

LITERATURE REVIEW

The basis of clinical reasoning strategies in relation to the nature of Osteopathic practice

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Abstract

Osteopathy is a discipline that has clearly defined philosophy and principles that are emphasized as being the basis for clinical reasoning in practice. This article explores the strategies used by osteopaths in clinical practice, and provides a model in relation to how clinical reasoning in practice relates to Osteopathic philosophy and principles. The intention of this article is to demonstrate that in the practice of Osteopathy, philosophy and principles are integral to the clinical reasoning process.

Background

Andrew Taylor Still, the founder of Osteopathy, in 1897 defined Osteopathy (cited in Latey, 1991, p13) as,

“Osteopathy is that science which consists of such exact, exhaustive and verifiable knowledge of the structure and function of the human mechanism, anatomical physiological and psychological, including the chemistry and physics of it's known elements, as has made discoverable certain organic laws and remedial resources, within the body itself, by which nature under the scientific treatment peculiar to osteopathic practice, apart from all ordinary methods of extraneous artificial or medicinal stimulation, and in harmonious accord with it's own mechanical principles, molecular activities, and metabolic processes, may recover from displacements, disorganisations, derangements, and consequent disease, and regain it's normal equilibrium of form and function in health and strength.”

Over the period of over one hundred years, the definition of Osteopathy has evolved and is currently defined as,

“a philosophy of health care and a distinctive art, supported by expanding scientific knowledge; its philosophy embraces the concept of unity of the living organism's structure (anatomy) and function (physiology). Its art is the application of the philosophy in the practice of medicine and surgery in all its branches and specialities. Its science includes the behavioural, chemical, physical, spiritual and biological knowledge related to the establishment and maintenance of health as well as the prevention and alleviation of disease.” (Seffinger et al, 2003, p10).

These definitions are reciprocally embedded in the classic Osteopathic philosophy defined by the following principles:

1. The body is a unit; the person is a unit of body, mind and spirit.
2. The body is capable of self-regulation, self-healing, and health maintenance.
3. Structure and function are reciprocally interrelated.
4. Rational treatment is based on an understanding of the basic principles of body unity, self regulation, and the interrelationship of structure and function.

(Seffinger et al, 2003, p10).

These principles are extrapolated in developing the concepts of health, disease and patient care that comprise Osteopathic practice. These concepts are characterised in Osteopathic practice as, in respect to,

1. Health

- a) Health is a natural state of harmony
- b) The human body is a perfect machine created for health and activity
- c) A healthy state exists as long as there is normal flow of body fluids and nerve activity

2. Disease

- d) Disease is an effect of underlying, often multifactorial causes
- e) Illness is often caused by mechanical impediments to normal flow of body fluids and nerve activity
- f) Environmental, social, mental, and behavioral factors contribute to the etiology of disease and illness

3. Patient Care

- g) The human body provides all the chemicals necessary for the needs of its tissues and organs
- h) Removal of mechanical impediments allows optimal body fluid flow, nerve function, and restoration of health
- i) Environmental, cultural, social, mental and behavioral factors need to be addressed as part of any management plan
- j) Any management plan should realistically meet the needs of the individual patient

(Seffinger et al, 2003, p 5)

Using these concepts, tenets for Osteopathic patient care (Seffinger et al, 2003, p11) have been proposed. These tenets are as follows:

1. The patient is the focus for health care
2. The patient has the primary responsibility for his or her health
3. An effective treatment for patient care is founded on the above tenets and incorporates evidence-based guidelines, optimizes the patient's natural healing capacity, addresses the primary cause of disease, emphasizes health maintenance and disease prevention, with particular emphasis on the musculoskeletal system as an integral part.

On comparing these tenets for Osteopathic patient care with those of other health care professions, it is apparent that these tenets are similar. In Osteopathic practice, as with other health care professions, these tenets facilitate the implementation of health care models and approaches that include:

1. sociological approaches to patient care, which try to explain patient care in terms of socio-economic, political, personal, environmental and chance factors
2. medical and biomedical science approaches to patient care, where there is an emphasis on patient care in terms of science and its branches
3. humanist approach to patient care, where there is an emphasis of recognizing that people are complex wholes living within and permanently influenced by a constantly changing world.

(adapted from Seedhouse, 1986, p29)

From the point of view of an Osteopath, a further model can be proposed based on the philosophy and principles of Osteopathic practice. This health care model can be defined as the musculoskeletal approach to patient care that emphasizes the recognition of musculoskeletal causes of disease and illness, based on professional practice knowledge and Osteopathic theory. In comparison to medical practitioners, there has been an emphasis to integrate scientific reasoning into medical practice (Schell and Cervero, 1993, p 606). This type of scientific reasoning has been undertaken through the integration of propositional knowledge (in the form of empirical knowledge and research-based theory) into medical and biomedical science approach to patient care.

On comparing in health care models between medicine and osteopathy in this instance and between other health care professions, an assumption can be made that due to the emphasis of one model of patient care over another, clinical reasoning strategies utilised in practice between professions differ. Research in clinical reasoning in a number of professions has yielded the following approaches or strategies:

- a) Hypothetico-deductive reasoning with variations (Fonteyn and Cahill, 1998, p149; Offredy, 1998, p988; Round, 2001, p111); also known as Deductive and Inductive reasoning (Lubsen, 1995, p252); Information processing theory (Greenwood, 1998, p843,844; Round, 2001, p110; Scott, 1996, p3); Procedural reasoning (Neistadt et al, 1998, p126; Van Leit, 1995, p349)
- b) Pattern recognition (Offredy, 1998, p 988); Scheme inductive reasoning (Coderre et al, 2003, p 695; Norman and Eva, 2003, p676); Perceptual reasoning (Cox, 2002, p1189); forward/backward reasoning (Fonteyn and Cahill, 1998, p149)
- c) Bayesian diagnostic reasoning (Noguchi et al, 2002, p848; Round, 1999, p480, 483; Round, 2001, p110)
- d) Knowledge-reasoning integration (Higgs and Jones, 2000, p7; Scott, 1996, p5)
- e) Intuition (Benner and Tanner, 1987, p23; Cioffi, 1997, p203; Offredy, 1998, p988, 993)
- f) Linear Progression Vs Discontinuous search (Fleming, 1991, p990)
- g) Interactive reasoning (Neistadt et al, 1998, p126; Van Leit, 1995, p349)
- h) Conditional reasoning (Neistadt et al, 1998, p126; Van Leit, 1995, p349)
- i) Pragmatic reasoning (Neistadt et al, 1998, p126; Van Leit, 1995, p349)
- j) Narrative reasoning (Neistadt et al, 1998, p126)
- k) Heuristics (Cioffi, 1997, p203; Cioffi & Markham, 1997, p265)
- l) Critical thinking (O'Neill and Dluhy, 1997, p825)
- m) Practical reasoning (Greenwood, 1998, p845)
- n) Decision analysis (Offredy, 1998, p992; Round, 2001, p110)
- o) Horizontal and vertical reasoning (Wong and Chung, p68-72)

Fleming (1991, p1007) proposes that health care practitioners are thought to use at least three types of clinical reasoning approaches when solving clinical problems. This article proposes that due to the nature, principles and philosophy of Osteopathic practice (particularly in relation to professional knowledge utilized in practice), an implementation of more than one health care model occurs, reasoning approaches reflect the health care models used in practice, and there is an overlap of these reasoning approaches in solving clinical problems, as stated to occur in other health care professions by Fleming (1991, p1007).

Osteopathic practice knowledge used in clinical reasoning

Professional knowledge is that which is relevant to and grounded in the practice context (Richardson et al, 2004, p2). In this respect, the context of Osteopathic practice is defined by its definition, philosophy, principles, health care models utilized and diagnostic reasoning strategies used in providing patient care. These elements of Osteopathic practice that form its context produce within a profession its own frames of understanding; Dahlgren et al (2004, p19) states that every profession as such has its own frame of understanding. Within this frame of understanding, there is a development of professional knowledge from the process of reflection by individuals and professional groups. Professional (practice) knowledge (Higgs et al, 2004, p58) is therefore the outcome of reflection by individuals and professional groups on their knowledge and practice.

In Osteopathy, reflection to development of professional knowledge has been made by a number of applied scientists through scientific inquiry, that include Irvin Korr (1994, p40), and Louisa Burns (1994, p149-257). Their reflection on osteopathic practice developed through gaining increments of information about a set of phenomena (Mosey, 1996, p178), and validity is conferred as in developing this professional knowledge, processes of formulation, refinement and testing have occurred and continue to occur (Mosey, 1996, p175, 183).

In 1901, Littlejohn wrote “Osteopathy did not invent a new anatomy or physiology or construct a new pathology. It has built upon the foundation of sciences already deeply seated in the philosophy of truth, chemistry, anatomy and physiology, a new etiology of diseases, gathering together, adding to and reinforcing natural methods of treating disease that have been accumulating since the art of healing began”; cited in (Seffinger et al, 2003, p 8). As defined by Meleis (1991) to have occurred in other health care professions and paradigms, professional knowledge that exists in Osteopathic practice can be used to describe a patient (or client), explain the actions of an osteopath and patient, and could predict further actions to be taken. Some osteopathic practice knowledge may

be considered as being borrowed, however Barnum (1990, p95; cited in Meleis, 1991) confers that when such knowledge and theories have been adapted to the osteopathic milieu, it is logical to refer to this knowledge (or theory) as borrowed knowledge.

Professional knowledge and theories need to fulfill the criteria of being testable, yet sufficiently general to still be scientifically interesting (Walker and Avant, 1995, p11). Professional knowledge and theories must also represent intelligible and systematic schemata for observation, account for the vast array of experiences encountered by human beings, and address a relatively concrete phenomenon by stating what the phenomenon is, why it occurs, or how it occurs (Fawcett, 1999, p5). Briefly, on review of the following exemplars and research, osteopathic professional knowledge and theories fulfill the criteria of being testable, represent intelligible and systematic schemata for observation, account for the vast array of experiences encountered by human beings, and address a relatively concrete phenomenon by stating what the phenomenon is, why it occurs, or how it occurs:

- a) Neural basis of the somatic component in health and disease and its clinical management by Denslow (1994, p28)
- b) The trophic functions of nerves and their mechanisms by Korr (1994, p40)
- c) The spinal cord – Active processor not passive transmitter by Patterson (1994, p69)
- d) The Osteopathic short leg syndrome by Magen (1994, p61)
- e) Review of the pathology of the lesion and evidences of its possible correction by Burns (1994, p157)
- f) Viscerosomatic and Somatovisceral reflexes by Burns (1994, p160)
- g) Early pathogenesis following Vertebral strain by Burns (1994, p170)
- h) Qualities distinguishing muscles affected by primary vertebral lesions from those affected by viscerosomatic nerve reflexes by Burns (1994, p166)
- i) Principles of therapy dependent on the osteopathic pathology of sprains and strains by Burns (1994, p244)

These exemplars relate to osteopathic professional knowledge in the area of neurology and its integration on Osteopathic practice. There are also a significant amount of professional osteopathic knowledge that relates to clinical specialties (for example, obstetrics and pediatrics), and to specific Osteopathic clinical approaches (for example, musculoskeletal assessment in the use of particular Osteopathic techniques, like High-Velocity Low-Amplitude Thrust techniques, Muscle energy techniques, Functional technique, Strain and Counterstrain techniques and Cranial techniques). This professional knowledge found in Osteopathic practice is presented by Ward (2003).

In developing professional knowledge and theory are pragmatic taxonomies are generally found, as areas of specialization are delineated in a profession (Mosey, 1996, p173). In osteopathy, such pragmatic taxonomies very likely relate to the fact that ‘Still maintained that his discoveries and thoughts were based on personal observation, experimentation, applications of factual knowledge, and the power of reasoning’ (Seffinger et al, 2003, p 8). Osteopathic professional knowledge and theory development did not begin ‘from the ivory tower’, where knowledge and theory development is initiated by contemplation of phenomena from a distance (with no immediate, direct involvement with the phenomena), but rather osteopathic professional knowledge and theory development was initiated ‘in the field’, where there was direct involvement with undifferentiated phenomena. This proposition is extrapolated from principles of knowledge and theory development by Mosey (1996, p178-185).

In developing professional knowledge and theory, Still and other osteopathic clinical and applied scientists the strategy used resembles practice-theory-research-theory strategy as identified by Meleis (1991), where there is an assumption that there is a significant relationship between practice, theory and research (Meleis, 1991). This strategy would be responsible for the development of osteopathic professional knowledge and theories that relate to clinical specialties,

and to specific Osteopathic clinical approaches that are found in Osteopathic practice and presented by Ward (2003).

In assimilating evidence-based, research centered and professional knowledge with philosophy, principles, patient care models and outcomes of practice, an awareness of paradigmatic features of a profession occurs. Paradigmatic features of a profession are derived as being the philosophy of purpose, the cognitive processes of practice, and the recognized discrete health goals of their profession (Dahlgren et al, p27). Figure 1 identifies these paradigmatic features in the context of osteopathic health care practice.

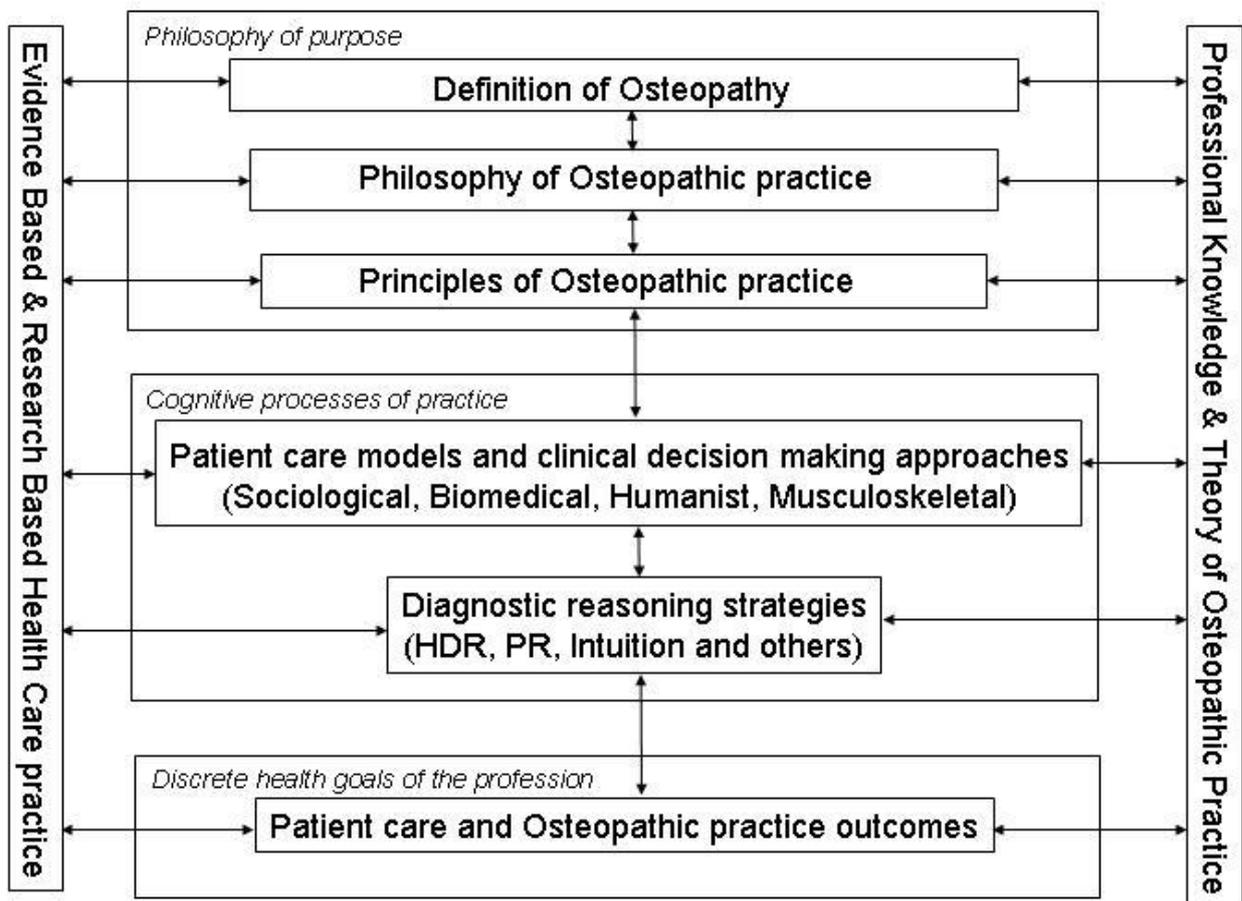


Figure 1. Osteopathic health care practice and its contextual elements

Clinical reasoning models used in Osteopathic practice

Clinical reasoning is a process that is found in the practice of Osteopathy, as in a number of other health care professions. In Osteopathic practice, though, this process has had little critical inquiry, while in a number of health care professions that include medicine, physiotherapy, occupational therapy, and nursing, inquiry has demonstrated that a number of clinical reasoning strategies are used by health care providers in these disciplines. From the literature produced by these disciplines, it is apparent that clinical reasoning strategies differ between these disciplines and between practitioners in these disciplines. Differences between professions seen in clinical reasoning are the particular focus, goals and tasks of the professions and the nature of the practice in these professions and in the area of health care that they exist (Fleming, 1991, p988). In osteopathy, goals and tasks of the profession are clearly defined by its definition, philosophy, and principles, forming the philosophy of purpose defined in figure 1. Cognitive processes of practice are derived from the philosophy of purpose, and incorporate clinical reasoning strategies used in osteopathic practice.

Clinical reasoning strategies are generally discussed as occurring individually, however often because of the complex nature of clinical reasoning a number of these strategies may overlap with each other and operate in a health care consultation between practitioner and patient. Health care practitioners are thought to use three types (or strategies) of reasoning when solving clinical problems (Fleming, 1991, p1007). It is not clear from any of the research literature whether these three strategies of reasoning relate to a particular patient model of care. In reviewing figure 1, the assumption is made that these clinical reasoning strategies can relate to any patient model of care, and that these strategies would relate to the philosophy of purpose (or definition, philosophy, and principles) of the osteopathic profession. It is therefore implied that the philosophy of purpose in the osteopathic clinical context would be embedded in the clinical reasoning strategies used.

Sprafka (2003, p258) identifies at least four clinical reasoning strategies in osteopathic practice. These clinical reasoning strategies are also found in other health care professions, however Sprafka (2003, p259) illustrates how, in osteopathy, professional practice knowledge is integral to the clinical reasoning strategies used. Two of these clinical reasoning strategies will be reviewed below.

One clinical reasoning strategy used in osteopathy is that of *hypothetico-deductive reasoning* (HDR). This clinical reasoning strategy is disease-oriented, highly cognitive, extremely focused and almost impersonal at times, and as such the osteopath is not encouraged to consider the whole person (Sprafka, 2003, p260 – 261). This clinical reasoning strategy was founded from research in the medical profession in the early 1970s by Barrows and Bennett (1972, cited in Scott, 1996, p2) and Elstein et al (1978, cited in Scott, 1996, p2). HDR is process-oriented and supports the notion that clinical reasoning is a generic and transferable skill, however this has been refuted by a number of preponderants. Clinical expertise and clinical reasoning in experts has been found to be case and discipline specific, and that propositional and non-propositional knowledge of the health discipline is required (Greenwood, 1998, p845). In osteopathic clinical reasoning, the assumption is made that propositional and non-propositional knowledge utilized is based on its philosophy and principles, or philosophy of purpose.

Often clinicians are in situations where time is limited, elements of uncertainty and ambiguity exist, and changes are constantly being made in vaguely formulated goals (Hedberg and Larsson, 2003, p216). Such variables have been considered by a number of authors in the Naturalistic Decision Making model (Klein, 1989, cited in Hedberg and Larsson, 2003, p216) and the Collaborative (or Patient-centred) clinical reasoning model (Jones et al, 2000, p117-120; Jones and Rivett, 2004, p4). These models demonstrate the integration of these clinical situational variables into the HDR model, where there is a focus on the clinician's recognition and assessment of the situation, how the clinician's knowledge, cognition, metacognition and experience is important in

the clinical setting, and how there is collaboration in the diagnostic reasoning process (Hedberg and Larsson, 2003, p216; Jones et al, 2000, p117-120; Jones and Rivett, 2004, p4). Jones and Rivett (2004, p4) is presented in figure 2 to demonstrate the integration of HDR in the clinical context.

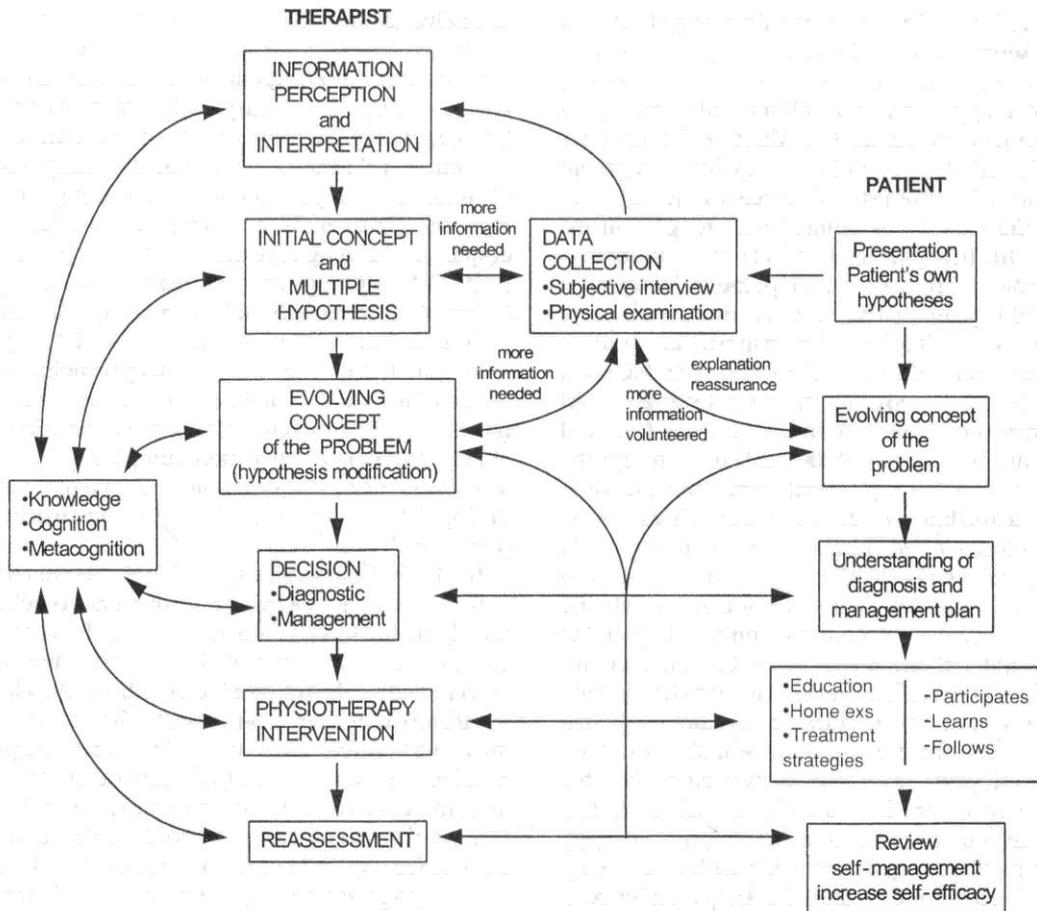


Figure 2. The Collaborative (or Patient-centred) clinical reasoning model

(Jones et al, 2000, p117-120; Jones and Rivett, 2004, p4)

Figure 2 above may also be relevant to osteopathic clinical reasoning, as it demonstrates how knowledge, cognition and metacognition relate to osteopathic philosophy and principles.

A second clinical reasoning strategy identified in osteopathic practice is that of *pattern recognition* (PR) (Sprafka, 2003, p258 – 259), where judgments are made on the basis of the initial data and cues provided by the patient (Offredy, 1998, p992). In osteopathic practice, a number of patterns are defined from the initial data and cues in clinical reasoning. These patterns include:

1. visual patterns, where visual cues are used to determine the presence of disease,
2. seasonal/environmental patterns, where environmental cues like occupational factors are used to determine the presence of a disease or condition
3. musculoskeletal patterns, where cues from assessment of a patient musculoskeletal system based on osteopathic professional knowledge determine the presence of a disease or condition
4. presenting complaint patterns, where cues relating to a patient's symptom presentation are used to determine the presence of a disease or condition.

The pattern recognition strategy of clinical reasoning develops as novice practitioners progress to being experts and relates to the fact that a significant proportion of new patients seen by practitioners resemble patients previously seen (Offredy, 1998, p992). When learners (or novices) are subjected to clinical case presentations, higher order cognitive processes and organized knowledge structures are allowed to develop in the learner (Scott, 1996, p5). Extensive exposure to domain specific clinical presentations and cases allows for the development of a deep highly organized knowledge base (a database of patterns) from which prompt retrieval of knowledge and understanding related to cues previously encountered in similar cases can occur in the presenting patient or case presentation (Marckmann, 2001, p88). Categorization occurs where learners recognize similarities between a set of symptoms and signs in a previous experienced case (Scott, 1996, p4). O'Neill and Dluhy (1997, p828) state that problem based approaches encourage prototype patterns to develop in the learner's cognition that become more generalized across patient presentations. Continual exposure to case studies, enable cognitive processes (like categorization) in

the novice (student or learner) to confirm or refine old patterns and acquire new patterns, which may be hidden within the ambiguity of the clinical presentation (O'Neill and Dluhy, 1997, p827). Thus, the primary feature of pattern recognition postulates that a new case is categorized by its similarity to a patient seen earlier and is therefore given the same diagnosis (Ross, 1984 cited in Offredy, 1998, p992; Brooks et al, 1991 cited in Offredy, 1998, p992). 'Chunking' of knowledge, formation of illness scripts and schemes in the mind of the practitioner occur as they gain experience, knowledge and cognitive processing skills (Boshuizen and Schmidt, 2000, p18; Coderre *et al*, 2003, p695-696, 700; Robertson, 1996, p181; Scott, 2000, p291-292), and these are dependent on extensive and structured knowledge bases (also in Round, 2001, p112; Schuwirth, 2002, p695).

In figure 3, Buckingham and Adams' general classification model demonstrates how pattern recognition may occur in the clinical setting. In this model, patient descriptors (the pattern vector) relate to relevant signs and symptoms (the feature vector), before leading to have a psychological representation in the clinician's mind. Nendaz and Bordage (2002, p761) also define semantic qualifiers (SQs), which may be seen to reflect this process, where a novice practitioner transforms patient cues to an abstract quality (or feature) (for example, the patient cue 'three times before' becomes 'recurrent'), and to a global sense or representation of the problem (for example, the patient cue 'acute, recurrent, large joint' relates to gout or septic arthritis). Following psychological representation in the clinician's mind, classification of the patient's presenting complaint occurs. Classification activities relating to the patient's complaint include the development of a number of hypotheses, decisions or intervention strategies (Buckingham and Adams, 2000, p992).

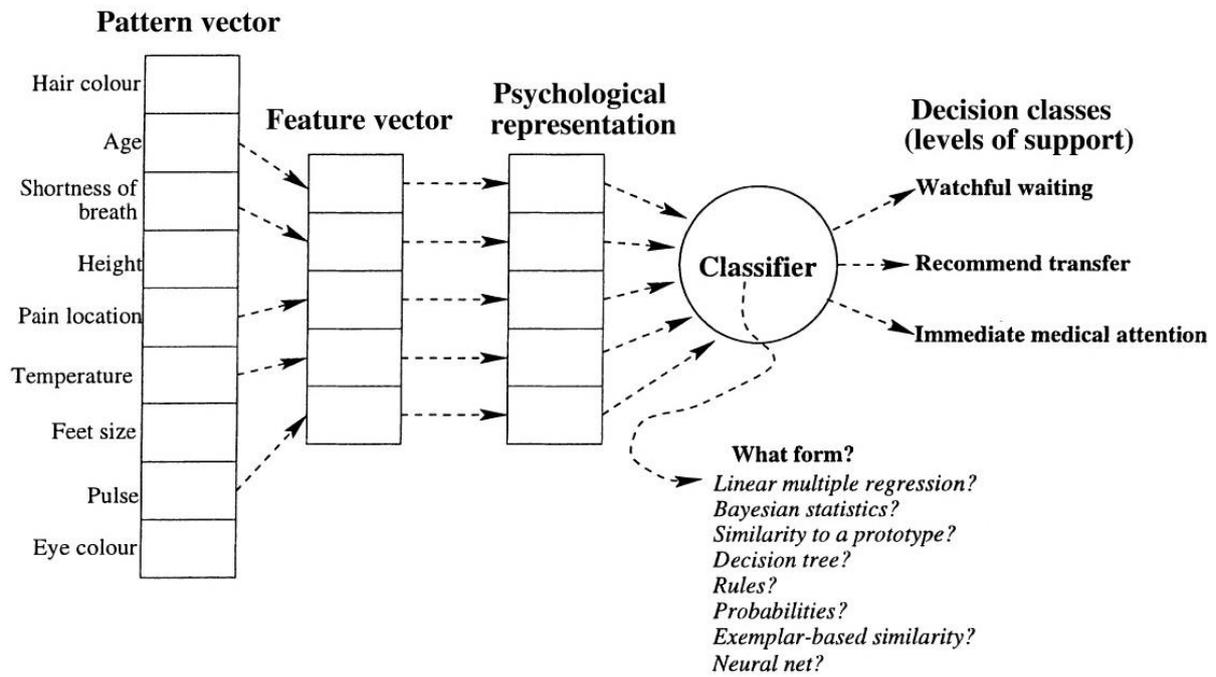


Figure 3: General classification model (Buckingham and Adams, 2000, p992)

In the novice practitioner, hypotheses and clinical decisions are developed based on rules that are consciously followed, and this process is consistent with the HDR model of diagnostic reasoning. However as a novice clinician gains experience, cues become automatically associated with hypotheses, outcomes and clinical decisions, and rules become redundant (Buckingham and Adams, 2000, p992). Pattern recognition performed by expert practitioners in clinical practice is said to be unconscious, in not following any rule-governing behaviour. While Radwin (1995, cited in Buckingham and Adams, 2000, p994) argues that pattern recognition approaches to clinical reasoning do not consider the individualized hypothesis development and clinical decisions related to the patient’s complaint, in reality, Buckingham and Adams (2000, p994) state that individualized hypothesis and clinical decision development is a specialization of patterns. The more patterns of care distinguished by the practitioners in the clinical setting, the greater potential exists for the clinician to correctly determine an individualized tailored clinical reasoning outcome. In this respect, expert practitioners use pattern matching techniques that are dependent on an extensive and structured (discipline-specific) knowledge base (Round, 2001, p112). Using figure 3 above, in osteopathy, the suggestion is made that osteopathic philosophy and principles are embedded in the ‘classifier’ field of this type of pattern recognition clinical reasoning strategy.

Conclusions on Osteopathic philosophy and principles in clinical reasoning

Osteopathic clinical reasoning is a complex process. Schell and Cervero (1993, p605) state that, in clinical reasoning, cognitive processes are inherently embedded in contextual situations, which in fact activate particular kinds knowledge, while Greenwood (1998, p845) states that the nature of reasoning is a function of task complexity than dependent of the characteristics of the practitioner. The contextual situation and characteristic of the osteopath in the process of clinical reasoning are defined in the following connotations:

1. Osteopathic practitioners have practice (propositional and non-propositional) knowledge that focuses on the musculoskeletal system, as their important diagnostic and therapeutic tool (Lesho, 1999, p477- 483; Sprafka, 2003, 269). Musculoskeletal dysfunction presentations that reflect disease or conditions found in patients (Beal, 1994; Lesho, 1999, p477- 483; Greenman, 1996; Ward, 1997) are well defined in professional knowledge that forms osteopathic practice. These form the basis for causal, inductive, intuitive, probabilistic and abstract reasoning required in clinical reasoning. A similar type of basis of clinical reasoning is found with professions like Occupational Therapy (Fleming, 1991, p991), nursing (Greenwood, 1998, p845), and Physiotherapy (Jones et al, 2000, p117-120; Jones and Rivett, 2004, p4);
2. Philosophy and principles in Osteopathic practice have a considerable emphasis on professional knowledge in the clinical context, and have been developed as higher order rules that have formed through practice knowledge through reflection and research. George and Davis (1998, p105-151) and Petersen (1994, p3) implicate that a similar process of philosophy and practice principle development occurred in medicine and other health care professions;
3. Hypothetico-deductive and pattern recognition reasoning strategies in Osteopathic practice are integrated with patient care models and clinical reasoning strategies found in the cognitive processes of practice;
4. Philosophy and principles of osteopathy infers that a number of patient care models (biomedical, sociological, humanist and musculoskeletal) are used to provide individualized,

patient centred and wholistic health care to patients. Osteopathic practice emphasizes the use of musculoskeletal patient care model, and the other is primarily the biomedical model of patient care.

References:

- Barrows, H. & Bennett, K. (1972). The diagnostic (problem solving) skill of the neurologist: Experimental studies and their implications for neurological training. *Archives in Neurology*, 26, 273-277
- Beal, M. (1994). *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy
- Benner, P. & Tanner, C. (1987). Clinical judgement: How experts use intuition. *American Journal of Nursing*, 87, 23-31
- Boshuizen, H.P.A. & Schmidt, H.G. (2000). The development of clinical reasoning. In Higgs, J. and Jones, M. (Eds). *Clinical Reasoning in the Health Professions* (2nd Ed.). London: Butterworth-Heinemann. (pp. 15 – 22).
- Buckingham, C.D., & Adams, A. (2000). Classifying clinical decision making: interpreting nursing intuition, heuristics and medical diagnosis. *Journal of Advanced Nursing*, 34(4), 990-998
- Burns, L. (1994). Early pathogenesis following Vertebral strain. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 170-175)
- Burns, L. (1994). Principles of therapy dependent on the osteopathic pathology of sprains and strains. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 244-250)
- Burns, L. (1994). Qualities distinguishing muscles affected by primary vertebral lesions from those affected by viscerosomatic nerve reflexes. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 166-169)
- Burns, L. (1994). Review of the pathology of the lesion and evidences of its possible correction. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 157-159)
- Burns, L. (1994). Viscerosomatic and Somatovisceral reflexes. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 160-165)
- Cioffi, J. & Markham, R. (1997). Clinical decision-making by midwives: managing case complexity. *Journal of Advanced Nursing*, 25(2), 265-272

- Cioffi, J. (1997). Heuristics, servant to intuition, in clinical-decision making. *Journal of Advanced Nursing*, 26(1), 203-208
- Coderre, S., Mandin, H., Harasym, P.H. and Fick, G.H. (2003). Diagnostic reasoning strategies and diagnostic success. *Medical Education*, 37, 695 – 703
- Cox, K. (2002). Perceiving clinical evidence. *Medical Education*, 36, 1189-1195.
- Dahlgren, M.A., Richardson, B. and Kalman, H. (2004). Redefining the reflective practitioner. In Richardson, B., Higgs, J., & Madeleine Abrandt Dahlgren (Eds). *Developing practice knowledge for health professionals*. London: Butterworth-Heinemann. (pp. 15 – 33)
- Denslow, J.S. (1994). Neural basis of the somatic component in health and disease and its clinical management. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 28-33)
- Fawcett, J. (1999). *The Relationship of Theory and Research*. (3rd Ed.). Philadelphia, PA: F.A. Davis Co.
- Fleming, M.H. (1991). Clinical Reasoning in medicine compared with clinical reasoning in occupational therapy. *American Journal of Occupational Therapy*, 45(11), 988-996
- Fleming, M.H. (1991). The therapist with the three-track mind. *The American Journal of Occupational Therapy*, 45(11), 1007-1014.
- Fonteyn, M. & Cahill, M. (1998). The use of clinical logs to improve nursing students' metacognition: a pilot study. *Journal of Advanced Nursing*, 28(1), 149-154.
- George, J. and Davis, A. (1998). Chapter 5: The Development of the Biomedical Model of Disease. In *States of Health: Health and Illness in Australia*. (3rd Ed.). South Melbourne: Addison Wesley Longman.
- Greenman, P. (1996). *Principles of Manual Medicine* (2nd Ed.). Baltimore: Williams & Wilkins
- Greenwood, J. (1998). Establishing an international network on nurses' clinical reasoning. *Journal of Advanced Nursing*, 27, 843-847.
- Hedberg, B. & Larsson, U.S. (2003). Observations, confirmations and strategies – useful tools in decision making process for nurses in practice? *Journal of Clinical Nursing*, 12, 215-222

- Higgs, J. and Jones, M. (2000). Clinical Reasoning in the Health Professions. In Higgs, J. and Jones, M. (Eds). *Clinical Reasoning in the Health Professions* (2nd Ed.). London: Butterworth-Heinemann. (pp. 3 - 14).
- Higgs, J., Andresen, L. and Fish D. (2004). Practice Knowledge – its nature, sources and contexts. In Richardson, B., Higgs, J., & Madeleine Abrandt Dahlgren (Eds). *Developing practice knowledge for health professionals*. London: Butterworth-Heinemann. (pp. 51 – 69)
- Korr, I. (1994). The trophic functions of nerves and their mechanisms. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 40-47)
- Latey, P. (1991). Osteopathy Ancient and Modern. *Australian Journal of Osteopathy*, 3 (2), 13 - 16
- Lesho, E.P. (1999). An Overview of Osteopathic Medicine. *Archives of Family Medicine*, 8 (Nov/Dec), 477 - 484
- Lubsen, J. (1995). Essentials of Bayesian diagnostic reasoning. *The Netherlands Journal of Medicine*, 17, 252-259.
- Magen, M.S. (1994). The Osteopathic short leg syndrome. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 61-65)
- Marckmann, G. (2001). Teaching science vs. the apprentice model – do we really have the choice? *Medicine, Health Care and Philosophy*, 4, 85-89
- Meleis, A. (1991). Chapter 10: Strategies for theory development. *Theoretical Nursing. Development and Progress*. Philadelphia: J.B. Lippincott Co.
- Mosey, A.C. (1996). Chapter 8: Basic Scientific Inquiry and Theory Development. *Applied Scientific Inquiry in the Health Profession. An Epistemological Orientation*. Bethesda, Maryland: The American Occupational Therapy Association, Inc. pp 171-190
- Neistadt, M.E., Wright, J. & Mulligan, S.E. (1998). Clinical reasoning case studies as teaching tools. *American Journal of Occupational Therapy*, 52(2), 125-132
- Nendaz, M.R. & Bordage, G. (2002). Promoting diagnostic problem representation. *Medical Education*, 36, 760-766
- Noguchi, Y., Matsui, K., Imura, H., Kiyota, M. & Fukui, T. (2002). Quantitative Evaluation of

Diagnostic Thinking Process in Medical Students. *Journal of General Internal Medicine*, 17, 848-853

Norman, G.R. & Eva, K.W. (2003). Doggie diagnosis, diagnostic success and diagnostic reasoning strategies: an alternative view. *Medical Education*, 37, 676-677.

O'Neill, E.S. & Dluhy, N.M. (1997). A longitudinal framework for fostering critical thinking and diagnostic reasoning. *Journal of Advanced Nursing*, 26, 825-832.

Offredy, M. (1998). The application of decision making concepts by nurse practitioner in general practice. *Journal of Advanced Nursing*, 28, 988-1000.

Patterson, M.M. (1994). The spinal cord – Active processor not passive transmitter. In Beal, M. (ed.) *1994 Yearbook – Louisa Burns, DO Memorial*. Indianapolis: American Academy of Osteopathy (pp 69-78)

Petersen, A.R. (1994). *In a Critical Condition: Health and Power Relationships in Australia*. St. Leonards: Allen & Unwin.

Rivett, D.A. & Jones, M.A. (2004). Improving clinical reasoning. In Jones, M.A. & Rivett, D.A. (Eds). *Clinical Reasoning for manual therapists*. London: Butterworth-Heinemann. (pp. 403 – 417).

Richardson, B., Higgs, J. and Dahlgren, M.A. (2004). Recognising practice epistemology in the health professions. In Richardson, B., Higgs, J., & Madeleine Abrandt Dahlgren (Eds). *Developing practice knowledge for health professionals*. London: Butterworth-Heinemann. (pp. 1 – 14)

Robertson, L.J. (1996). Clinical Reasoning, Part 1: The nature of Problem Solving. A literature Review. *British Journal of Occupational Therapy*. 59(4), 178-182.

Robertson, L.J. (1996). Clinical Reasoning, Part 2: Novice/Expert Differences. *British Journal of Occupational Therapy*. 59(5), 212-216.

Round, A. (2001). Introduction to clinical reasoning. *Journal of Evaluation in Clinical Practice*, 7, 109-117.

Round, A. P. (1999). Teaching clinical reasoning – a preliminary controlled study. *Medical Education*, 33, 480-483.

Schuwirth, L. (2002). Can clinical reasoning be taught or can it only be learned? *Medical Education*, 36, 695-696

- Scott, I. (1996). *Understanding and developing clinical reasoning skills*. Australian and New Zealand Association for Medical Education Occasional paper
- Scott, I. (2000). Teaching clinical reasoning: A case-based approach. In Higgs, J. and Jones, M. (Eds). *Clinical Reasoning in the Health Professions* (2nd Ed.). London: Butterworth (pp. 290-297)
- Schell, B.A. and Cervero, R.M. (1993). Clinical Reasoning in Occupational Therapy: An Integrative Review. *The American Journal of Occupational Therapy*, 47(7), 605-610.
- Seedhouse, D. (1986). Chapter 4: Theories of Health. *Health: The Foundations for Achievement*. Chichester: John Wiley & Sons (pp 26 – 56)
- Seffinger, M., King, H., Ward, R., Jones, J., Rogers, F. and Patterson, M. (2003). Chapter 1: Osteopathic Philosophy. In Ward, R. (ed.) *Foundations of Osteopathic Medicine*. (2nd Ed.). Philadelphia: Lippincott Williams and Wilkins (pp 5 – 18).
- Sprafka, S.A. (2003). Chapter 19: Clinical problem solving. In Ward, R. (ed.) *Foundations of Osteopathic Medicine*. (2nd Ed.). Philadelphia: Lippincott Williams and Wilkins (pp 257 – 279).
- Still, A.T. (1897). *Autobiography of A.T.Still*. Kirskville: MO
- Still, A.T., (1892). *The Philosophy and Mechanical principles of Osteopathy*. Kansas City, MO: Hudson-Kimberely Publishing Company.
- Van Leit, B. (1995). Using the case method to develop clinical reasoning skills in problem-based learning. *American Journal of Occupational Therapy*, 49, 349-353.
- Walker, L. O. and Avant, K. C. (1995). *Strategies for theory construction in nursing*. (3rd Ed.). United States: Longman
- Ward, R. (1997). *Foundations of Osteopathic Medicine*. Philadelphia: Lippincott Williams and Wilkins
- Ward, R. (2003) *Foundations of Osteopathic Medicine*. (2nd Ed.). Philadelphia: Lippincott Williams and Wilkins
- Wong, T.K.S. & Chung, J.W.Y. (2002). Diagnostic reasoning processes using patient simulation in different learning environments. *Journal of Clinical Nursing*, 11, 65-72.