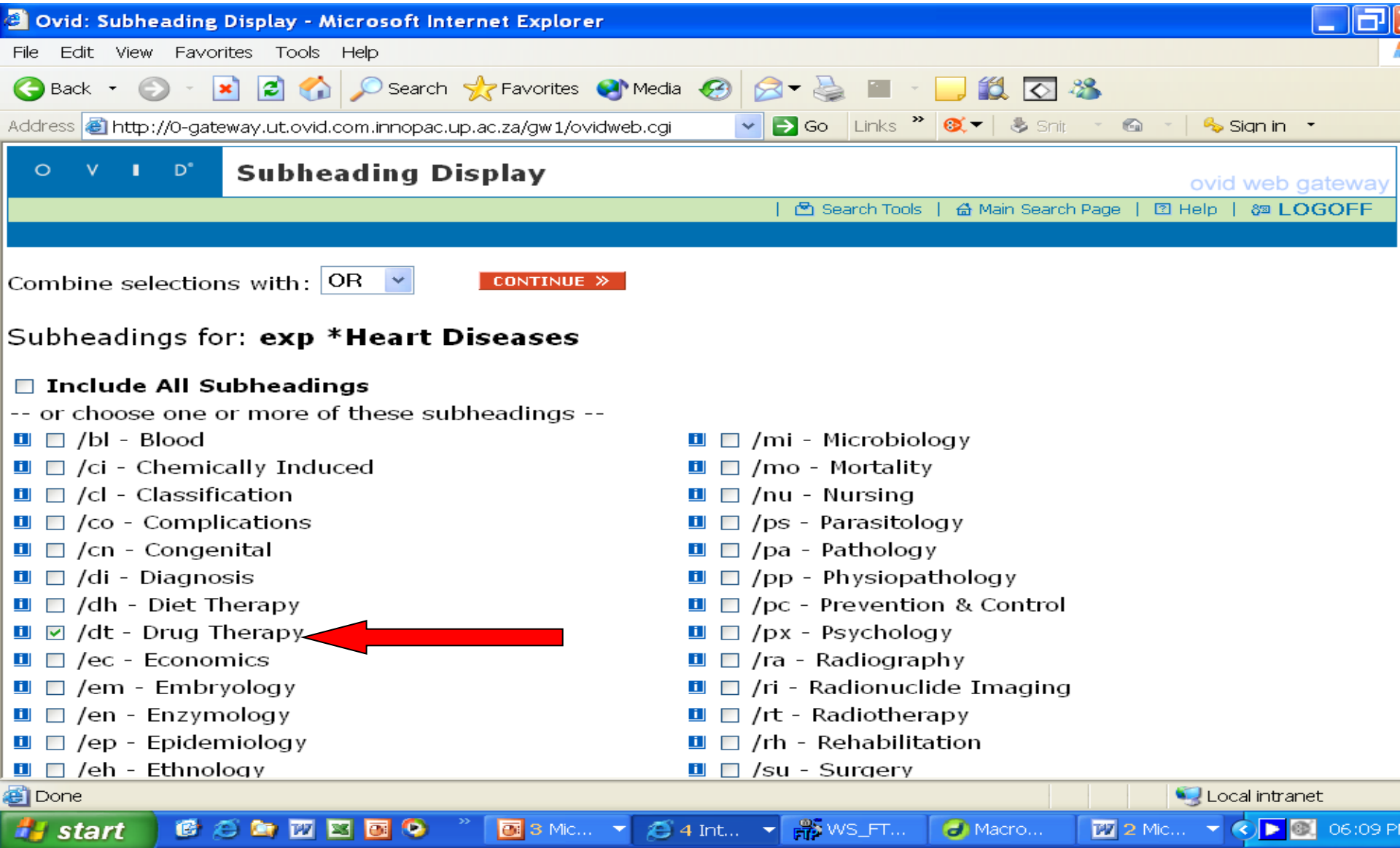
FOCUS

- Medline has the powerful function of focusing
- Focusing means to throw out less important articles
- You can restrict your MESH term to the most important articles on that topic by clicking in the FOCUS block at the far right side of your MESH term

Subheadings

- Subheadings enable searching on specific aspects of your topic eg ***diagnosis***, ***etiology***, ***economic***s or ***epidemiology***
- You can mark more than one subheading simultaneously
- Using subheadings = potent searching!

Choose one or more subheadings or none if so preferred



KM

Knowledge Management

Knowledge is a high value form of information that can be used to make decisions and take action (Davenport et al, 1998). A key difference between knowledge and information or data is that it is *intellectually intensive* rather than IT-intensive: knowledge is produced as the result of human interpretation and analysis rather than data processing. Knowledge can be classified as either:

- *Tacit*: knowledge stored in people's heads
- *Explicit*: knowledge which has been written down or *codified*

Explicit Knowledge

Explicit knowledge is the more familiar form of knowledge, and is found in books, manuals and reports. Tacit knowledge is a much higher value form of knowledge, because we always know more than we can say (Sveiby, 1997). To be able to apply explicit knowledge to make decisions or take action, it must be made tacit. For example, you must read and understand a book in order to be able to apply the knowledge it contains.

Managing knowledge has recently become a major concern for many organisations, and is increasingly being seen as a source of sustainable competitive advantage (Hansen et al, 1999; Nonaka and Takeuchi, 1995; Broadbent, 1997). While there are many different approaches to knowledge management, their objectives are the same: to make more effective use of "know-how" and expertise in an organisation (Martin, 1999).

Evidence Based Medicine

Evidence Based Medicine

Medical research findings are slow to change medical opinion and practice (Phillips, 1998). Empirical studies have shown that on average, there is an 8—13 year time lag (depending on the specialty) between a treatment being proven to work and its adoption as standard practice. It has also been found that 70% of treatments currently in use do not have sufficient evidence to support that they are any more effective than doing nothing (Chalmers, 1993). One of the major barriers to the implementation of research findings is the volume and geometric growth of the medical literature. It is not humanly possible to keep up with all the advances in all areas of medical research (Jordens et al, 1998). It is also difficult for medical practitioners to make sense of the often-conflicting research findings in a particular area.

EBM Tools

Recognition of such problems led to the discipline of *evidence based medicine* (EBM). The aim of EBM is to bring research and practice closer together and reduce the time lag between the development of clinically proven treatments and their use in everyday medical practice. One of the major methodological tools in EBM is the *systematic review*, which are used to synthesise research findings in a certain area (Cochrane, 1972). Systematic reviews begin with an exhaustive search for published and unpublished research studies addressing a particular clinical issue (e.g. treatment of asthma). The next step is to critically evaluate the studies to identify which are of sufficient quality to contribute to decision making. The final step is to pool the results of the studies to arrive at a quantitative estimate of the effectiveness of the treatment(s).

Research Evidence & Disemmination

Synthesising the research evidence is only the starting point for using research to improve practice. Equally important is the *dissemination* and *use* of this information. To make a practical difference, systematic reviews must be readily available to medical practitioners, and must be actively used in everyday clinical practice. Reviews must also be regularly updated to take account of new research developments. Evidence based medicine is an application of knowledge management principles in the medical field, although it pre-dates the knowledge management literature by more than two decades. It focuses on synthesising *explicit knowledge* in the form of research findings, and applying this in clinical practice.

Objectives of Knowledge Management Projects

1. Create knowledge repositories: The majority of knowledge management projects focused on creating structured repositories to store codified (*explicit*) knowledge. Three types of knowledge repositories were identified: *external knowledge* (knowledge from external sources), *structured internal knowledge* (internal documents) and *informal internal knowledge* (tacit knowledge extracted in the form of "lessons learned").
2. Improve knowledge access: A second type of knowledge management project focused on providing access to *tacit knowledge* and facilitating its transfer between individuals.
3. Enhance the knowledge environment: A third type of project focused on establishing an environment conducive to knowledge creation, transfer and use.
4. Manage knowledge as an asset: The final type of knowledge management project focused on managing knowledge as an asset. One approach to this involves measuring the value of knowledge assets and including this information in financial statements.

KM Strategies

Knowledge Management Strategies

Strategies define methods for achieving objectives. In one of the most detailed studies of knowledge management, Hansen et al (1999) studied knowledge management strategies used in consulting firms, health care providers and computer manufacturers. They identified two broad types of strategy for implementing knowledge management:

1. Codification Strategy: Codification is about turning tacit knowledge into *explicit knowledge*. Knowledge is extracted from the person who developed it and stored in electronic repositories, easily accessible by anyone in the organisation.
2. Personalisation Strategy: Personalisation focuses on *tacit knowledge* and involves the sharing of knowledge directly between people. Knowledge is closely tied to the person who developed it, and is shared not only face to face but also over the telephone, by email and by videoconference.

Success factors for KM Projects

Success Factors for Knowledge Management Projects

Success factors define the conditions that lead to success in knowledge management projects—these define "independent variables" or causal factors. Davenport et al (1998) identified eight factors that contributed to the success of knowledge management projects:

1. Link to economic performance: The most successful knowledge management projects involved money saved or earned.
2. Technical and organisational infrastructure: Knowledge management projects are more likely to succeed when they involve both technology and organisational infrastructure.
3. Flexible knowledge structure: Finding the right balance between too much structure and too little structure in knowledge repositories was a critical factor in many projects.
4. Knowledge-friendly culture: Aspects of a "knowledge friendly" culture include people with a positive attitude to knowledge, an organisation that values learning and innovation, and establishes appropriate incentive and reward systems.
5. Clear purpose and language: A clear purpose for the knowledge management project with objectives that are clearly defined and communicated is important for success.
6. Change in motivational practices: Incentives and rewards need to be introduced to motivate people to create, share and use knowledge.
7. Multiple channels for knowledge transfer: A variety of channels for knowledge transfer is desirable, as each adds value in a different way. It is particularly important to provide opportunities for face to face contact as well as electronic forms of communication.
8. Senior management support: This includes sending messages that knowledge management is critical to the organisation's success and providing funding and other resources.

Nonaka Model

1. *Externalisation*: the process of articulating tacit knowledge into explicit knowledge. This corresponds to Hansen at al's codification strategy.
2. *Socialisation*: the process of transferring tacit knowledge between people. This corresponds to Hansen et al's personalisation strategy.
3. *Internalisation*: the process of absorbing explicit knowledge into tacit knowledge. This process is an essential part of applying knowledge in practice.
4. *Combination*: the process of combining together different bodies of explicit knowledge to form new explicit knowledge.

Nonaka Model – Clinical Applications

Use of the medical reference databases probably fits best into *internalisation*, in that clinicians use the knowledge in these databases to make decisions and recommend appropriate treatments. As discussed earlier, knowledge must be made tacit (internalised) to be used to take action. The clinician will need to extract the relevant knowledge and combine it with what they already know (tacit knowledge) and information about the patient's condition (symptoms, diagnostic results) to make an appropriate decision.

The posting of clinical protocols fits best into *combination*, since it involves peer review and collaboration—the desired result of such collaboration is identification of "best practice" and ultimately, improved policies and protocols. The process of producing systematic reviews as part of evidence based medicine also fits into *combination*, since it is about synthesising explicit knowledge in the form of medical research studies to form new explicit knowledge.