Model Approach for Incorporating Informatics in Optometric Curriculum

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Abstract

The digital revolution is transforming the profession of optometry. Increasingly, optometric information is being recorded, stored and analyzed using computerized tools. This concept paper discusses the integration of informatics into clinical optometry training and, specifically, a framework for an optometric informatics curriculum. Within this framework, the objectives, course sections and a model curriculum are described. Optometry informatics curriculum aims to equip students with the knowledge and tools they will need in their future role as decision-makers to use, design, implement, maintain or evaluate an optometric informatics application.

Key Words: *education, informatics, optometry*

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Introduction

Rapid innovation in information technology is having a significant impact on the profession of optometry. Innovations include technologies such as high-capacity digital networks, powerful computer hardware and software, high-resolution digital image compression, the Internet, very high data speeds and the capability for faster and lossless image transmission.[1] By embracing these innovations in ways such as tying in digital devices to the electronic medical record, optometric practices and clinics may improve workflow, maximize electronic medical record use, and enhance patient experiences and satisfaction.[1] Despite some attention to the advances relevant to the practice of optometry in the past decade, many optometric educators are still not fully embracing these advances in the informatics field and their growing importance to optometric practice or the delivery of optometric curriculum.[2-4] Optometric education is a relative latecomer to the field of medical informatics.[5] Nevertheless, some optometry schools have increased the use of informatics in their programs, but only in their clinical facilities.[2-6] Although computing skills have increased among optometry students,[2] and prospective students may enter optometry school better prepared to use the technology,[3] there is still a need for improvement in preparing optometry students for the technology challenges they will encounter as future practitioners.[3] After graduation, information technology and computing resources can play a major role in their optometric practice.[4]

Optometric informatics may be defined as the use of electronic communication and information technologies to provide and support a diverse group of activities related to eye health and vision care for the practitioner. This definition of optometric informatics could even be expanded to include the myriad technologies used in educating the optometric physicians of tomorrow. The American Medical Informatics Association (AMIA) defines medical informatics more broadly, "Biomedical and health informatics has to do with all aspects of understanding and promoting the effective organization, analysis,

management, and use of information in health care."[7] Optometric informatics covers many activities, including diagnosis, treatment, prevention, patient education, practice management, research, community outreach and even optometric education of future practitioners. If implemented and used optimally, it will change the delivery and efficiency of eye health and vision care curricula and better prepare future optometric physicians. The Association of Schools and Colleges of Optometry (ASCO) formally recognized the importance of informatics to optometric education by supporting formation of the ASCO Optometric Informatics Special Interest Group (SIG) in December of 2000.[8] Now known as the Educational Technology SIG, one of its most important activities has been the development of guidelines (June 2007) for the use of information technology by ASCO's member schools and colleges of optometry.[9] Unfortunately, a review of many of the current programs' curricula finds optimal application of these guidelines lacking.

Jenna Hildebrand et al. (2007) suggest, contrary to popular belief, that optometry students may not be as "computer-savy" as many educators expect them to be.[10] Interviewees, after experiencing their clinical externships, expressed a general interest for more exposure and training in information technology within the optometric curriculum.[10]

In the following section, integration of informatics into an optometry program is discussed, and a framework for the design of an optometric informatics curriculum is presented. The aim is to discuss concepts and topics that would be essential for integration into an optometry program and to present an approach currently being utilized at the Southern College of Optometry (SCO) in Memphis, Tenn.

Objectives

An optometry informatics curriculum should be designed to develop intelligent consumers, managers and researchers of optometric informatics through guided exploration into the components of information systems. The courses should involve the practical application of optometry informatics. Specifically, the courses should address the following:

- Overview of the field of optometric informatics
- The role of optometric informatics in practical applications of information systems in eye health and vision care
- Fundamental concepts of information systems in the optometric setting
- Current trends in health care and telecommunication technology that affect the design and evolution of optometric informatics applications
- The use of optometric informatics in the assessment of a community's eye health and vision care needs.

Upon successful completion of this curriculum, students should be able to:

- Determine the need for optometric informatics applications in practice
- Utilize the role of informatics in optometric care process re-engineering
- Describe the data and information security needs of optometric care processes
- Implement an evaluation framework for optometric informatics applications
- Utilize current technology in the diagnosis, treatment and management of eye health and vision care disorders.

Curriculum Framework

The proposed model curriculum described below is adapted from one currently in use at SCO. For several years now, the administration, faculty and staff have incorporated new approaches to didactic, laboratory and clinical instruction to fully utilize optometric informatics. From technology in the classroom and laboratory to focused instruction in clinical (CLN) courses, every attempt is being made to assist the Millennial learners' acceptance and assimilation of material and technology.

The process of conversion to this new delivery system has been rather smooth yet not without challenges. Faculty members with 15 or more years of experience in academic optometry have had to rethink their delivery methods and find ways of incorporating technology and engaging students for the most effective outcomes. In the clinical setting, attending optometric physicians have been challenged to interact with interns and residents with technology and in ways other than the traditionally accepted Socratic Method of engagement. The students and residents have responded positively to SCO's attempts at making material accessible utilizing technology.

The following sections outline the ideal components of an optometric informatics curriculum.

Definitions/glossary

Students should be introduced to formal definitions of health informatics and optometric informatics. Because of the continuous advancements in telecommunications, application areas for informatics are evolving, and new terms arise. Frequently, one term is used to describe different tasks. It is important for students to be equipped with a definitions list, which should include the items of the "Informatics Guidelines for Schools and Colleges of Optometry" proposed by ASCO[11] and be expanded to incorporate specific terms that are currently used in optometric informatics. In addition, students should be introduced to the wealth of resources related to informatics, such as the major journals of the field, sites of national and international associations and online databases.

Evolution of the field

Interest in optometric informatics seems to have increased in the past few years due to recent advances of telecommunication technology.[12] An introduction to the history and evolution of optometric informatics will help students understand the diffusion and development of this innovation and its growing use in optometric practice.

Technical background

Optometry students are traditionally being introduced to data transfer and communication within other undergraduate or graduate courses related to computer science. However, a brief review of information technologies and protocols that are being utilized for informatics applications is a necessary

component of an optometry informatics course. This section is *not* designed to provide expertise in the technical aspects of informatics but rather to familiarize optometry students with the terminology and different types of technologies and networks, their features, limitations and costs. Students' awareness of clinical and practice management technology limitations, including costs, facilitates the understanding of informatics evaluation studies.

Informatics' Impact on Optometry

Cost of care

One of the learning objectives of this section should be to make clear that the measurement of potential cost savings associated with informatics application depends on the interest group (e.g., optometrist, patient, health maintenance organization, society).[13]

Quality of care

Informatics assists in the measurement of the quality of care provided either on a biomedical/bioengineering basis (clinical performance, clinical efficacy, efficiency, safety) or a health services basis (appropriateness of the treatment chosen, policy adapted to improve health status).[14,15]

Access to care

Access to health services reflects the "fit between healthcare resources (including hospitals, clinics, optometry offices) and the healthcare needs of the people they serve."[14] Students should discuss the three primary types of barriers to access[16] in relation to informatics — structural, financial and personal/cultural — and the ways informatics can eliminate those and possibly introduce new ones because of the technology use.

Success and failure factors

Students should study literature that shows the success or failure of informatics interventions and identify common patterns that could be listed as success predictors or lessons learned from past applications.[16,17]

Legal and ethical issues

A series of legal and ethical issues associated with the utilization of informatics should be introduced to students. These issues should include licensure, accreditation, privacy of medical data, malpractice liability and reimbursement to name a few. For example, interstate practice of optometric consultations using optometry informatics or telemedicine raises licensure questions, such as whether optometrists can be practicing telemedicine in a remote state in which they do not have a practicing license. The Health Insurance Portability and Accountability Act of 1996 (HIPAA)[18] and the Family Educational Rights and Privacy Act of 1974 (FERPA)[19] are two examples of federal legislation to protect the personal information of all individuals to whom clinical or academic services are provided. Other federal and state legislation extends similar protection to sensitive information. It also includes protection from the inadvertent destruction or corruption of information due to failures of hardware or software, losses of information due to carelessness, ignorance, accident on the part of authorized users, and those resulting from natural disasters such as fire, flood, earthquake and unexpected surges or loss of electrical power.[11]

Security essentials

It is essential that optometry students understand the importance of information confidentiality, integrity and accessibility. These goals safeguarding patient privacy may be achieved more efficiently through the application of informatics applications in addition to current administrative and physical safeguards.[11] ASCO lists guidelines to follow when adopting clinical systems at schools and colleges of optometry, which include that clinical software should be Health Level 7 compliant, and diagnostic instruments should be DICOM-compliant.[11]

Training tools

Active learning in the classroom is achieved through incorporating interactivity into instruction. Today's students are tapping into numerous technologies to enhance productivity as well as lend real-world relevance to their studies.[20] We must no longer expect teaching methodologies of the past to be sufficient for the Millennial learner. The lecture, structured note service, guest speaker and activities in which students work individually and in groups must utilize new technologies to present time-honored material and provoke ever-increasing levels of critical thinking.[21] Throughout the curriculum the following tools should be used:

1) Literature review. Because of the innovative and recently evolving nature of the field, optometric informatics literature is lacking a great number of quality studies, data collection instruments that have been tested for reliability and validity, and, in some cases, sound statistical methods. It is therefore important to encourage students to be critical of the generalization of methods and results.
2) Practical exposure. On-campus clinical facilities should be equipped with state-of-the-art diagnostic, treatment, patient care and business operations technology. During the first two years of the professional program, site visits to clinical settings where informatics is being practiced can be of benefit to optometry students. During the clinical externship, selection of sites with advanced technology and clinicians versed in informatics applications is desirable. During these experiences, students will have the opportunity to assess healthcare providers' perceptions of and attitudes toward optometry informatics applications and discuss their impact on daily care delivery. Additionally, industry representatives and vendors should be invited to interact and present their products for different application areas throughout the program.
3) Use of educational technology. Tools such as Computer-Assisted Testing System (CATS), CourseWeb, MediaSite, Moodle, Student Response Systems and Tegrity Campus should be implemented throughout the didactic and laboratory course work. The application of informatics in patient care and business operations in the clinical setting is also essential.[22]

Optometric Informatics Experience: Southern College of Optometry

SCO has been working to most effectively model the leading-edge 21st

century optometric practice in its clinical facilities while incorporating appropriate standards as outlined in the Educational Technology Guidelines for Schools and Colleges of Optometry.[11] This effort has resulted in the incorporation of various topical and technological inclusions in SCO's curriculum to address the changing needs of today's professional student and to highlight the use of optometric informatics in clinical practice. An emphasis is placed on the aspects of optometric informatics relating to cost of care, quality of care, access to care, use of electronic health records and privacy of personally identifiable health information.

The use of technology to better meet the needs of the Millennial-aged professional student in knowledge acquisition and critical thinking has been implemented throughout the curriculum. Most recently these changes have taken place in the didactic classroom and laboratory as educational technology, and new approaches to the traditional lecture have been applied.[21,23-25] SCO has been involved in optometric informatics through a vision science index-referenced service, Visionet, since 1975. Technology advances have allowed SCO to embrace the concept of library as a "Learning Commons" – a physical and virtual space providing access to information, materials and software to authenticated users regardless of their physical location. Today our students have access to the same resources at home or in the local coffee shop as they do in our library on campus. Additionally, since early in the 21st century, SCO has had faculty actively engaged in the development and utilization of educational software specific to optometric education, from computerized models to assist in understanding ray tracings and physiological optics to simulation of the eye movements of a patient with Brown's Retraction Syndrome.[26,27]

Within the past three years, SCO has added the use of four forms of commercially available educational technology to assist in the delivery of curricular content. These include Moodle, McGraw-Hill's Tegrity Campus, Turning Technologies Turning Point audience response system (ARS) and Tech Smith's Camtasia Studio. Moodle is an open-source, course management system. SCO uses this system as a platform for online courses and in "blended learning" courses to augment face-to-face instruction. The software contains activity modules such as forums, databases and "wikis" that provide for the creation of elaborate communities around individual courses. Tegrity Campus is an automated lecture capture system that SCO utilizes in traditional, hybrid and online courses. It records presentations and supplemental course content for reference, review and study by students. This has proven to be especially helpful as students prepare to take national board examinations. The software package also allows personalized learning features for users enabling them to better organize material and even review related topical content in previously taken courses. Use of Turning Point ARS helps faculty better engage students and creates a more active learning environment. This automated student response system is composed of radio-frequency (RF) ResponseCards. It provides an opportunity for student-lecturer interaction in larger classes and accommodates testing. **(Figure 1)** When it is used as a means of formative assessment, immediate feedback is provided to students on their performance as it relates to other members of their class or team-based learning (TBL) group. Student data is captured, graded and prepared for transfer to Moodle or other grading formats. Camtasia Studio is a powerful software format that facilitates the creation of professional-grade videos allowing on-screen activity and interactive elements and transmission capabilities for sharing with anyone, on nearly any device in person or remotely.

Figure 1
Turning Technologies ResponseCard RF

Little has been written regarding the Millennial-aged learner in professional healthcare education, especially optometric curriculum, and the SCO faculty is working to adapt the current theories and approaches in pedagogy and use of technology.[20,22,24] This requires a rethinking of delivery methods at all levels of the curriculum and cannot be adequately undertaken without a firm understanding of the role of technology and informatics.

Table 1 represents a curriculum model for optometric informatics instruction. Beginning in the first professional year (PY1) of the program, concepts related to optometric informatics are presented in OPT 219 - Practice of Optometry I. In this course, PY1 students are introduced to the impact of informatics on quality of care, cost of care and the importance of published studies to aid utilization. The first in a two-year sequence of Optometric Theory & Methods courses (OPT 110, 120, 200, 210, 220) introduces the PY1 student to Compulink Electronic Health Records (CEHR). **(Figures 2 and 3)** The CEHR is in use in the clinical facilities of the program, and students begin recording data and manipulating screens in the system two years before using the CEHR to assist optometric physicians in the provision of patient care in The Eye Center (TEC) at SCO or other external clinical facilities.

In the second professional year (PY2), concepts of patient access, inter-pro-

Table 1
A Curricular Model for Optometric Informatics Instruction*

Professional Year	Course Title	Relevant Content	Educational Modality
PY1	***Optometric Theory & Methods I & II***	Application of optometric informatics in clinical setting - skills and techniques for direct patient care	**Traditional lecture, e-capture, e-management & practical laboratory**
	Practice of Optometry I	Introduction to optometric informatics in clinical setting - access, quality of care, cost of care	**Blended learning, e-capture, e-management**
PY1	***Optometric Theory & Methods III , IV & V***	Application of optometric informatics in clinical setting - skills and techniques for direct patient care	**Traditional lecture, e-capture, e-management & practical laboratory**
	Practice of Optometry II	Legal & ethical issues related to informatics, assessing community health needs, HIPAA, DICOM	**Blended Learning, e-capture, e-management**
	Clinical Communication & Patient Care	Application of optometric informatics in clinical setting - skills and techniques for direct patient care	**Blended learning, e-management & practical laboratory**
PY3	***Clinical Internship I, II & III***	Application of technology in patient care, general office operation and patient satisfaction	**Active participation, online resources**
	Practice Management	Design & assessment of optometric informatics for patient flow, patient contact, office efficiencies, patient experience	**Blended learning, e-capture, e-management**
PY4	***Clinical Internship IV***	Application of technology in patient care, general office operation and patient satisfaction	**Active participation, online resources**
	Clinical Externship I	Observation, assessment and critical analysis of optometric informatics in various practice modalities	**Active participation, online educational modules**
	Clinical Externship II	Observation, assessment and critical analysis of optometric informatics in various practice modalities	**Active participation, online educational modules**

***Curriculum based, in part, on that in place at SCO for Academic Year 2012-2013. This model does not include the various basic science and optometric curricular components without a direct tie to the informatics content.**

e-Capture with Tegrity Campus®

e-Management with Moodle®

Online Educational Modules with Camtasia Studio® by Tech Smith® & Moodle®

Figure 2
Compulink Sign-In Tab

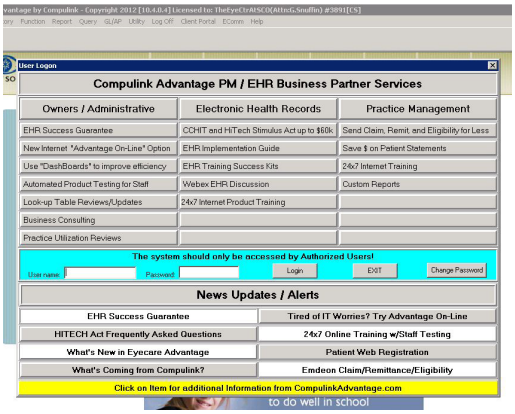
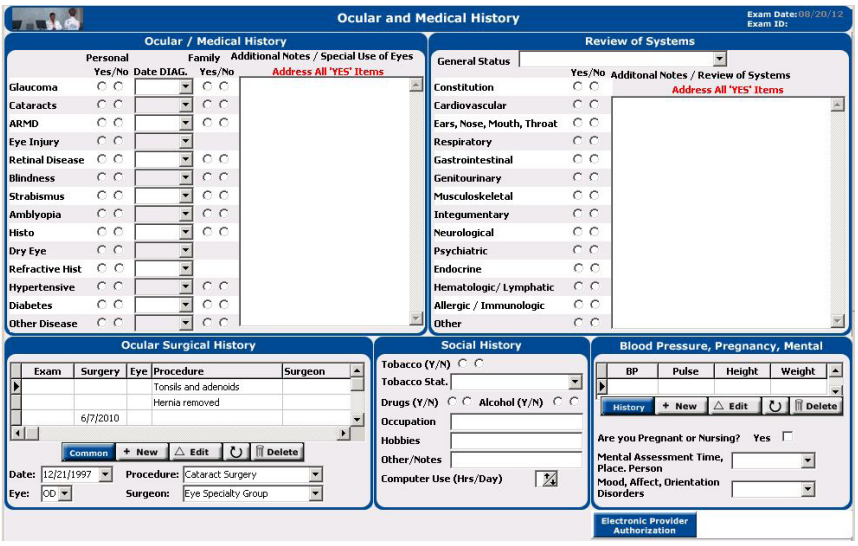


Figure 3
Compulink Electronic Health Record (CEHR) History Tab



fessional relationships and legal and ethical issues associated with informatics use are covered (OPT 219 – Practice of Optometry II). In this course a thorough review of the application of HIPAA is covered. In OPT 216 – Clinical Communication & Patient Care, PY2 students are involved in the practical application of informatics and data manipulation as it relates to community health initiatives and direct patient care. Vital data gathered from the School Screening Program of the Community Vision Health Services of the Clinical Programs at SCO is analyzed by students including various forms of statistical analysis aided by technology.

Third professional year (PY3) interns are introduced to the many uses of informatics in the practice setting in courses entitled Clinical Internship I, II, and III (CLN 306, 316, 326). The students' use of CEHR reaches its most practical application in the clinical setting during PY3. During this first year of the clinical internship, the PY3 student is actively engaged, as a non-physician extender, with optometric physicians (i.e., clinical faculty) providing comprehensive eye health and vision care at TEC. Through secure, encrypted web-based access, interns utilize the CEHR in external clinics as well as the nursing home/assisted living program. Clinical faculty utilize each patient encounter for maximum educational exposure including, but not limited to, enhancing quality of care, increasing efficiency, enhancing patient satisfaction, and practice management utilizing informatics and technology. An emphasis is placed on the methodical development of appropriate critical thinking skills in the clinical setting.[21,29] Informatics is utilized in the clinical facilities at SCO including practice management software (PMS); interfaces with external databases and clearing houses for insurance authorization and electronic claim submission; CEHR; e-prescribing; interface with the Essilor Mr. Blue Fabrication System in the SCO finishing laboratory; and in conjunction with Demand Force, a web-based patient contact software system providing text and e-mail contact for scheduling appointments, appointment reminders and notification of completed optical jobs.

During PY3, the interns are immersed in these practice management and efficiency-enhancing aspects of effective patient care, and utilize the clinical application of basic technology in the contemporary practice of optometry (i.e., diagnosis, treatment and management). Today, it is considered "standard of care" to utilize what even a decade ago might have been considered futuristic technology. Computerized tomography, digitized photography, computer-enhanced and validated perimetry, optic nerve head imaging, electronic transmission of fundus photography, image archival systems and even corneal thickness measurement and analysis is commonplace. All instrumentation in SCO clinical facilities is DICOM (Digital Imaging Communication in Medicine) compliant. This facilitates the development of common formats and protocols for the sharing and output of data from diagnostic equipment. Optometric faculty have naturally incorporated these and many other advanced technologies as they have become accepted and supported by evidence-based studies for their application in patient care.

In the Fourth Professional Year (PY4) of the curriculum, the intern spends one of three trimesters on campus (CLN 400 Series). Two are spent on clinical externship. During their clinical assignments on campus the PY4 interns become fluent in use of the latest in automated technology for subjective refraction. The Marco Total Refraction Systems (TRS) are used in the PY4 Adult Primary Care Services in TEC. These systems incorporate clinical informatics by gathering pretesting data that is automatically entered into the phoroptor and CEHR. Use of this technology enhances efficiency and allows us to model the use of technology in the provision of patient care for the 21st century practice of optometry. While off campus in one of their two clinical externship rotations, interns are engaged and interact with faculty on campus through both required and optional online educational modules. These modules are designed to enhance the clinical externship experience by drawing parallels between the various sites through standardized business

Figure 4
Southern College of Optometry's Advanced Procedures Theater

Figure 5
Digital Observatory at the Southern College of Optometry

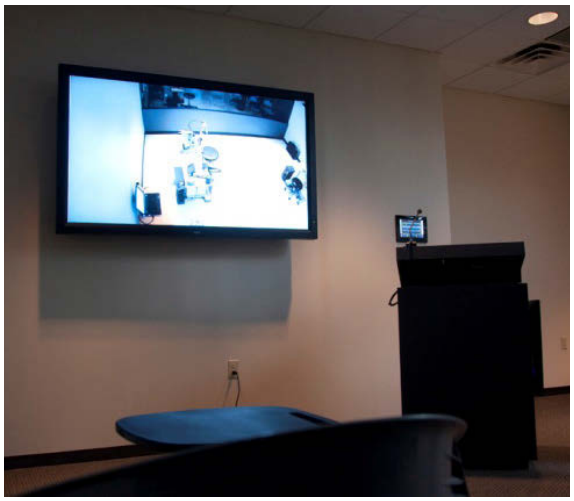
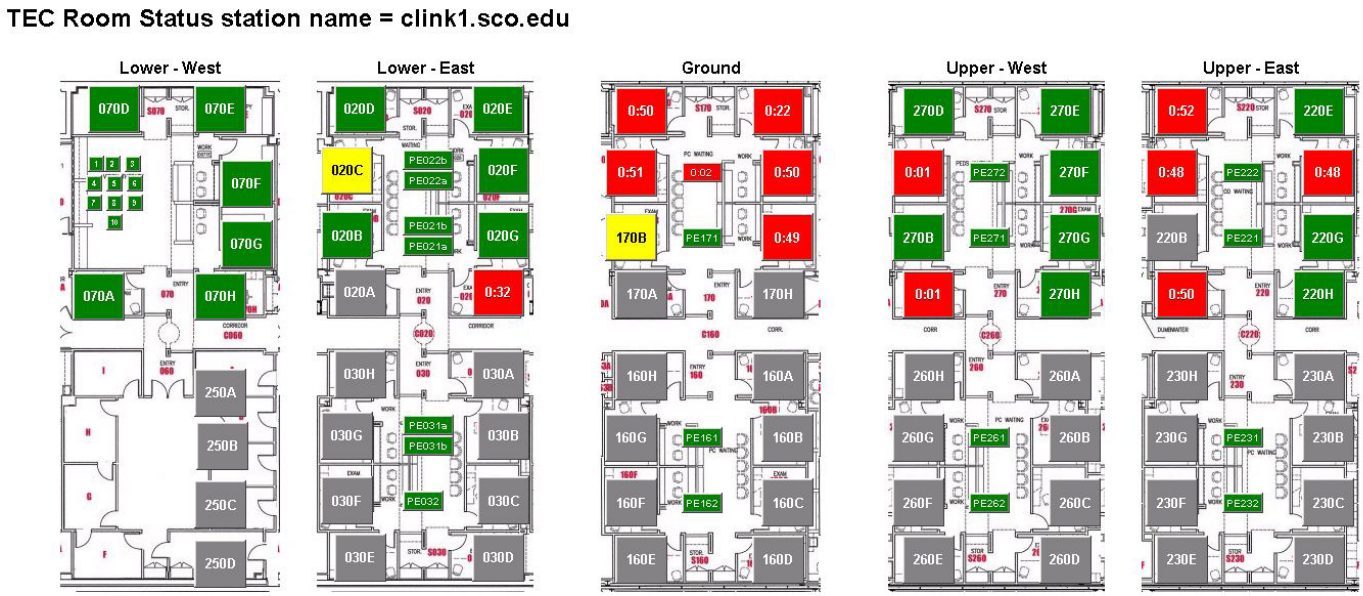


Figure 6
Southern College of Optometry's Patient Flow System
(grey = blocked room, green = room available, yellow = patient in route, red = exam in progress)



practice models. The development of critical evaluation of business practices in various modalities are also fostered through use of this technology.

SCO recently completed construction of a unique Advanced Procedures Theater/Digital Observatory and Digital Examination Rooms located in TEC. **(Figures 4 and 5)** These state-of-the-art teaching facilities use new informatics technology for the clinical instruction of diagnostic and therapeutic procedures including, but not limited to, binocular indirect ophthalmoscopy, biomicroscopy and various ophthalmic laser procedures. Utilizing new video and audio technologies applied to Zeiss ophthalmic equipment, interns are able to observe these procedures being performed in a unique way. Remote observation of the surgeon's field of view, the patient's field of view and generalized video of the procedure environment is transmitted for presentation by clinical faculty in one of two different theater-like settings. The Digital Examination Rooms afford clinical faculty the opportunity to expose greater numbers of students to techniques and interesting clinical findings and SCO interns the opportunity to practice examination techniques in an environment modeled after the National Center of Clinical Testing in Optometry (NCCTO) of the National Board of Examiners in Optometry in Charlotte, NC.

SCO interns also have exposure to proprietary systems designed in-house for the efficient delivery of patient care and clinical instruction. The Information Services Department (ISD) at SCO consists of a half dozen individuals committed to assisting all aspects of the institution in efficient use of technology and informatics. In conjunction with TEC staff members, the ISD developed a one-of-a kind software application, the SCO Patient Flow System. **(Figure 6)** This informatics application monitors examination room status and patient movement throughout the clinic in order to streamline and enhance the patient experience. With 35 optometric physicians, more than 100 interns and 45 staff members providing care to as many as 350 patients each day, TEC could easily become disorganized. The SCO Patient Flow System keeps that from happening. This web-based patient flow system assists in providing care without undue wait times for patients and keeps physicians, interns and staff on schedule. Effective application of informatics is important to patient care but also is essential to 21st century clinical education. SCO clinical Chiefs of Service worked with ISD to develop SCO's e-Clinical Grading System. **(Figures 7 and 8)** This web-based software application tracks each intern's encounters, automatically forwards content to clinical faculty for grading and then sends the results to the intern's internal e-mail immediately upon completion. SCO is currently in the process of evaluating faculty/student reaction to the curriculum.

Conclusion

The use of informatics will be a key element in the future delivery of eye health and vision care for the continued success of optometric practices. It is also essential to include these technologies and practices in the educational curriculum itself. Informatics will not only improve quality of care, patient experiences and business practices but also help to ensure the continued success of the optometric practice in an increasingly discerning and competitive marketplace. The proposed framework in this concept paper constitutes the outline of an optometric informatics curriculum for optometry programs that provides students with an overview of the field and practical ap-

Figure 7
E-Clinical Grading System – Student Tab

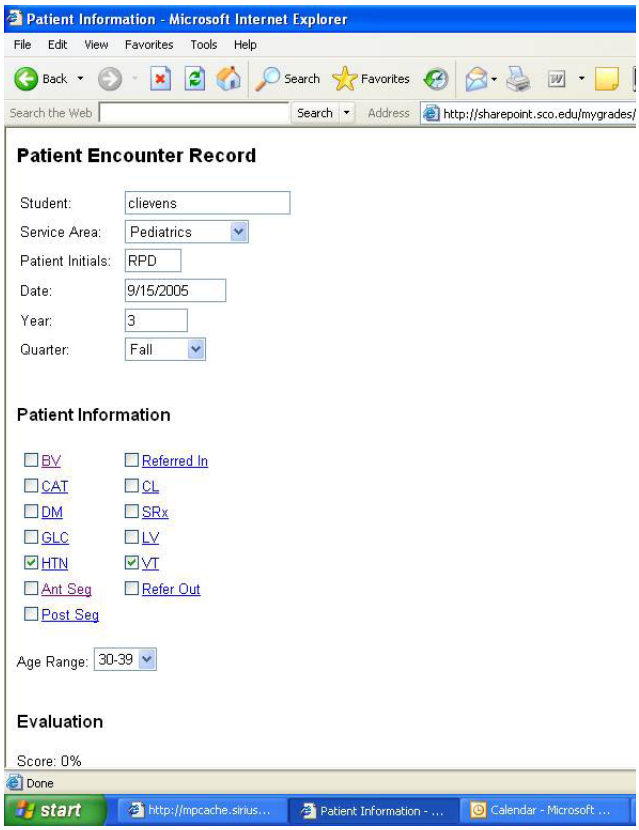
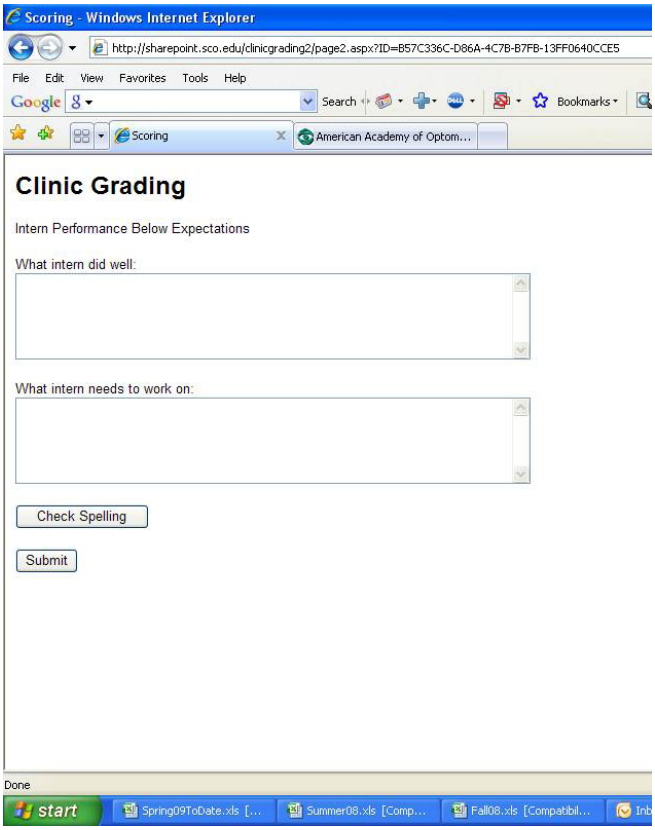


Figure 8
E-Clinical Grading System – Attending Staff Doctor Tab



plication experience and prepares them for their future roles as decision-makers and healthcare practitioners.

Despite these observations, the authors recommend that new studies be conducted to specifically identify learning attributes and outcomes of teaching and utilizing optometric informatics in the widely accepted framework of today's optometric curriculum.

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