The Importance of Teaching Critical Thinking Early in Dental Education: Concept, Flow and History of the NYU 4-Year Curriculum or "Miracle on 24th Street: the EBD Version"

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INTRODUCTION: "REALITIES VS DREAMS IN THE LAND OF EBD"

As a foundation for the assigned topic, "The Importance of Teaching Critical Thinking Early in the Dental Education," and to ensure that the "official" (and rather broad) definition of evidence-based dentistry forms this foundation, I'd like to briefly address 3 fundamental considerations about evidence-based dentistry: what it is, what it cannot be, and how to use it wisely.

In order to ensure validity, as well as brevity, I will merely quote from "the tablet-maker himself," as written in a 1996 editorial by David Sackett and several of his colleagues in the *British Medical Journal*, entitled: "Evidence-based medicine: what it is and what it isn't."¹ First, Sackett et al open with a simple, clear statement: "It's about integrating individual clinical expertise and the best external evidence" (p. 71)¹ followed by this amplifying thought: "[e]vidence based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research" (p. 71).¹

After giving a concise history of the origins of evidencebased medicine, which they state extends "... back to mid-19th century Paris and earlier" $(p. 71)^1$... they point out that evidence-based medicine "... remains a hot topic for clinicians, public health practitioners, purchasers, planners, and the public" and that "[d]espite its ancient origins, evidence based medicine remains a relatively young discipline whose positive impacts are just beginning to be validated and it will continue to evolve. This evolution will be enhanced as several undergraduate, postgraduate, and continuing medical education programmes adopt and adapt it to their learners' needs" (p. 71).¹ And by that statement Sackett et al introduce and identify the need for professional educational schools to "adopt" evidence-based medicine, and to "adapt" their curricula to the meeting of their "learners' needs" on this vital approach to health care practice.

Sackett et all then provide insights into how to use evidence-based medicine wisely (and not naively) when they state that: "Good doctors use both individual clinical expertise and the best available external evidence, and neither alone is enough. Without clinical expertise, practice risks becoming tyrannised by evidence, for even excellent external evidence may be inapplicable to or inappropriate for an individual patient. Without current best evidence, practice risks becoming rapidly out of date, to the detriment of patients" (p. 71).¹ They then reinforce this central and critical concept of how to use "evidence-based medicine" wisely by clarifying that as: "[e]vidence based medicine ... requires a bottom up approach that integrates the best external evidence with individual clinical expertise and patients' choice, it cannot result in slavish, cookbook approaches to individual patient care. External clinical evidence can inform, but can never replace, individual clinical expertise, and it is this expertise that decides whether the external evidence applies to the individual patient at all and, if so, how it should be integrated into a clinical decision" (p. 72).¹

Finally, Sackett et al urge health practitioners to have that necessary measure of courage in clinical decision making, as required to provide best current care to their patients, as they observe that: "Evidence based medicine is not restricted to randomised trials and meta-analyses," rather that "... [i]t involves tracking down the best external evidence with which to answer our clinical questions... . And if no randomised trial has been carried out for our patient's predicament, we must follow the trail to the next best external evidence and work from there" (p. 72).¹ For the past 25 years I have been urging dental students to "to be guilt free" and to live with, and even be comfortable with, this reality ... that most (I typically use 85% as a specific number by way of illustrating my point) of what dentists and physicians do in their practices is not now, nor will it ever be, based on clear scientifically based evidence from randomized clinical trials. So sitting back and waiting for "that evidence is a clear dereliction of duty to ones' patients" and would result in the clinical training portion of dental school only occupying a

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brief month of training ... and medical school, perhaps, 2 months. And it will be ever so ... as we will never ... not in 20 years nor in 220 years ... have either the time, the required level of research funding, or the research manpower to provide this level of assurance in clinical fields that are themselves "shape-changers" with modified and even new clinical approaches overlapping continually with current practices that "we are trying to study in 'set and static" protocol-driven, randomized clinical trials.

The foregoing thus clearly establishes that evidence-based health care is "composed of many facets" and requires that the health care practitioner acquire of a rather broad array of skills ... and, in time, experience and judgment as well, in order to practice "evidence-based" health care. My specific charge is to address how dentistry ought to approach the teaching of one requisite skill in this arsenal of skills needed to properly practice evidence-based dentistry, namely critical thinking in the assessment of the professional literature. To accomplish this I will present our approach at the New York University (NYU) College of Dentistry, and via that model, suggest topics, sequences, and reinforcements that enhance dental education's appropriate goal to "adapt" their curricula to meet their "learner's needs" on this vital approach to health care practice. While the skill of critical thinking related to the assessment of the professional literature is clearly is just one of many skills needed to practice evidence-based dentistry, I would argue that it is one of the essential and fundamental skills needed by dentists in order to practice evidence-based dentistry ... and one that is "under-valued by the profession, at-large" as well as "under-taught in all dental schools."

In another, and more recent editorial in the *British Medical Journal* in 2004, it was noted that the evidence-based medicine literature "has grown exponentially form one Medline citation in 1992 to more than 13,000 in 2004" (p. 535)² and that as a result of this enormous interest in evidence-based medicine, the current debate has advanced from "whether to teach" the skills necessary for evidence-based medicine to today's topic of "how to teach it" (p. 535).²

THREE PRINCIPLES: TEACH IT EARLY AND LARGE, TEACH IT REPEATEDLY, TEACH IT AT THE RIGHT LEVEL

The 3 principles that will most likely contribute toward a successful outcome (ie, impact on our dental students who are the dentists of the future) are teach it early and large, teach it repeatedly, teach it "at the right level." For me this is merely "deja-vu, all over again" (thank you, Yogi Berra!). I think back to my very first teaching assignment 30 years ago in 1976 as a "new" Course Director at the University of Minnesota Dental School. The founder, and then Chair, of that Department of Health Ecology, Dr. Larry Meskin, had just taken stock of all the Department's one- or 2-credit courses in "community dentistry, social dentistry, dental

ecology" ... (call them what you will; their common denominator in the currency of dental students and practitioners, including clinical preceptors in the school's own dental clinics, was "I don't do it, nor do I need it in my practice, and it's only going to get in the way of you making money in the practice of dentistry"). The Chair had made the decision to take these 5-6 "low credit" and "not loved" courses that were scattered throughout the 4 years of the dental school curriculum, and condense them all into a megaton 7-credit course in the first year of dental school. The principles he used to make that decision were not based on rocket science, nor meta-analysis, but rather on good teacher-commonsense ... borne after decades of teaching in "the uphill battle." Teach it early and large: Early ... so the blush of intellectual curiosity from college days has not "completely disappeared" under the crushing pressures of the dental school educational experience; Large ... so it appears to-and does, in fact-have "currency value" ... as tallied by the number of credits assigned by faculty to this topic in the curriculum. That is Principle Number One as established long ago for "non-wet fingered" topics such as skills in critically assessing the professional literature in a dental school: teach it early and large.

Principle Number Two, teach it repeatedly, is based on my own experience with freshman French in college, and is reflected in—what has become—my personal, lifelong choice of an analogy whenever I want to make a point about the futility of 1-time courses in a curriculum for which there is no relevant reinforcement over the total educational pathway. I took freshman French, with little talent, less interest ... learned nothing of lasting value and moved on. So, Principle Number Two (ie, teach it repeatedly) evolved to avoid this "undesirable trio" of educational outcomes. So after you've taught it in the first year of dental school, teach it every year of dental school if you want the students to have some modicum of skills when they graduate.

Once the curriculum time over the 4 years of dental school has been carved out in keeping with Principle Number One and Principle Number Two, then be careful, be very careful, to follow Principle Number Three: teach it "at the right level." One of the most oft-committed teaching mistakes I have observed over my 30 years in dental education is the sad situation where an enthusiastic and well-intentioned teacher has either "not considered" or "not thought well enough about" the needs of a general dentist (for that is what we graduate!) within that teacher's realm of expertise ... especially in our "non-wet fingered" areas of the curriculum. Often denied access to "true graduate students in our field" ... we unload "what we need to teach" upon "future general dentists" at a level often more appropriate for field-specific doctoral graduate students ... than at the "right level needed by" a future general dentist. One safeguard is to gain access to graduate students in one's own scientific discipline (and "unload" there) ... the other is to deeply, carefully, and continually access what a general dentist "really needs to know" to be a fine general dental practitioner ... and teach it

at the right level." Example: do general dentists really need to have skills in manipulating data within statistics tests (which I often refer to as "statistical equivalent of the Krebs Cycle memorization Hell Week" event) ... or are they better served by understanding what statistical tests do, the concept underlying α and β errors, the meaning of a *P* value or confidence intervals to a reader ... as they apply their decision making on behalf of their patients after reading an article?

To achieve Principle Number Three, it might be best to focus on students learning, and retaining knowledge of, a selected subset of major research design and methodologic elements "truly fundamental" to thoughtful reading and critical assessment of the professional literature. My list for these essential core concepts is presented in Table 1 and includes 9 basic take-home skills that dental students are expected to grasp conceptually and have available for "critical thinking" when reading the professional literature.

So, there are the three Principles. Two are about "process, including course time and sequencing" and one is about "content." Teach it early and large, teach it repeatedly, and teach it "at the right level": easy to grasp; tough to remember to apply and stick with; and often difficult to gain the cooperation school-wide to implement. What follows is the description of our current 4-year curriculum at NYU on critical thinking Skills for Assessing the Professional Literature, known internally at NYU as the SAPL courses.

HISTORY OF THE NYU 4-YEAR CURRICULUM MODEL FOR BUILDING CRITICAL-THINKING SKILLS

The origins of the core instrument, the Literature Analysis Form (LAF), that forms the basis for NYU's Skills in Assessing the Professional Literature (SAPL) curriculum preceded the terminology of "evidence-based dentistry," as the LAF began to take shape in 1974, and was first developed by the author and used in specialty residency training literature review courses offered at the US Army Institute of Dental Research at the Walter Reed Army Medical Center in Washington, DC. This basic literature analysis instrument, the LAF, has been in continuous use—and routine refinement—in a variety of courses offered in schools of dentistry, public health, medicine, and even high schools over the past 30 years. Over these past 3 decades, the LAF has been used up until 4 years ago in courses ranging from full semester courses for predoctoral and graduate classes ranging in size from 8 to 18 students to single-day continuing education courses for groups of 15 to 20 biomedical librarians as well as for dentists.

Given the "presence and availability" of the core instrument, the LAF, it took the confluence of a "trinity of favorable circumstances" (not unlike "a miracle") for the current SAPL curriculum to become a reality at NYU. First, a new and visionary dean (Michael Alfano) assumed his post as dean of the NYU College of Dentistry in 1998 and shortly thereafter charged the faculty of the college to "completely rethink, and if necessary, reconstruct ... not tweak ..." the predoctoral curriculum to improve the dental educational experience at NYU. Second, this "charge from the dean" was reacted to by the then associate dean for academic affairs at NYU, Dr. Fred More, who both "took the dean at his word" and happened to be one of the most insightful and innovative curriculum experts in the United States. At NYU we currently "play ball" within the ballpark designed by Dr. Fred More, which was only slightly modified as it passed through the "input of all faculty" via committees and subcommittees as well as individual suggestions. Third, as these latter steps of "review and revision" of the newly proposed curriculum were occurring, a new post was created at NYU (the executive associate dean position) and occupied by yet another deeply committed, high-energy educational reformer, Dr. Rich Vogel, who was then essential to ensuring that this new (and completely revised) curriculum "rolled in" sequentially year-by-year, while the classes under the old curriculum were "rolled out".

I mention these above details as to the "trinity of favorable circumstances" and specific people, to explain "the miracle on 24th Street" (N.B., the NYU College of Dentistry is on E. 24th Street in New York City) with full recognition that those of us who then developed the "specific content" within the "curriculum space" provided for a new (in 2000) Department

 Table I. Teaching it "at the right level": the Big 9 basic take-home skills for dental students from the SAPL curriculum

- 1. Ability to use the Basic Research Paradigm for stretching out the fabric of a research study
- 2. Ability to clearly state the research question, ie, write (the usually implied) Null Hypothesis
- 3. Understand what statistics does for a reader (vs ability to directly manipulate data)
- 4. Understand the concepts of α error and β error, and their rational use to provide scientific "cut-off" points
- 5. Understand the reasons scientists aim at "isolation of the independent variable"
- 6. Know and understand the design techniques epidemiologists and other clinical investigators use to achieve "isolation of the independent variable"
- 7. Understand what "causation" means in epidemiologic studies, including RCTs
- 8. Ability to categorize the study design into a specific type of epidemiologic study with its own inherent potential for making a statement of causation ... so the reader can apply "brakes on the brain" on how far an author is entitled to go toward claiming causation based solely on study design used (vs "how well they carried out that study design")
- 9. Ability to make "a decision on utility" of the findings, ie, how findings get transplanted into patient care

of Epidemiology and Health Promotion, were in fact handed a "miraculous gift and opportunity" that we are still working to fulfill completely. Thus "time and space in the curriculum," which will be the "first major hurdle" faced by most, if not all schools, in considering how to capitalize on, or perhaps adapt aspects of, this NYU model for teaching SAPL skills within the broader topic of evidence-based dentistry, was in fact "gifted to our Department by this 'trinity of favorable circumstance." Truly I would like to offer more rational insights based on our experience that would be of true utility to other faculties seeking this same goal, better advice than "pray for a miracle." But in truth, it never gets beyond "the people" and "the timing" ... and each school will have to find "its key players" and "its key moment."

DESCRIPTION OF THE NYU 4-YEAR CURRICULUM MODEL FOR BUILDING CRITICAL THINKING SKILLS

The Critical Thinking curriculum in the predoctoral dental curriculum at the NYU College of Dentistry has 3 goals: (1) to provide a foundation of knowledge in epidemiology and epidemiologic methods; (2) to provide a rich and utilitarian set of "professional literature analysis skills"; and (3) to provide a grasp of the context for use of these critical-thinking skills within the challenges of providing "best patient care" in their future dental practices.

The first 2 goals are largely addressed via a series of courses over the first year of the predoctoral curriculum at NYU, including a Competency Examination for Skills in Assessing the Professional Literature (SAPL), which occurs at the end of the first year. The third goal—and arguably—most difficult goal to achieve, requires that it be addressed by repeated, overt emphasis and use over the 4 years of dental school ... in clinical settings routinely, as well as "skill reinforcement" sessions in didactic courses in the third and

fourth years of dental school. It requires that there be a school-wide adoption of the educational philosophic stand (or, put more loftily: the "aspirational educational philosophic stand") that "best patient care" absolutely requires a patient-by-patient application of these critical thinking skills to the usual duo of memorized knowledge and acquired surgical skills, the duo that usually comprise the underpinnings of clinical care. Additionally, and importantly, students are repeatedly reminded to be aware of the subtleties inherent within phrase, "realities vs dreams in the land of EBD," as they are urged by faculty to go forth to routinely apply critical-thinking skills within their dental practices with full realization that not all "best evidence" will be supported by RCTs or meta-analysis summaries.

The NYU 4-Year Curriculum Model for Building Critical Thinking Skills includes a series of 6 focal courses over the 4 years of the predoctoral curriculum, with reinforcement in complementary clinical cases conferences and seminars and is outlined in Table 2. (Three of the "offerings" over the 4 years are true independent courses in the curriculum in the first year, while the other 3 SAPL "courses" are integrated components within other clinical didactic courses in the second, third, and fourth years of the curriculum.) The 3 foundation courses occur in the first year, and occupy a total of 72 hours of class time. The first-year courses are Application of Technology in Health and Health Practice (12 hours), Epidemiology & Critical Thinking in the Practice of Dentistry (40 hours), and Skills in Assessing the Professional Literature (20 hours). At the end of the first year, the students demonstrate a competency in Critical Thinking by individually taking a 4-hour SAPL Competency Examination in which they read and analyze a published scientific article using an examination version of the Literature Analysis Form (LAF). The primary instrument used to develop literature analysis skills in the NYU 4-year Model for Critical Thinking skills, the LAF, has been in continuous use-with periodic

Table 2. The NYU 4-year model: overview

- The Foundation Core: 1st Year Course: 3 Core Courses = 72 hours
- (1) Information Technology Course: (12-hour component in course) which focuses on skills in searching the professional literature
- (2) Epidemiology & Critical Thinking Course in the Practice of Dentistry (40 hours in fall semester)
- 20 hours on basic epidemiology
- 20 hours on application of epidemiology knowledge to SAPL skills
- (3) Skills in Assessing the Professional Literature (SAPL) Course (20 hours in spring semester)
- 8 two-hour SAPL skills seminars (en masse with 240 students) on 1 article per seminar
- 4-hour in-class SAPL Competency Examination (assessing 1 article using LAF)
- Reinforcement and Refinement: (6 hours per year)*
- 2nd year: SAPL II Sessions, plus Case Conferences
- 3rd year: SAPL III Sessions, plus Case Conferences
- 4th year: SAPL IV Sessions, plus Case Conferences
- SAPL Skills Competency Certification: 4-hour, full-article examination at end of 1st year

SAPL Skills Competency Recertification: 6 quizzes annually in 2nd to 4th year, with 4-hour, full-article examination if student fails to br recertified via the quizzes

refinement—in a variety of courses offered by the author in schools of dentistry, public health, medicine, and even high schools over the past 30 years.

Following the 12 hours in the Application of Technology in Health and Health Practice course's focus on skills for online searching for articles (eg, Medline searches), the first 20 hours of the 40-hour course Epidemiology and Critical Thinking in the Practice of Dentistry provide a basic course in epidemiology in the fall semester (see Table 3). The first half of this course is devoted to teaching the fundamentals of epidemiology, which includes 14 hours on basic epidemiology and 4 hours on the current epidemiologic state-of-the-art knowledge about 4 topics: dental caries, periodontal disease, oral cancer, and aging. The second half of this course totally focuses on teaching the students how to apply this epidemiologic knowledge toward critical reading and interpretation of the professional literature via a series of 10 two-hour lectures and discussions of homework exercises with all homework assignments discussed fully, and at length, in a seminar "of the whole" (ie, all 240 first-year dental students) in a step-wise fashion to build the specific skills needed to address each item on the LAF. This course has a 1-hour midterm exam and a 1-hour final exam, both given in the multiple-choice format.

In the spring semester, the 20-hour Skills in Assessing the Professional Literature (SAPL I) course is given in 16 two-hour sessions followed by a 4-hour final competency exam (see Table 4). The first 2 hours of this course provide a "review and refresher" of the LAF skills built in the previous course (about a 4-month gap since that first course). The next 6 sessions in this SAPL course consist of 6 two-hour sessions in which one article from the professional epidemiologic literature has been assigned and read by all students (dissemination via the College's intranet Web site), and prior to class the students each, individually, complete an LAF form (blank LAF forms also provided on the College's intranet Web site). Each of these 6 class sessions provides opportunity for students to "rehearse" for the competency exam (comparable to the Formative Competency Exams given in the clinical setting for Clinical Competencies in preparation for the endpoint, the Evaluative Competency Exam). These sessions again are run as "seminars of the whole" with all having read the same article and all having completed their own LAF; class sessions consist of simply "marching through" the LAF item-by-item, beginning with the Title of the Article section followed by each item within the Introduction, Materials and Methods, Results, Discussion, Conclusions, and Utility sections of the LAF (see Tables 5 to 9).

The final examination for the SAPL course, which serves as the Competency Exam for SAPL skills, uses questions from the LAF with only 2 minor modifications. First, the actual item on the LAF form is re-worded to be, in fact, a "question" and the Yes/No choice for that question is converted to a "discuss and defend" comment area for that question on the examination version of the LAF. (The LAF **Table 3.** Syllabus topics for Epidemiology & Critical Thinking in the Practice of Dentistry Course a 40-hour, 1st year course

I. Fundamentals of Epidemiology (14 hrs)

- Introduction to Epidemiology/Descriptive Epidemiology (2 hrs)
- Descriptive Epidemiology Studies (1 hr)
- Case-Control Studies (2 hrs)
- Cohort Studies (2 hrs)
- Experimental/Intervention Studies (2 hrs)
- Bias, Confounding & Effect Modification (2 hrs)
- Statistical Concepts and Basic Statistics: The Role of Chance (1 hr)

Screening and Diagnostic Uses of Epidemiology (1 hr)

- Review of Epidemiological Concepts (1 hr)
- II. Current Epidemiologic State of Knowledge for Specific Oral Diseases (4 hr)
- Aging: Epidemiology, Demographics, and Health
- Epidemiology of Periodontal Disease
- Epidemiology of Tooth Loss and Dental Caries
- Epidemiology of Oral and Pharyngeal Cancer
- III. Application of Epidemiology to Critical Thinking in Assessing the Professional Literature (20 hrs)
- Skills in Assessing the Professional Literature, Part 1 (2 hrs)
- Skills in Assessing the Professional Literature, Part 2 (2 hrs)
- Skills in Assessing the Professional Literature, Part 3 (2 hrs)
- Skills in Assessing the Professional Literature, Part 4 (2 hrs)
- Skills in Assessing the Professional Literature, Part 5 (2 hrs)
- Skills in Assessing the Professional Literature, Part 6 (2 hrs)
- Skills in Assessing the Professional Literature, Part 7 (2 hrs)
- Skills in Assessing the Professional Literature, Part 8 (2 hrs)
- Skills in Assessing the Professional Literature, Part 9 (2 hrs)
- Skills in Assessing the Professional Literature, Part 10 (2 hrs)
- IV. Examinations:
 - Mid-term exam, before SAPL sessions (1-hr exam) Final Exam (1-hr exam)

format was designed to stimulate class discussion, so the Yes/No choices with appropriate follow-up questions work well in the class "seminar-of-the-whole" setting.) Second, as some items on the LAF do not lend themselves to "testing and grading," these items are omitted from the examination version of the LAF, eg, the LAF item on "Satisfies reader regarding the Literature Review?" is omitted on the **Table 4.** The Skills in Assessing the Professional Literature course: syllabus outline and typical session day. Sheet from syllabus, the third EBD skills course in the 1st year predoctoral curriculum (20 hrs)

Syllabus Outline:

Session #1: Introduction to Course: Course Logistics and Review of Basic Skills for the Literature Analysis Form (2 hrs)

Session #2: Analysis of Assigned Reading #1 (2 hrs)

Session #3: Analysis of Assigned Reading #2 (2 hrs)

Session #4: Analysis of Assigned Reading #3 (2 hrs)

Session #5: Analysis of Assigned Reading #4 (2 hrs)

Session #6: Analysis of Assigned Reading #5 (2 hrs)

Session #7: Analysis of Assigned Reading #6: Key features only and Introduction to *Journal of Evidence-based Dentistry* (2 hrs) Session #8: Discussion of readings from *Journal of Evidence-based Dentistry* (2 hrs)

FINAL COMPETENCY EXAMINATION:

Using the Literature Analysis Form (4 hrs)

Typical Session Day Sheet in SAPL Syllabus:

Title: Using the Literature Analysis Form (LAF):

Sessions: # 1-7: Discussion of Assigned Readings #1-7

Purpose:

Based upon information in this session, dental students will be able to:

1. identify the key elements of the research design on the LAF

- 2. discuss (and defend) their answers to questions on the LAF
- 3. demonstrate an understanding of the strengths and limitations of epidemiologic research methods by placing the findings of this article into proper scientific perspective by defending their agreeing or disagreeing with the author's conclusions 4. demonstrate an understanding of the implications of the findings for the practice of dentistry
- 5. state whether and how the findings of a given study would/could be incorporated into their dental practice on behalf of their patients

Class Activity: Discussion of Assigned Readings #1-7

Reading Assignments for Sessions #1-7:

For each of the following 6 sessions, a published article from the dental literature will be assigned, and you will complete an LAF on each week's article prior to the next class session and be prepared to discuss that article based on your completed LAF

examination version of the LAF. If a student fails the SAPL Final Competency Exam (usually completed by the end of April), they are permitted to retake this required competency exam after a brief remedial course offered in June, when all first-year F grades can be remediated. If a student fails this retake of the SAPL Competency Exam, the student is dismissed from the College, as would be with any other course or competency examination in our curriculum.

As NYU has a major commitment to creating professional opportunities for dentists from around the world who immigrate to the United States, the NYU College of Dentistry offers a 3-year Advanced Placement curriculum for foreign-trained dentists seeking a US dental degree. Approximately 110 APS (Advanced Placement Students) are accepted each year, and they attend a 5-week "review and orientation" from late-July through the end of August before they join the rising second-year student class. This "review and orientation" course provides a review of much of the first-year curriculum, as well as original teaching for topics they likely did not have in their prior dental education. It is required that the APS students take and pass the SAPL Competency Examination after taking the Epidemiology & Critical Thinking and SAPL components of this 5-week course.

These first-year SAPL skills are taught using several underlying pedagogical principles. First, the teaching of SAPL is approached as "a skill to be mastered" as surely as operative dentistry does with the teaching of amalgam restorations. Second, this model of teaching of SAPL skills follows the "didactic, pre-clinical, and clinical" stepwise progression from the first half the of the Epidemiology & Critical Thinking course's didactic lecture, through the practice sessions in the second half of this course on use of the LAF, culminating in the direct application to "live literature" in the SAPL course. Third, the first-year SAPL skills curriculum obsesses on teaching, not testing (ie, the only testing of SAPL skills in the first-year curriculum prior to the SAPL Competency Exam is limited to a few isolated questions on the final examination of the Epidemiology & Critical Thinking course). Fourth, this model of teaching of SAPL skills, after the first year, is fully integrated into a wide variety of clinical didactic courses in the remaining 3 years of the

Table 5. The cover page for the Literature AnalysisForm (LAF)				
LITERATURE ANALYSIS FORM by R.V. Katz ARTICLE TITLE:				
AUTHOR(S):				
JOURNAL REFERENCE:				
REVIEWER:				

curriculum ... with a future goal of getting it integrated onto the "clinic floor," ie, integral to patient care in years 3 and 4.

To date, approximately 1400 dental students at NYU have taken the competency examination, as this new curriculum including the courses that support critical thinking skills was first implemented for the 2001–02 academic year, and thus has been taught for 4 full years (ie, $\sim 1400 = 240$ four-year students + 120 three-year APS students per academic year). The results to date have been encouraging, despite the fact that this curriculum is new, that this is the first time the author ever used the LAF for the teaching of SAPL skills in a predoctoral curriculum, and that this is the first time it has been taught in a "seminar-of-the-whole" to an entire dental school class (of 240, no less). The usual failure rate for the first-year dental students has consistently been about 2% to 3% (some 6 to 7 students annually per class of 240) and about double that rate (ie, 4% to 6%) for the APS students as they get a "shortened course given in their second language." As for the remediation pathway outcomes, only one student (of the approximately 1400 who have taken the SAPL competency exam) has failed to earn a passing grade in the SAPL Competency, and that student was dismissed from the College. A final optimistic note for SAPL lovers, an extracurricular "Spaghetti and Science Society" has convened monthly in a private room in an Italian restaurant in Greenwich Village for a plate of pasta, a glass of wine, and an LAF discussion of an assigned reading for the past 3 years. Routinely, 8 to 10 students—presumably those who cannot get enough of this SAPL stuff—sign up and attend this "above and beyond" monthly event.

During each of the remaining 3 years of the predoctoral dental curriculum, the students must recertify their SAPL competency skills by attending 6 one-hour SAPL sessions (review "seminars-of-the-whole," tucked into courses offered by various clinical departments, which are led by an epidemiologist and focused on discussion of a single published scientific article for which each student has completed an LAF) and by passing 4 of the 6 quizzes (one given at each session) each year. Should a student not recertify SAPL skills by passing 4 quizzes in that academic year, the student must retake and pass the 4-hour SAPL competency examination at the end of that academic year in order to proceed to the next academic year. Given that SAPL skills constitute 1 of the 32 competencies that NYU graduates will possess as stated in our ADA Accreditation Document, failure either to initially certify in the first year, or to recertify in each of the following 3 years results in dismissal from the College. Additionally, EBD skills are routinely reinforced via

Table 6. The Title and Introduction sections of the Literature Analysis Form (LAF)					
I. TITLE: Informative Comments	Merely appropriate	Misleading			
II. INTRODUCTION: 1. Presents logical and solid rationale 2. Satisfies reader regarding Literature Review 3. Null Hypothesis (Ho) is explicitly stated. a. If NO, state the implied Null Hypothesis:	YES	NO 			
 4. States purpose (goal) of research a. Clearly specifies dependent variable(s) in stated goal b. Clearly specifies independent variable(s) in stated goal 5. Given the rationale for the study, the outcome of greatest interest is to reject Ho 6. Therefore, the type of error that must primarily be guarded against is: 		6. error			
Comments:	<u> </u>				

Table 7. The Materials and Methods Section of the Literature Analysis Form (LAF)					
A. Raw Study Design Evaluation (Structural, Universal)		YES	NO	
1. Is the population under study adequately specified?					
2. Was the population selection method specified and p	roper?				
3. Did control groups actually "control" important vari	ables?				
Identify the control group(s)					
4. Are all materials thoroughly described?			·		
5. Are time elements of the study clearly specified?					
6. Does the study design isolate the independent variab	le(s)?				
a. State the independent variable(s)					
7. Was the measurement of the independent variable re	producible?				
8. Is the measurement of the dependent variable a valid	measurement?				
State the dependent variable(s)					
9. Was the measurement of the dependent variable repr	roducible?				
10. Could you replicate this study from the data in this	section?				
11. Classify the study as either:		A 1		1	
Lab Study		Analy	tical Epi Exp	erimental Epi	
	Cross-sectional I	Kando	mized Clinical	Trial (RCT)	
Case History	Case Control		Out an error	- (-1::-1 (:-1	
Descriptive Eni	Retrospective Conort	_	Other type	of cliffical trial	
Descriptive Epi	Prospective Conort				
B. Professional Study Design Evaluation			YES	NO	
1. Are the dependent and independent variables of prof	essional interest?				
2. Did the chosen measurements for the dependent variable lend themselves to clinical interpretation?		nical			
3. Did the chosen measurements for the independent variable lend themselves to clinical					
interpretation?					
4. Would you want to replicate this study? (i.e., does th	e research question seem impor	rtant			
to you?)					
Comments:					

discussions within case conference seminars offered by several clinical departments in each of the last 3 years of the curriculum. To date, all students in the second, third, and fourth curriculum years, within every academic year since this curriculum was implemented in the fall of 2001, have "recertified" their SAPL competency in the SAPL II, SAPL III, and SAPL IV "courses" via the quizzes, ie, no one has had to recertify "the hard way" by a retaking of the 4-hour SAPL competency examination.

Despite this fine, and relatively rich, beginning at NYU as regards SAPL skills within an evidence-based dentistry approach to dental practice, there is plenty "to do" yet, and—at least—one major hurdle that we have not cleared yet. As any seasoned dental educator knows, if it's not validated "on the clinic floor" during clinical sessions in the third and fourth years of the dental curriculum, SAPL skills and the EBD concept will surely "die a death as ignominious" as does so much of the basic science teachings,

pharmacological intervention. After 4 years, with our current SAPL curriculum footings solid as regards the first 2 years of the curriculum, including didactic reinforcement in didactic courses in years 3 and 4, we are just now turning our educational focus on addressing this critical "validation" step. If we find a way to achieve this most difficult-but essential-of steps, we will have "a complete teaching model" and one that holds the promise to alter the nature of dental practice and thereby raise the quality of dental care for future dental patients. Alternatively, one can predict with even more certainty that the failure to achieve this full integration into the clinical activities/years of dental school, will relegate this "fine SAPL skill within an EBD approach" to the tragic category of "yet another sound idea bites the dust." Hence, in reaility, if we seek a "real dental world impact," the accomplishment to date at NYU can be no more than the first step of a "2-step" dance, one that will now

teachings so very relevant to disease management, including

Table 8. The Results and Discussion sections of the Literature Analysis Form (LAF)				
IV. RESULTS: 1. Are tables and graphs properly presented?		Yes	No	
2. The level of measurement was (specify for each	variable):	100	110	
(-)	Nominal			
	Ordinal	_		
	Interval-Ratio			
3. Type of analysis performed:	Descriptive			
	Percentage			
	Test for Difference between Me	ans		
	Correlation			
	Other If so, specify	_		
4. Were the statistical tests used appropriate	Yes No		None Used	
for the level of measurement?				
5. Overall, was the analysis performed sufficient				
to answer the objectives of the study?				
	Yes	S	No	
V DISCUSSION		VEC	NO	
V. DISCUSSION:	no now once wood	<u>IES</u>	NU	
1. Are tables and graphs property presented?	no new ones used			
2. Is the discussion limited to data presented in th	e Results section?			
3. Does the discussion proceed logically based on	the data presented?			
4. Does the author claim:	association relationship o	nly		
	no relationship			
	other type of relationship)		
	if so, specify:			
5. The claim is justified by:	the data analysis			
	the research method			
	both			
Commenter	neither			

require "clinical integration" of these SAPL skills within an EBD approach to the practice of dentistry.

CONCLUSION

The NYU 4-year curriculum model for building critical thinking skills was implemented 4 years ago in the fall of 2001. This track of our curriculum focuses on teaching basic epidemiologic knowledge and understanding, which is then directly applied to building skills in the assessment of the professional literature (SAPL skills) via a stepwise series of first-year courses that emulate the "didactic, preclinical, and clinical" sequence used so successfully in other parts of the traditional dental curriculum. This series of courses culminates in the taking of the first of NYU College of Dentistry's 32 competencies, the SAPL competency, at the end of the first year. Once "SAPL competency" is demonstrated by the students, they get reinforcement "quasi-courses" embedded within other didactic courses on specific clinical subjects in

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each of the remaining 3 curriculum years, with "recertification" of their SAPL competency required annually using a Continuing Education model with quizzes. To date, with approximately 1400 predoctoral students having taken this curriculum, students appear to acquire the requisite skills at a high success rate, with only a single student having been dismissed from the College for having failed both the SAPL competency and its remediation examination.

In conclusion, the experience at NYU suggests that this material can be successfully integrated into the dental school curriculum with a minimum number of hours required (72 hours in year 1, and 6 hours in each successive year = 90 hours total, which includes the basic course in epidemiology). Given that the typical dental 4-year curriculum will contain a minimum of 4000 hours, this "rich and full SAPL skills curriculum" at NYU occupies but 2% of the total curriculum time (and only 7% of the first-year curriculum time where the bulk of it is taught) in order to put this critical lifetime,

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Table 9. The Conclusions and Utility sections of the Literature Analysis Form (LAF)				
VI. CONCLUSIONS	YES	NO		
1. Is the original research objective directly answered?				
2. Is it brief and to the point?				
3. Are further possibilities for related and follow-up				
projects offered?				
4. Are the conclusions solidly based on the data from the				
Results and Discussion sections?				
5. Are the conclusions justified by the research design?				
6. Do the author(s) avoid generalizing beyond the				
limitations of the study?				
Comments:		-		
VII. UTILITY of this article and its findings for your dental practice.				
1. State whether you would incorporate findings of this article into your dental practice.				
yes yes, but	no	no, but		
2. Briefly state your reasons.				
3. If you answered "yes" or "yes, but" in #1 above, briefly state how you would incorporate these findings into your				
practice.				

self-learning skill into future dentists. This SAPL skill is, in fact, "the" foundation skill that supports all that should follow in the creation of a curriculum that teaches an evidence-based dentistry approach to dental practice.

Clearly, "unknowns" abound related to this beginning effort at NYU: Will our NYU dental graduates retain these SAPL skills 1, 2, and more years after they graduate? Will our NYU dental graduates ever look to apply these SAPL skills, even if they are retained? Will our NYU dental graduates annually read more articles ... more knowingly ... given they have these SAPL skills? ... and will that continue ... for how many years into practice? Will our NYU dental graduates "practice better dentistry" because of the use of these SAPL skills? ... just to name the first batch of "research-able" questions that will need to be answered to ultimately determine the "long-term outcome" and thus the "external value" placed on this newly introduced component in our dental curriculum.

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