Evolution of Clinical Reasoning in Dental Education


Abstract: The approach to care in dentistry has evolved over the past couple of decades from a narrow focus on oral disease to addressing the psychosocial determinants of oral health. Subsequently, there have been many attempts to reform dental curricula through alternative models of education, such as competency-based and community-based educational models and problem-based learning. These efforts aim to improve the abilities of dental students in problem-solving, critical thinking, professionalism, and social and cultural competence to help them cope with the complexity of dealing with oral health-related issues and the constantly changing evidence underlying the practice of dentistry. However, it is not yet clear how well these educational initiatives meet their objectives or how they influence the reasoning skills of dental students. There is now a need to develop a conceptual framework for clinical reasoning in dentistry grounded on empirical evidence to direct the future evolution of dental education.

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Clinical reasoning is central to the activities of health care providers. It involves a process of thinking and interacting with the environment to understand clinical situations, to make diagnostic and therapeutic decisions, and to frame and solve clinical problems. The acquisition of knowledge and skills needed to reason competently in clinical situations appears to be a continuous and dynamic process extending well beyond predoctoral education. However, a critical challenge for educators of health care professionals is to establish the essential competencies required for the immediate demands of clinical reasoning upon graduation. This is a difficult objective for dental educators to address because of three closely connected reasons: 1) a growing awareness of the scope of problems that involve dentists, compounded by the inadequacy of information and resources required to address the problems; 2) limited understanding of the process of clinical reasoning and strategies that should be used directly or reflectively to identify and solve the problems; and 3) conflicting views about the relative importance of the objectives and priorities of dental education.

Clinical Reasoning and Health Care Professions

Clinical reasoning is an interactive process occurring within a multilayered context. The context of clinical reasoning includes the clinician, the patient, and the clinical problem, all interacting within a larger social, cultural, and global environment. Higgs and Jones\(^1\) have described those interactions as overlapping “problem spaces” that individually or collectively influence how health-related decisions are made. For example, the problem space of the clinician consists of the personal and professional knowledge, experiences, and values that contribute to the individual perspective through which a clinician sees, interprets, and frames clinical problems.

The “clinical problem” denotes a wide range of health-related issues that bring about a need or demand for care. The nature of the clinical problem and the type of care that it requires determine which health care profession should address the problem. Historically, awareness of the extent and diversity of health-related problems has led to the health care professions that operate in most countries today.\(^2\) This evolution has brought about various approaches to care and consequently various concepts of health and disease. For example, medicine in large part promoted the biomedical model of health, assuming that diseases happen as a result of biological malfunctions of the body with little influence from the mind. However, Parsons’s theory of the “sick role”\(^3\) challenged the medical model by introducing the influence of health and disease on the patient’s role in society. This theory launched a move to explore the psychosocial aspects of medicine from which...
emerged the biopsychosocial model of health care promoted by Engel. The change of perspective from biomedical to psychosocial models of health redefined the concept of health from a simple perception of physical disease to the current view that health occurs when there is a general feeling of physical, psychological, and social well-being. This view of health manifests itself clearly in the practice of occupational therapy and physiotherapy, in which the care primarily involves chronic conditions and related psychosocial problems.

The conceptual diversity of health and health care probably explains why the various health care professions study clinical reasoning differently. For example, medicine has primarily focused on the reasoning strategies used to diagnose disease, with an underlying assumption that appropriate treatment will follow a correct diagnosis of the disease. Alternatively, occupational therapy and physiotherapy have taken interpretive approaches (which involve any form of written, verbal, or physical human expressions within a broad historical and social context) to explore the various reasoning strategies relevant to chronic conditions and the treatment strategies appropriate to them.

Dental education and practice are based largely on a biomedical model of health care from its historical relationship with medicine and surgery and the emphasis on managing diseases. Dentistry, following medicine’s lead wittingly or unwittingly, adopted decision theory and information-processing theory to guide the process of diagnosing oral diseases and clinical practice guidelines. However, the change in emphasis from the biomedical to the psychosocial models of health brings out the diversity and complexity of problems that arise when oral health is compromised. The change has led also to explorations of the psychosocial basis of diagnosis and treatment planning through inductive or interpretive methods rather than through deductions and hypotheses that dominate medical research in health care and clinical practice. However, this change of approach to research has yet to influence explorations of clinical reasoning in dentistry.

The dominance of the biomedical perspective in dentistry is apparent globally as dental curricula evolved. Traditionally, dental curricula focused mostly on developing a student’s psychomotor skills and scientific knowledge to perform intraoral surgical and restorative procedures. However, recent awareness of the significance of the psychosocial determinants of health and disease poses a difficult challenge for dental educators, a challenge that is only now beginning to influence the structure and process of dental education everywhere.

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**Evolution of Dentistry as a Health Care Profession**

Dentistry claimed professional status within the health care system in the eighteenth century in Europe and about a hundred years later in North America. Professional associations developed and monitored ethical codes of conduct for the practicing dentist along with standards of education for dental students. At the outset, dental associations attracted physicians, surgeons, apothecaries, and even barbers who practiced dentistry, so that the diversity of membership created difficult regulatory challenges, especially in an era of medical dominance when the profession of medicine as a political force dictated the accreditation standards of education, research, and service in all aspects of health care.

The authority of the medical profession is derived predominantly from the concept of “technical rationality,” which asserts that clinicians should apply scientific evidence to solve the problems of clinical practice. The concept of technical rationality—the science of how and why to operate on the body—dominated surgery during the eighteenth century when surgeons sought a “noble” social status similar to that of physicians. Dentistry, emerging as a specialized branch of surgery, strived to develop a similar body of scientific knowledge to comply with the standards established for surgeons and physicians. Consequently, the scientific perspective prescribed the objectives of dental education, and dental politicians and educators, like their medical colleagues, sought affiliations with universities as a credible base of education and research. Slowly but increasingly, dental research attracted funding from philanthropic and proprietary organizations to explore the principal manifestations of poor oral health and to seek effective management strategies for oral disorders.

Dental researchers in the late nineteenth and early twentieth centuries focused mostly on oral rehabilitation and the pathogenesis of oral diseases. However, science has provided only some answers to the cause and management of chronic disease in the mouth and teeth. Recently, alternative approaches to health research have emerged to explore the impact...
of diseases and disease-related behaviors in society and moved to the role of personal, social, and other environmental factors in the initiation and maintenance of disease. An example of this research in dentistry today is the investigation of oral health as a direct or indirect influence on quality of life. In turn, the search for clinical evidence associated with these psychosocial influences requires a more inductive form of inquiry than the deductive methods of science.

The social concept of a health care profession has been redefined also in recent years to highlight the role of health professionals in society. Of course, past and current beliefs about dentistry as a health profession endorse the idea that dentists must be knowledgeable and competent, but now, according to Welie, there is an expectation that dentists should “continually revisit their own ‘profession’ and reinterpret the terms of the resulting social contract with the public.” This reinterpretation implies a responsibility to adopt an equitable approach to professional service, yet there is neither understanding nor consensus about the professional responsibilities and competencies underlying this service. Consequently, dental educators may be confused and challenged about setting priorities to cultivate the knowledge, skills, or competencies required of new dentists in order to fulfill their responsibilities to society. Indeed, this confusion crosses health care in general, and medical education faces a similar challenge.

Problems and Approach to Care in Dentistry

Historically, the approach to care in dentistry has revolved around three large themes: treating disease, treating the person, and treating all in need of care. Each reflects an evolving awareness of the range of clinical problems and the accompanying evidence that influences how dentists apply reason to address the problems.

Treating disease. Dentistry has always been concerned about caries and periodontal disease, pain, and tooth loss. A surgical perspective on the management of dental disorders produced a wide array of biomaterials along with numerous techniques and instruments to remove and restore oral structures. Alternatively, adoption of the medical or physician’s model of care produced a shift from surgery (e.g., extractions and fillings) to medications (e.g., fluoride) and behavioral therapy (e.g., diet counseling). Undoubtedly, advances in oral biology are influencing dental care, and current predictions suggest that by 2030 innovations in oral biology such as gene therapy, DNA vaccinations, and tissue engineering might change current clinical practices altogether. However, for the moment at least in this new millennium, surgery, medications, and efforts at behavioral modification continue to dominate dental practice and dental education.

Treating the person. Dentistry during the 1960s emphasized prevention of disease and began to explore the social and behavioral aspects of oral diseases and their psychosocial impact. So, by the end of the twentieth century, dentistry had recognized the demographic emergence of the aging population along with a need to focus on the patient rather than the disease and, more recently, on provision of a more equitable distribution of oral health services.

Treating all in need of care. Equity of access to care broadens the social context of dental practice from dental clinics to hospitals, schools, community-based clinics, and long-term care facilities and with all the necessary interdisciplinary collaboration that this requires. The complexities of dentist-patient relationships in the context of long-term care facilities, for example, poses new challenges that as yet have not been addressed satisfactorily.

Evolving Evidence on Caries

Past and current concepts of caries offer interesting examples of how dentistry sought and produced evidence to address this disease initially as a pathological state and then as part of a range of problems closely associated with the person and society. Early anatomical and histological observations of teeth with carious lesions led to a belief that caries develops as a result of developmental defects within enamel and dentin. However, the chemical action of food and acid in saliva under the influence of an array of micro-organisms were later implicated in the process of tooth decay, all of which focused attention on the need for personal hygiene, professional instrumentation (e.g., dental scaling), and pharmacotherapy, mostly in the form of fluoride. Therefore, gradually, the base of knowledge about caries and its management expanded to include dynamic associations among bacteria, diet, tooth structure, and community action.
The history of dental education in North America and Europe has evolved in stages since the mid-nineteenth century. The traditional apprenticeship of the trades dominated dental education almost everywhere until 1840, when the odontological model of education emerged at the College of Dental Surgery in Baltimore, Maryland, emphasizing psychomotor skills along with knowledge of biomaterials and techniques needed to restore or replace teeth. The political consequences of this educational model, with support from the Gies report in 1926, led to recognition of a dental profession with educational standards and professional regulations distinct from medicine in North America. Europe, in contrast, promoted models of dental education based largely on medically oriented stomatological concepts. Consequently, the education of dentists in Europe in contrast to North America remained more closely aligned with medical education.

Subsequent attempts to adopt and adapt the odontological and stomatological models of dentistry created the duality of conflicting objectives in dental education globally where development of psychomotor skills for precise restorative techniques compete for curricular time with the acquisition of scientific knowledge to diagnose and manage disease: the clinicians versus the basic scientists. In many ways, this reflected previous battles between surgery and medicine that raged in the seventeenth and eighteenth centuries. The educational situation grew even more complicated in the 1960s when dental educators became aware of the psychosocial determinants of health and began to incorporate behavioral studies into their curricula. Currently, we are in the midst of this confusion as many educators question their effectiveness in preparing competent and responsible dentists.

Approaches to Dental Education

Dental education has evolved around four major themes: teaching sciences and techniques; promoting problem-solving skills; developing competencies; and community service-learning. Each of these reflects a range of competencies required for oral health care.

Teaching sciences and techniques. The odontological model developed slowly into a sophisticated compendium of medical, technical, and behavioral courses and specifically dental courses to develop psychomotor clinical skills. It assumed initially a horizontal curricular design in a four-year curriculum to accommodate the biomedical sciences and laboratory courses during the first two years followed by two years of clinical instruction. This model has been criticized for failing to connect efficiently the basic sciences to the clinical experiences because of limited opportunity for students to synthesize and integrate knowledge and apply it in relevant clinical situations. Consequently, the diagonal and stepwise curricular designs emerged as alternative models integrating basic science and laboratory courses with early clinical experiences. However, the duality of conflicting objectives is transforming into a “surreal duality” as dental educators struggle to provide students with adequate knowledge and psychomotor skills to practice evidence-based dentistry.

It appears now that the conventional four-year North American dental program has neither the time nor the resources to teach everything. Some educators have suggested extending the length of dental education to accommodate all the necessary courses as “curricular decompression” became...
both a high priority and a simple solution to the demands of limited time and scarce resources.\textsuperscript{21} Currently, recommendations for curricular reform offer a change of process and overall focus by adopting problem-based and competency-based models in efforts to integrate both horizontally and vertically the knowledge and clinical experiences needed for professional competence.\textsuperscript{18,38,53}

**Promoting problem-solving skills.** The hypothetico-deductive model of clinical reasoning offered a theoretical basis for problem-solving in medicine,\textsuperscript{54} and during the 1970s, there was a shift of emphasis in medical education from teaching the ever-expanding source of biomedical knowledge to developing problem-solving skills.\textsuperscript{55,56} This happened concurrently with the concept of problem-based learning (PBL), which was introduced at McMaster University in 1969.\textsuperscript{57} Advocates of PBL adopted this model to guide students through the process of generating and testing hypotheses associated with a selection of real clinical problems that coincide with the instructional objectives of the curriculum.\textsuperscript{58,59} Nonetheless, despite boundless enthusiasm, the advocates are challenged constantly to characterize and construct high-quality clinical problems that reflect an evolving body of complicated didactic and clinical evidence—some that has been tested hypothetically but much more that is integral to clinical practice without the imprimatur of science.\textsuperscript{6,60,61}

About 5 percent of dental schools in North America have adopted PBL as their primary method of learning.\textsuperscript{21} Hendricson and Cohen\textsuperscript{18} believe that this lack of enthusiasm is due to the traditional surgical-restorative dominance in dental education. They suggest also that PBL has been inserted more as an add-on to an already overcrowded dental curriculum rather than an overriding educational approach and that there are widespread concerns about PBL as “faculty-intensive” without evidence of “effort-effectiveness.” Moreover, there remains much skepticism about the need for change from lectures to the PBL format of small-group seminars.\textsuperscript{62}

**Developing competencies and other curricular challenges.** Traditionally, the curricular design in dental education identified prerequisites for entry to the program, specific learning objectives, and outcome measures for graduation. The major assumption underlying this design is that students upon graduation can or will integrate the fragmented knowledge and skills acquired throughout the program.\textsuperscript{63} Alternatively, a top-down design analyzes the responsibilities and tasks of dentists and defines the competencies relative to the knowledge, skills, and values required to practice.\textsuperscript{64} This curricular design attempts to provide an environment for students to become competent and a readiness-based model of assessment to evaluate their competence. Theoretically, at least, students progress through the program regardless of time but according to individual abilities.\textsuperscript{18}

Dental educators have defined competencies and suggested assessment techniques to ensure the validity of their assessments.\textsuperscript{55-69} However, DePaola and Slavkin\textsuperscript{70} argue that the health professions have yet to develop a common language or core competencies for each discipline and that current dental curricula do not have appropriate evaluation components to assess the core competencies. A recent summary of dental education in Europe and the Americas identified a general framework for dental competencies showing much variation in format, detail, and expectations between jurisdictions examined.\textsuperscript{70} However, there appears to be a growing interest in dental competencies pertaining to decision making, critical thinking, professionalism, information management, and comprehensive patient care, although achievement of these competencies remains a challenge involving a complicated combination of knowledge, skills, and values.\textsuperscript{63,67}

**Community service-learning.** The report on dental education by the Institute of Medicine in 1995\textsuperscript{71} brought to the forefront the issue of poor access to dental care for particularly vulnerable populations. It was followed by numerous reports and programs (e.g., the Pipeline, Profession, and Practice: Community-Based Dental Education program\textsuperscript{71}) promoting community-based dental clinics for students to care for underserved populations.\textsuperscript{20,22,23,72,73} This change of context from university-based dental clinics to the community not only gives students more varied dental experiences, but seems to help reduce the overwhelming cost of dental education.\textsuperscript{74} However, the challenge of providing patient-centered care together with developing and assessing competencies poses yet another duality in curricular operations and challenges without ready solutions.

**Need for a New Conceptual Framework for Clinical Reasoning**

Dental education and practice have evolved over the last two centuries from a narrow focus on the biology of oral diseases to a broader awareness of the environmental and psychosocial determinants of oral
health and disease. This evolution has led recently to a substantial revision of curricular objectives in many dental schools and a renewed focus on the nature of clinical reasoning that is essential for competent health care practice. Clinical competence requires integrated networks of knowledge to identify and solve problems during clinical encounters with patients and a keen sensitivity to the social, cultural, and political environment of practice through competent communications, critical thinking, professionalism, information management, and ethics. However, we do not know when and how those skills are developed or integrated into practice.

Higgs and Loftus emphasize the need for models of clinical reasoning grounded in the practice of each health care discipline and specific to the type and scope of problems addressed by each discipline. There is no model or description of clinical reasoning to explain this complicated cognitive and interactive process used by dentists in dental practice. Consequently, current curricular models and assessment methods in dental education are incomplete.

We suggest that there is need now to broaden our perspective of clinical reasoning to include a keener and more dominant sensitivity to the environment of health care within which dentists encounter the oral health-related problems of individual patients and the communities in which they live. However, before this can happen, we need some essential ingredients that currently are missing: a conceptual framework for clinical reasoning in dentistry grounded on empirical evidence and reflective of the contextual determinants of oral health and diseases; a practical list of competencies required for clinical reasoning grounded on this conceptual framework; and educational strategies and assessment methods to address this broader view of clinical reasoning in dentistry. This overview aims to point dental education in that direction.

REFERENCES
