

Portfolio-Based Credentialing for Health Professions Education: Collecting Encounter-Based Data in Digital Format for Students and Residents in Non-Classroom Learning Situations

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Existing Programs/Organizations Involved:

- College of Allied Health Sciences

- College of Medicine
- College of Nursing
- College of Pharmacy
- Distributive Learning Collaboratory, Medical Center
- Academic Information Technologies & Libraries, Medical Center
- UC Physicians
- Health Alliance of Greater Cincinnati / University Hospital

Objectives/Needs

Exploiting advances in IT, we will provide a framework in which students and residents can use digital standards-based portfolios to document the non-classroom portions of their health sciences education, and instructors are able to assess student performance immediately following clinical encounters. The main objectives of this project are:

1. To improve the learning effectiveness, and to raise the level of clinical skills performance of students and residents, by shifting the skills assessment process from an end-of-term summative evaluation of performance to a continuum of formative assessments at each clinical or training encounter. This shift in process will provide students with immediate feedback after each session, which they can use to engage in continuous skills improvement across the entire curriculum.
2. To create a student, resident, and faculty driven standards-based portfolio designed to encourage the development of reflective practice and analytical skills. The portfolio will support the collection, review and analysis of formative and summative evaluations of health professions students during the didactic, laboratory and experiential portions of the curriculum, and of residents throughout their complete program. The portfolio will be accessible from any location using a variety of wired and wireless devices.
3. To develop interactive web-based applications that allow for ongoing student self evaluation of clinical knowledge and clinical skills development.
4. To create an on-line reporting system that displays student and resident progress toward the achievement of required clinical skills. This system will assist faculty in developing customized curricular pathways, identifying and providing supplementary instructional material to students and residents needing additional attention on an ongoing basis, and evaluating curriculum delivery.
5. To provide documentation that health professions students and residents have acquired the clinical skills required for awarding of their degree and for credentialing by accrediting and or licensing agencies.

Background/Local Context

Students in the health professions colleges at The University of Cincinnati Medical Center are expected to develop the knowledge, attitudes and skills necessary to be competent practitioners during their course of study. Objective documentation of knowledge has been the focus of most educational programs, largely through traditional written examinations, including capstone examinations required for licensure. Although formative and summative evaluations of student achievement occur throughout the curriculum, documentation of acquisition of clinical skills and demonstration of appropriate professional attitude using objective evaluations has proved much more

difficult. Most colleges have incorporated standardized patients and case based teaching exercises to demonstrate the acquisition of clinical skills.

All four colleges at the Medical Center have developed clinical skills teaching laboratories to provide our students with a mechanism for skills development. These labs have focused on teaching the skills that must be obtained before students interact with patients. Standardized patients or cases are frequently used in conjunction with videotaping of encounters to allow for instructor and student critique of the student's performance. Objective standardized clinical examinations (OSCE's) have been used to evaluate student performance in the taking of a patient's history, in conducting the physical examination, and in developing a treatment plan. Residents and some students use actual clinical experiences in their training. Other opportunities to identify skills development in traditional didactic, laboratory and recitation courses are frequently lost or buried in the knowledge assessment portions of these courses.

The current assessment process is heavily dependent on paper-based systems and therefore, provides limited opportunities for longitudinal inspection in an efficient manner. These individual evaluations represent single measures of performance, occur at the end of the term, are not indexed electronically, and are not available for faculty and student review later in the curriculum. In many instances, predetermined learning objectives have not been developed and or matched to student activity. Feedback on performance and achievement is often delayed until the paper-based assessment is complete, at the end of the term. Learning is enhanced when assessment and feedback occur close to the activity.

Our vision is to have the clinical skills of residents and students from the colleges of medicine, pharmacy, nursing, and allied health sciences evaluated and documented on a continuous basis with feedback to identify opportunities for self-improvement. New data capture technologies should permit the creation of a database of individual assessments that could be used to construct a student specific portfolio in a digital format. The multimedia repository would include pictures, audio, video, written text, and other structured data that would serve to document student performance. These password-protected portfolios would contain formative and summative information about clinical knowledge and skills. In addition, faculty, residents, and students will add additional examples of their work to the digital portfolio that demonstrates their abilities.

The information in these portfolios will be pushed to students, residents, and instructors by the *Consultant* when they start their PDAs or log into the university network. Students, residents, and instructors would review the portfolios and measure their performance against predefined competencies on an ongoing basis. The portfolio will document skills development as the student progresses through their degree or residency program. At graduation the portfolio will become a permanent summative documentation of skills for use in professional licensure or credentialing. Summary student performance data collected over time will serve as a dynamic database to guide curricular development and assessment. At the Medical Center we have developed over the past few years an integrated database as the foundation for many institutional applications. We will store the electronic portfolios in the integrated database, and use features of the integrated database to implement portfolio functionality.

Several years ago, AIT&L received external funding, from the Ohio Board of Regents (OBR), to provide an environment where students, faculty, and staff have wireless access to the computer network in many areas of the Medical Center. To accommodate the many students with personal digital assistants (PDAs), AIT&L has recently implemented an electronic course calendar, maintained in the integrated database and viewable as a web page on a PDA. From their homes, students can synchronize their PDAs to include the calendar information. With this new application, the Medical Center no longer needs to print out weekly course schedules, and students can easily verify the times and places for their courses. The Medical Center is currently purchasing a dedicated server to cache PDA web pages (from AvantGo) under a new OBR grant that will be used to extend PDA support to include wireless synchronization of PDAs with the Medical Center computer network via wireless connections in the Medical Center computer labs. Once the AvantGo server is in place, the Medical Center will have a means to collect data from students via web forms on their PDAs and later upload this data to the university's computer network. This project, called "Students on the Move," is also discussed in Section C of the IAIMS operations grant proposal.

Assessment requirements for residents are similar to those for students in the four colleges of the Medical Center. During their residencies, residents learn clinical skills in three stages: First they observe experienced physicians performing a procedure, then they perform the procedure under the guidance of a physician, and finally they perform the procedure on their own, with a physician reviewing their work upon completion. The credentialing process requires documentation of all three stages, verifying the number of instances, the required distribution of patients by type, and assessments of clinical skills shown by the residents. Currently, this documentation is maintained manually in a paper-based system and the main focus of the system is to ensure that the required number of clinical encounters has occurred, rather than to assess the quality of each clinical encounter.

National Context

To address the gap between theory and practice, national accrediting and licensing agencies are requiring colleges and universities to develop ongoing curricular assessment and evaluation mechanisms that demonstrate that graduates of college or residency programs meet or exceed the minimum competencies necessary to practice in the health professions. Objective testing and examination measures do not adequately measure the knowledge, skills and attitudes necessary to establish and maintain a practice. Colleges and universities are experimenting with alternative forms of instruction, including case-based teaching and student portfolios in an attempt to document the development of new skills. Although learning assessment against pre-determined goals and objectives for individual courses has been demonstrated using a variety of assessment procedures, an assessment of student performance across the curriculum continues to be the major challenge.

The Accrediting Council on Graduate Medical Education (ACGME) has adopted new competency and evaluation standards that apply to Internal Medicine Residency programs starting in July of 2002. Assessment of students must include formative and summative evaluations across 6 competency areas. In addition every training program will need to document attainment of these competencies by each of the trainees. UC Department of Internal Medicine programs already have in place the requirement for trainees to track such data as the numbers and types of procedures performed, their attendance at required conferences throughout the academic year, and numbers and types of

patients followed. There must be a mechanism for performance feedback and a process for using the assessment to achieve progressive improvements in competence and performance. We expect this trend to continue across the health care disciplines. An electronic portfolio system would facilitate the collection and analysis of the information collected and allow for resident and faculty review and reflection across the curriculum.

The increased use of PDAs in all health disciplines provides the framework for the collection and display of information in electronic databases. Previous grant activities at the Medical Center have expanded the wireless infrastructure to include most of our teaching sites and on a limited, but rapidly expanding basis, our clinical practice sites. This project will build on the expanding role and growing capabilities of these devices. In the near future, advances in wireless technology will make it possible for students or residents to collect encounter data via a web form, and then transmit the web form to their instructors or supervising physicians for on-the-spot assessments of their related performance.

Students, residents, and faculty use UC computer resources to collect, maintain, and use data in the portfolios. When people log onto the network, they are validated against an Eduperson-compliant directory of personal information in the integrated database. In the future, we will be able to use this Eduperson-compliant directory to cross-validate users from other institutions associated with the Medical Center.

At some other institutions, students and residents are using PDAs to collect encounter-specific information at the time of the encounter for posting into a database. However, we are not aware of other institutions that are combining this collection of encounter data with immediate performance assessment by the instructor.

The Health Information Portability and Accountability Act of 1996 (HIPAA) poses a significant challenge in the development of a portfolio related to students' actual clinical experiences, because of the need to preserve patient confidentiality. To meet these needs, this proposal will collect to the maximum extent possible only non-identifying data about clinical encounters. All clinical encounter data transmitted across computer networks will be properly encrypted, and any such data stored in the integrated database will be encrypted and anonymized. Authentication of users against the directory of approved users will ensure that the database is protected from unauthorized use.

Description

The overall goal of this project is to develop an on-line digital portfolio that will track student and resident performance throughout the didactic, laboratory and experiential portions of their program. The student portfolio will be developed using web pages for data capture and performance assessment, real-time recording of video and audio clips, and a variety of assessment instruments. Samples of student performance, including posters, video clips, audio clips and text documents will be included in the portfolio. Whenever possible, materials will be captured at the source and electronically transmitted to the portfolio via a combination of wired and wireless devices. The portfolio will be developed to include those performance indicators necessary to document competencies as defined by accrediting and licensing agencies. All material in the portfolio will be indexed for easy on-line access and retrieval across a variety of search criteria. (Although we currently collect some of the components for this portfolio using paper-based systems, they are not

currently indexed or stored for on-line access or retrieval.) The portfolio will be based on a defined data dictionary and will include mechanisms for archiving information and storing large data objects off-line, yet readily available. The portfolio will be managed as a part of the integrated database.

The customer– student, resident, or faculty – is the center of this system. When a customer brings up the starting web page on a PDA or logs into the network, he or she will see a page customized to deliver the information pertinent to his/her needs. Context appropriate information will be “pushed” from the underlying systems to the customer, organized for ease of use. Specific system functionality is illustrated later.

The system is intended to change the process used for assessment of clinical skills in students and residents from a paper-based, summary process where assessment occurs at the end of the term, to a more interactive process where assessment occurs at, or close to, the actual encounter and students have on-going feedback regarding their performance. To accomplish this, faculty will be able to use web forms from any networked device to complete Clinical Exercise Examination (CEX) assessments at the time of the encounter. In the current environment, CEX’s are completed much later, generally at the end of the term, and students/residents do not have the opportunity to use on-going performance evaluations to improve their performance.

Initially, most student data included in the proposed digital portfolio will be collected by students completing web forms on their PDAs while not connected to the university network. The PDA-cache server will provide a convenient means by which these data can be uploaded to the computer network, and then stored in the integrated database. By year four of the IAIMS program we expect the ubiquity of wireless networks and the continued development of micro-technology to allow for mostly synchronous network transfer of data and full real-time access to other resources. Similarly, at the start of the project most resident data included in the digital portfolio will be collected by residents completing web-based forms on their PDAs while not connected to the university computer network. Again, by year four of the program, residents will have wireless access from at least one patient care site (a new internal medicine ambulatory teaching clinic to be constructed in a Health Alliance/University Hospital facility near the Medical Center). The Health Alliance and the UC Medical Center are committed to resolving security and firewall issues between their discrete networks, which currently make it difficult to access the UC network from within The Health Alliance. As an interim solution, we will provide a number of synchronization stations located in The Health Alliance space and providing access to the UC network. Residents, students, and faculty physicians who spend time in The Health Alliance space will be able to use these synchronization stations to synchronize their PDAs with the UC network and to upload encounter and assessment data to the integrated database.

Here are some use cases illustrating the functionality that a student, resident, faculty member, or system administrator can expect from the Portfolio-based Credentialing System.

Scheduling a Clinical Lab Session: A student preparing for an Emergency Medicine rotation is sent an e-mail by the course director with a list of skills students should have prior to starting the rotation. John Rogers (our medical student) hasn't used his suturing skills since his surgery rotation six months ago. From his PDA, connected live to the Internet, he enters the Clinical Lab web site. He enters his desire for a suturing refresher session and some time parameters (for example, next week). He is

given a list of times available from which he chooses next Tuesday at 10:00 am. He confirms his choice, but selects not to send a copy of the confirmation to the course director.

Entering Encounter Data: The day before John Rogers is scheduled for his clinical skills exam in Cardiology the clinical skills lab schedule application "pushes" his evaluation form to his PDA so that he can record session information. On starting the session, John starts his PDA and the web form appears after selecting the clinical skills exam icon. He fills out and saves the web form. After the session ends, the data from the form is pushed back to the portfolio database. At this point, John also transmits the completed web form to the instructor ("share") for an on-the-spot performance assessment. If the instructor was not present, the data will be automatically forwarded to him/her for review at a future time. The instructor "grades" the student's performance electronically and submits the evaluation form back to the John's portfolio. The next time John is online the evaluation is available to him on his PDA or Internet portal.

Signing In to a Session with a Card Reader: John is on an Internal Medicine rotation that requires him to attend a number of conferences and to complete several exercises in the Clinical Skills lab. After morning rounds, John and his team head off to a grand rounds presentation. As they enter the room they use their ID badges to sign in by swiping their cards into a device that is attached to a PDA on a table by the door. The PDA is later synched to the central database that records attendees at the session. John's information is also forwarded to his portfolio and the course director's log for students in that rotation. The clerkship director, Dr. Simon, has reviewed the patient encounter logs for John and other students during their first week on the rotation. He has set up several practice cases specific to the needs of each student. He has forwarded the information to the Clinical Skills Lab director and John has scheduled a practice case for 1:00 pm. When John arrives at the lab he "swipes" himself in. The Lab recognizes that John has arrived at the Lab and forwards case information to his PDA via a live wireless connection. The information includes instructions, case information, and data forms that must be completed. If John does not have his PDA or if it is inconvenient for him to use it, he can access the information from any of the PCs in the Lab by logging into his portfolio account. After completing the case John signs out by swiping his badge as he leaves the lab. All of the information from the session is forwarded to the portfolio database. An alert is sent to Dr. Simon, who can access the exercise data for review at his convenience.

Student/Resident Review of Current Status: Any time John starts his PDA or logs onto the network, he can click a button on his Portfolio screen to display a table showing his own current performance assessments, and a summary of completed requirements vs. not-yet-fulfilled requirements. With this information, students and residents will be able to make adjustments in their plans of study to ensure that all competencies have been met.

Adding a Document to the Portfolio: Students and residents can add Clinical Vignette Presentations ("posters"), PowerPoint presentations of cases, and other documents to their portfolios, from a PDA or computer connected to the network. The student/resident will log in and follow instructions on the "Add Material to Portfolio" web page. This web page can be used to add an existing electronic document to the portfolio, or to scan an image into the portfolio. The document or image is stored on the network, and the media repository holds classification information and a link from which the actual document or image can be retrieved.

Faculty Assessment of Performance: A faculty member will observe a student or resident in a training session, and then will call up a web form on his/her PDA to record an on-site assessment of performance (a CEX examination). Data will include the name and other information for the student or resident, appropriate encounter data, and assessments of each procedure observed. When the PDA is synched, the assessment data will be stored in the integrated database and associated with the student- or resident-entered encounter data. It will also be possible for a faculty member to queue up encounters, and enter the assessments for multiple encounters at a later time. (This model parallels the current practice of summary rather than formative evaluation of performance.)

Faculty Review of Student/Resident Performance: Dr. Simon is spending the afternoon looking at next month's students who will be coming into the Internal Medicine Clerkship. He's reviewing their clinical experiences to-date and comparing their current competencies with some benchmarks he has developed. He notices that Jill Brown has had some difficulty with understanding and utilizing prescription medications and that Bill Cooper has seen very few geriatric patients in his rotations to-date. He adjusts the Clinical Skills Lab cases for Jill so that she can practice cases with a greater focus on pharmacological issues and he pairs Bill with a preceptor whose practice is heavily populated with geriatric patients.

Administrative Functions: The Clinical Biennium Committee (medical school years III and IV) are meeting this afternoon to discuss possible changes in the curriculum for next year. In preparation for the meeting a staff member from the Medical Education office uses aggregate scores on standardized exams and clinical skills cases to prepare a statistical chart for five skill areas identified by the chair of the committee. It's clear from the report that students need to improve their skills in the area of nutrition. The committee recommends that the Clinical Skills Lab develop more learning exercises in that area and clerkship directors are advised that they should add materials related to nutrition in their discussions and that electronic patient encounter forms be altered to monitor student skills in this area.

Linking Internal Systems to External Data Sources: The student will be able to directly link to external information sources from their portfolio. The portfolio database will contain context appropriate links that will be provided to on-line tutorials and bibliographic services, including PubMed, using standard MESH descriptors.

Program Uniqueness/Benefits

All health professions programs at the Medical Center recognize the need to develop better processes for systematic evaluation of students and residents. Current paper and electronic systems do not allow for efficient capture and display of assessment data and are not useful for longitudinal, summative assessment of students across different learning environments. Students and faculty are not able to evaluate student performance using summary data from a representative group of their peers. Feedback on performance is frequently delayed until paper-based systems are processed. The on-line portfolio will provide timely feedback to students and faculty about student performance and will provide them with an opportunity to monitor and measure their success in achieving stated program competencies. Although several vendors are currently offering electronic portfolios, the content scope does not include the types of electronic media that we would like to include. The commercial products also do not offer wireless mechanisms for assessment capture and entry.

Management

The faculty of the Medical Center's four colleges, representing the clinical skills laboratories and experiential training programs, have been working cooperatively for a number of years to promote interdisciplinary cooperation. New accreditation guidelines increasingly require health systems practice and health systems integration as a major competency. We currently share laboratory and experiential training facilities and participate in interdisciplinary teaching programs. Our recent efforts to consolidate central information technology services will provide a mechanism for sharing of electronic resources and for the development of shared information databases. This project builds on our continuing efforts to develop systems and processes that translate across college boundaries.

The Portfolio Oversight Committee, chaired by Dr. Fant, will meet regularly to determine the strategic direction, to ensure coordination of clinical skills assessment efforts in the four Medical Center colleges, and to monitor the progress of the development of the digital portfolio components. The Committee consists of the associate deans for education of the four colleges plus key members of the Distributive Learning Collaboratory and of clinical skills laboratories. The committee will report to the Senior Vice President and Provost for Health Affairs, who chairs the IAIMS Steering Committee.

The portfolio project team, led by Drs. Fant, Kues, and Rouan, will be responsible for the development and deployment of the project. The project team will meet regularly to assess progress, solve problems, and redirect activities as required. They will receive direction from the Oversight Committee and will make adjustments throughout the course of the grant funded program based on data provided by the formal process of evaluation.

For the past several years, AIT&L has used the Unified Method of software development, and especially Use Cases, to determine and refine customer needs and develop software that addresses these needs. This method encourages customer participation in the development phase and gives people a sense of "ownership" of the resulting products, while providing ample opportunities for "tuning" the software during the development stages to ensure that needs are fully addressed.

Technical Description

The entire Portfolio-based Credentialing System is based on the multi-tiered database-driven architecture used at the UC Medical Center. With this architecture, applications share information across the integrated database, and the database provides different views of the data to different individuals, based on their needs and position at the university. People primarily interact with the system via web applications. Different groups see different presentations of the data, determined by pre-defined access rights. Access to the system is managed by the Security Component of the integrated database, a middleware component based on an Eduperson-compliant directory of personal information. When a person logs onto the system, he or she will see a portal customized to provide the access that he/she needs to all relevant features of the various applications.

Technical Environment

The database underlying the system will be a relational database, currently based on the SQL Server 2000 platform. Because data stored in the database will be central to all applications, we will be using Windows 2000 clustering and/or load balancing to provide maximum availability and performance.

The web applications will be primarily developed using Cold Fusion, the Microsoft .NET framework, Macromedia products, and other programming environments as defined by specific needs. Middleware components will be written in various languages as appropriate.

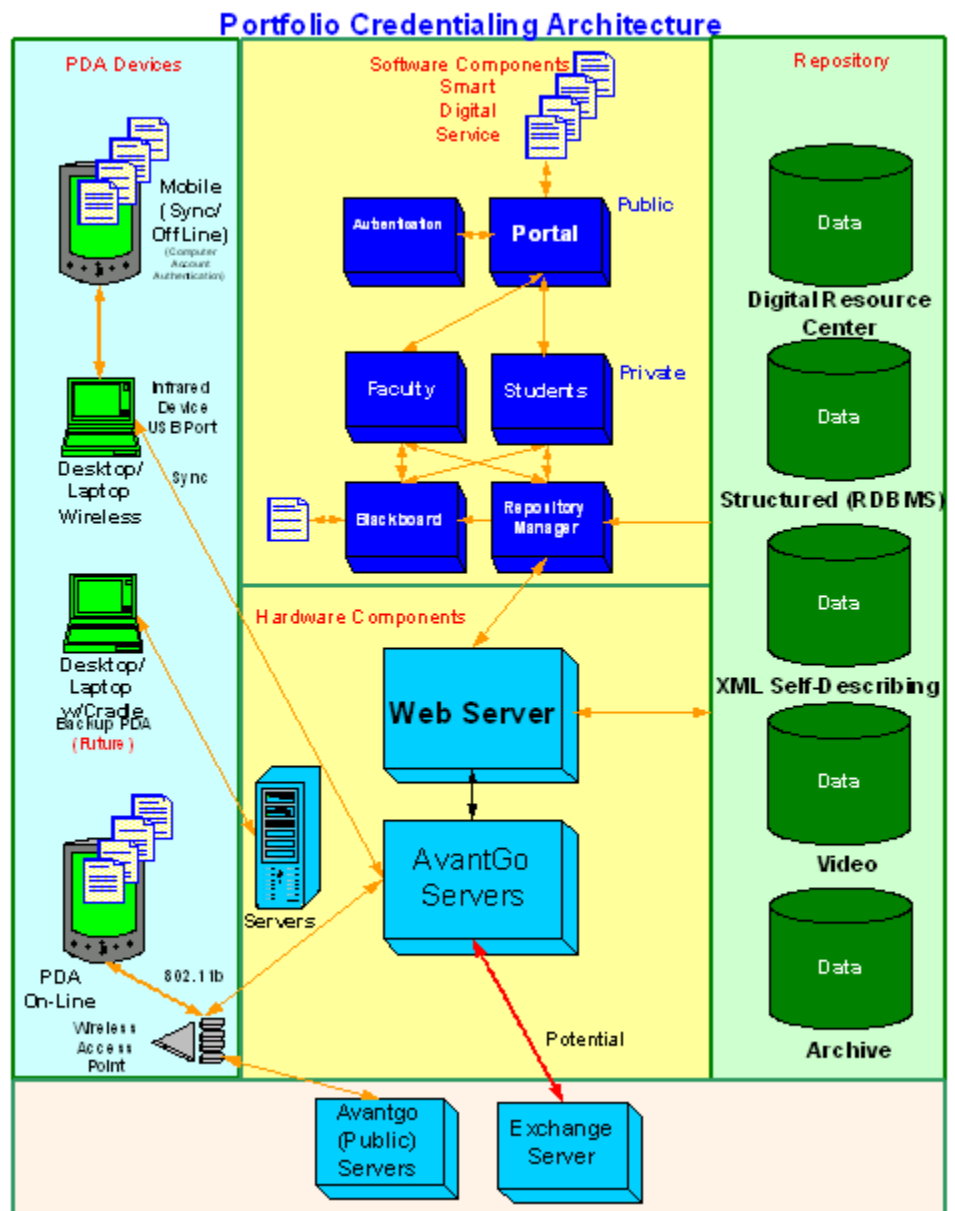
The web application layer is central to all applications. To provide maximum availability and performance, we will use a combination of hardware- and software-based load balancing.

To ensure system security, we will use multiple firewalls, intrusion detection software, anti-virus software, digital signatures, encryption and other components. Typically, there will be multiple levels of firewalls, with the web servers protected, but quite accessible, the database servers protected behind additional levels of firewall for greater security, and additional security measures applied to certain workstations.

To manage user log-ins and access rights we will use the Security Component of the integrated database, a middleware authentication-and-authorization component that validates logon information against an Eduperson-compliant directory.

Most students and residents will provide their own PDAs, used for entering encounter data via web forms and viewing personal Current Status reports. The common standard PDA operating systems will be supported.

Video and audio recorders will be required in settings where recordings of sessions are made. For the most part, these will be used in the College of Medicine's Center for Competency



Development and Assessment, where fully digital recording equipment is already in place.

For the most part, the hardware and server software used for the Portfolio-based Credentialing System will be shared with other systems developed at the Medical Center under the same multi-tiered database-driven architecture. Videos included in the portfolios will be stored on dedicated video servers, provided by the laboratories where the video recordings are captured. The system will also use an AvantGo server, to support the use of PDA devices. At least initially this system may require dedicated synching stations at some off-campus sites where Resident and Student Clinical training occurs, to provide PDA synchronization with the UC network across inter-institutional firewalls.

Functional Specifications

Capacity Planning for Portfolio-Based Credentialing System:

Unit	Development	Beta	Production
# Concurrent on-line Users	10	15	50
Data Storage	50 MB	100 MB	1500 MB
Software/Program/Storage)	10 MB	15 MB	50 MB
Peak Usage Periods	M – F 9:00 am – 9:00 pm		

Security and Control of Access Rights to the digital portfolio and other clinical and training data information is managed by the Security Component of the integrated database. We will require that the PDA-cache server preserve the security and access rights of web applications; the AvantGo system being purchased under the OBR grant meets this requirement.

Web-based forms will be the key technique used to record structured data about encounters, and to perform real-time evaluations of student performance during and after such encounters. The preferred technique will be to use a PDA-cache server to download web forms to PDAs. Then the students, preceptors, and others involved in the encounters will be able to record encounter-specific data (date, time, procedure, etc.) via the web forms on their PDAs before, during, or at the end of the encounter. At a later time, this data can be synchronized and uploaded via the PAD-cache server to the DB.

Because these web pages must be accessible from both regular computers and PDAs, adjustments to current web page design principles may be required. To the maximum extent possible, the web pages will be designed to work on both platforms; in some cases it may be necessary to implement parallel web pages, one set for desktop and laptop computers and the other one for PDAs. Development of a prototype PDA-compatible web form will require a significant expenditure of resources, since that activity will include learning how to adjust current web page design principles for effective use on both platforms. Once a prototype has been developed and the necessary adjustments to web design principles have been incorporated into our design/development methodology, development of additional web forms that are PDA-compatible will follow standard Unified Method practices. Development of web forms for specific purposes is covered in the corresponding sections of this Technical Specification.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	24	Customer needs collection and define workflow
Analysis	25	System Analysis and Preparation of Specifications
Design	39	Database and web interface design
Implementation	50	Database Development / Middleware Development / Interface Development
Quality Assurance	21	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	3	Ongoing maintenance – 5 hours per week.

Scheduling a Clinical Lab Session: When a student connects to the network on either a computer or PDA and selects “Schedule Training Session”, the system will use the student’s program information to create a list of available training sessions appropriate for that student occurring in a specified time range (default is next 7 days). When the student selects a session, that choice is recorded in the integrated database. An option on the screen will allow a student to display his/her currently scheduled sessions and reschedule one as needed. (This builds on a self-scheduling system for an OSCE laboratory in the College of Medicine, which will be implemented in the spring of 2002.)

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	23	Customer needs collection and define workflow
Analysis	23	System Analysis and Preparation of Specifications
Design	28	Database and web interface design
Implementation	33	Database Development / Middleware Development / Interface Development
Quality Assurance	26	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	2	Ongoing maintenance – 5 hours per week.

Encounter Data Web Forms: For each type of encounter, there will be an Encounter data form on which the student or resident records relevant encounter parameters, and later additional encounter information. Similar forms are used by instructors for performance assessments. Upon synchronization, data from completed forms is stored in the integrated database. The development task will be to create a parametrizable encounter data collection form, from which specific encounter forms can be dynamically generated from a field list contained in a text file. XML offers a valuable tool for modeling and managing encounter data dynamically, both in forms and in the database.

Estimated Resources (based on 100 different encounter types)

Stage	Person Days	Roles
Build parametrizable encounter data form		
Project Management	12	Project planning, scheduling, and monitoring
Requirements	55	Customer needs collection and define workflow
Analysis	58	System Analysis and Preparation of Specifications
Design	81	Database and web interface design
Implementation	90	Database Development / Middleware Development / Interface Development
Quality Assurance	50	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	1	Ongoing maintenance – 5 hours per week.
Build 100 encounter forms		
Requirements	103	
Analysis	100	System Analysis and Preparation of Specifications
Design	0	Database, middleware, and interface design
Implementation	80	Database development / middleware component development / web page coding
Quality Assurance	26	Interface (browser testing) / Usability / Error / Load / DB Verification.
Maintenance		Ongoing maintenance

Getting Encounter Data for a Scheduled Session: When a student starts a scheduled session, he/she can select the session from a calendar, and the appropriate encounter data collection form will be displayed, with any pre-scheduled information filled in. He/she completes the form, and follows the previous use case.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	18	Customer needs collection and define workflow
Analysis	18	System Analysis and Preparation of Specifications
Design	16	Database and web interface design
Implementation	26	Database Development / Middleware Development / Interface Development
Quality Assurance	18	Interface (browser testing) / Usability / Error / Load /

		DB Verification.
Evaluation	1	Evaluate Project
Maintenance	6	Ongoing maintenance – 5 hours per week.

Signing In to a Session with a Card Reader: Instructor will enter session information into computer to which card reader is attached. As students/residents swipe their cards, their attendance will be recorded in the computer, for uploading to the database upon synchronization.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	14	Customer needs collection and define workflow
Analysis	13	System Analysis and Preparation of Specifications
Design	16	Database and web interface design
Implementation	23	Database Development / Middleware Development / Interface Development
Quality Assurance	15	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	2	Ongoing maintenance – 5 hours per week.

Automatically Recording Session Data: When a student starts a recordable session with a card swipe, the recording machine will automatically store student and pre-defined encounter data and start the recording session. Upon receiving a terminating card swipe, the recording session will end and additional session data will be written to the database. This functionality is already in place for the College of Medicine’s CCDA laboratory, and will require minor modification for use in the Portfolio.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	11	Customer needs collection and define workflow
Analysis	13	System Analysis and Preparation of Specifications
Design	16	Database and web interface design
Implementation	23	Database Development / Middleware Development / Interface Development
Quality Assurance	12	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	4	Ongoing maintenance – 5 hours per week.

Adding a Document to the Portfolio: Functionality to add existing electronic documents or scanned images to the media repository already exists. This will require some modification for use in the digital portfolio.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	18	Customer needs collection and define workflow
Analysis	18	System Analysis and Preparation of Specifications
Design	17	Database and web interface design
Implementation	24	Database Development / Middleware Development / Interface Development
Quality Assurance	12	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	2	Ongoing maintenance – 5 hours per week.

Faculty Assessment of Performance: The main task will be to develop web based forms to capture the information currently used for student/resident evaluation via paper forms.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	13	Customer needs collection and define workflow
Analysis	33	System Analysis and Preparation of Specifications
Design	55	Database and web interface design
Implementation	67	Database Development / Middleware Development / Interface Development
Quality Assurance	21	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	2	Ongoing maintenance – 5 hours per week.

Reports of Current and Cumulative Status: These reports will be used by both students/residents and faculty. Both current-term and cumulative information reports will be available. The cumulative reports will list all requirements in the program, and show current status for each requirement. The current term reports will provide a detail covering all encounters in the current term. Students/residents will see only their own data; faculty will be able to see information for 1 student/resident or for all students/residents they currently supervise.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	28	Customer needs collection and define workflow
Analysis	38	System Analysis and Preparation of Specifications
Design	63	Database and web interface design
Implementation	77	Database Development / Middleware Development / Interface Development
Quality Assurance	36	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	2	Ongoing maintenance – 5 hours per week.

Administrative Functions: The system will require administrative web pages to manage student requirements, set up clinical lab and OSCE sessions, create skills improvement information packets to send to students with poor assessment ratings, review assessment ratings, view non-structured information included in the portfolio, and compile CD's from the portfolio to document student/resident performance.

Estimated Resources

Stage	Person Days	Roles
Project Management	12	Project planning, scheduling, and monitoring
Requirements	58	Customer needs collection and define workflow
Analysis	59	System Analysis and Preparation of Specifications
Design	121	Database and web interface design
Implementation	118	Database Development / Middleware Development / Interface Development
Quality Assurance	66	Interface (browser testing) / Usability / Error / Load / DB Verification.
Evaluation	1	Evaluate Project
Maintenance	2	Ongoing maintenance – 5 hours per week.

Resources Required

This project will require 2.58 full-time equivalent staff for each of four years to complete. These personnel will fall into the following categories:

Faculty/content experts	.72 FTE
Technology specialists	1.76 FTE
Administrators	.10 FTE

Evaluation

The evaluation of this project is focused on two major issues: the ability to capture and organize disparate types of data from a wide range of sources, and the use and utility of these data to improve the educational enterprise of the UC Medical Center. The potential impact of this project extends into an attitudinal shift by trainees that promotes life-long learning and maintenance of competence.

The strategy for evaluating the first issue is two-fold. First, it will be important to identify the universe of information that would be relevant to collect for trainees in order to assess their knowledge, skills, and behavior. Training programs currently have access to a wide range of data that are used to evaluate students. Not all of these data are being collected. Of the data that are being collected, not all are being used, or used effectively, to assess students. This project will have to choose a finite set of data to collect for the portfolio. Data will be collected from trainees, faculty, and administrators to assess the validity and reliability of the data collected. The second part of the strategy is to address issues of data cataloging, organization, access, and analysis. The data for trainee portfolios will be gathered from a variety of different sources, input by different people, "pushed" or deposited into different places, and analyzed in different ways. A system of alerts, form uploads and downloads, and interfaces with support resources must be well orchestrated in order for the portfolio to integrate into the training routine of students and residents. Data failures, time delays, and system incompatibilities will be monitored as well as student, faculty, and administrator evaluations about the intrusiveness of data collection and the impact the portfolio data system on the training routine.

The evaluation of the use and utility of the portfolio focus on the three major user groups: students, faculty, and administrators. The student level evaluation will examine the amount of time and effort expended to keep the portfolio current, the reasons students use the system (for example, inputting required data, self-assessment, modifying their educational pathways, making career decisions), and the impact the portfolio has on their career after graduation (for example, post-graduate training, practice choices, style of practice). The faculty level evaluation will examine the amount and type of uses of the portfolio system (for example, evaluating trainees, planning curriculum, counseling students, customizing training to students' needs) as well as the impact it has on faculty teaching behavior (for example, changes in teaching style, integrating portfolio information into specific teaching content). The administrator level evaluation will examine the impact of the portfolio project on curriculum assessment and modification. It will also monitor changes in policies and procedures that result from portfolio use or data review.

The following matrix outlines a number of key milestones, some major types of evaluation data used to assess them, and the use of the data. This project is dynamic in nature and is deeply integrated into curricula throughout the four colleges and residency training programs at the UC Medical Center. As such, most of the evaluation data will formative in nature. We will, however, be monitoring system use statistics, student scores on standardized exams, failure rates, etc.

1. Capture and organize disparate types of data from a wide range of sources

Milestone	Evaluation Measures	Feedback
Identification of portfolio data items	<input type="checkbox"/> Student/faculty assessment (survey evaluation) of information to be collected	Evaluation surveys will be reported to the Project Team

Milestone	Evaluation Measures	Feedback
	<p>in the portfolio</p> <ul style="list-style-type: none"> ❑ Comparison of portfolio data items against school/course educational objectives ❑ Comparison by faculty/administrators of portfolio data items with evaluation data not included in the portfolio 	<p>within 2 weeks of the survey at the beginning of the project</p> <p>Comparison with school/course objectives will be reported at the beginning of the project and annually to Project Team.</p> <p>Comparison with items not in the portfolio reported to the Project Team annually</p>
Validity/Reliability of portfolio data items	<ul style="list-style-type: none"> ❑ Spot checks of data in the Clinical Skills Lab and patient encounters with students ❑ Computer logs of missing data, system downtime, transmission failures, etc. 	<p>Both reports will be delivered monthly to the Project Team for the first six months or until the Project Team feels that data validity/reliability is not a problem. Reports will be made biennially thereafter.</p>
Efficient/effective and reliable data flow	<ul style="list-style-type: none"> ❑ Data trails to follow data through the system ❑ Log of student/faculty reports of problems with alerts, transmitted information, lost information or wrong information ❑ The need for, or use of, a parallel paper system of evaluation data 	<p>Data trail reports will be presented to Project Team monthly for first six months and as needed (not less than quarterly) thereafter.</p> <p>Student/faculty problems will be presented monthly to the Project Team throughout the project</p> <p>The creation and use of parallel paper systems will be reported as discovered to the Project Team</p>
Integration of Portfolio data collection into curricula	<ul style="list-style-type: none"> ❑ Student/faculty assessment of time/hassle associated with portfolio data collection (survey and focus groups) ❑ Faculty/administrator descriptions of changes in curriculum to accommodate portfolio data collection (curriculum committee discussions) ❑ Time/hassle comparison with paper systems used prior to electronic data collection 	<p>Student/faculty assessments will be collected annually and reported to Project Team</p> <p>Curriculum Committee discussions (quarterly for first year - as needed thereafter) will be reported to Project Team</p> <p>Comparison will previous paper systems will be reported to Project Team after Year 1</p>

2. Use and utility of portfolio data to improve the UC educational enterprise.

Milestone	Evaluation Measures	Feedback
Student self-assessment and improvement	<ul style="list-style-type: none"> ❑ Number and type of reports generated by students of portfolio data ❑ Student educational/career decisions 	<p>Student use statistics presented to Curriculum Committees and Project Team quarterly</p>

Milestone	Evaluation Measures	Feedback
	utilizing portfolio data (survey) <input type="checkbox"/> Student assessment of portfolio (survey)	Career decisions survey reported annually to Project Team Student survey reported annually to Project Team
Faculty use of portfolio to meet students needs	<input type="checkbox"/> Number and type of reports generated by faculty <input type="checkbox"/> Use of portfolio data by faculty advisors <input type="checkbox"/> Faculty use of portfolio data for student evaluation/remediation (survey) <input type="checkbox"/> Faculty assessment of portfolio data reports (survey/focus group)	Statistics on faculty reports reviewed by Project Team monthly Faculty advisor use reported quarter to Project Team college administrators Evaluation/remediation survey conducted annually and reported to Project Team Faculty assessments conducted biennially for first two years and annually thereafter. Results reported to Project Team
Faculty integration of portfolio into teaching	<input type="checkbox"/> Faculty use of portfolio data to guide curriculum content (survey) <input type="checkbox"/> Number of students guide individually with support of portfolio data (survey and resource log) <input type="checkbox"/> Change in use of student-directed resources monitored by portfolio (resource log)	Faculty content change survey reported annually to curriculum committees and Project Team Resource logs will be reviewed and reported quarterly Faculty development of individualized instruction reported to Project Team annually
Curriculum-wide assessments and review with portfolio data	<input type="checkbox"/> Number and type of administrative reports generated from portfolio data <input type="checkbox"/> Curricular/administrative changes based on portfolio data <input type="checkbox"/> Administrator assessment of portfolio data (survey/interview)	Reports statistics will be reviewed by Project Team quarterly Curricular changes will be examined annually by Project Team and college administrators Administrator data will be reviewed biennially for the first two years and annually thereafter. The report will be reviewed by the Project Team
Impact of Portfolio on professional career behavior	<input type="checkbox"/> Survey of assessment tool use by graduates <input type="checkbox"/> Continuing Education behavior survey <input type="checkbox"/> Licensure/professional exam scores and pass rates	Survey of graduates reported annually to Project Team Exam information reported annually to Project Team and college administrators

Bibliography

1. AAMC, The role of faculty observation in assessing student's clinical skills; Contemporary Issues in Medical Education Vol 1 No 1 October 1997
2. AAMC, Emerging trends in the use of standardized patients; Contemporary Issues in Medical Education Vol 1 No 7 May 1998
3. Akehurst JC. Electronic monitoring of clinical experience during undergraduate training in diagnostic radiography. *Br J Radiol* 1999 Jan;72(853):76-9
4. Bird SB, Zarum RS, Renzi FP. Emergency medicine resident patient care documentation using a hand-held computerized device. *Acad Emerg Med* 2001 Dec;8(12):1200-3
5. Bossers A, Kernaghan J, Hodgins L, Merla L, O'Connor C, Van Kessel M. Defining and developing professionalism. *Can J Occup Ther* 1999 Jun;66(3):116-21
6. Brody JA, Camamo JM, Maloney ME. Implementing a personal digital assistant to document clinical interventions by pharmacy residents. *Am J Health Syst Pharm* 2001 Aug 15;58(16):1520-2
7. Dornan T, Lee C, Stopford A., Skills base: a Web-based electronic learning portfolio for clinical skills. *Acad Med* 2001 May;76(5):542-3
8. Duncan RG, Shabot MM. Secure remote access to a clinical data repository using a wireless personal digital assistant (PDA). *Proc AMIA Symp* 2000:210-4
9. Finlay IG, Maughan TS, Webster DJ. A randomized controlled study of portfolio learning in undergraduate cancer education. *Med Educ* 1998 Mar;32(2):172-6
10. Forker JE, McDonald ME. Methodologic trends in the healthcare professions: portfolio assessment. *Nurse Educ* 1996 Sep-Oct;21(5):9-10
11. Fung MF, Walker M, Fung KF, Temple L, Lajoie F, Bellemare G, Bryson SC. An internet-based learning portfolio in resident education: the KOALA multicentre programme. *Med Educ* 2000 Jun;34(6):474-9
12. Gallagher P. An evaluation of a standards based portfolio. *Nurse Educ Today*. 2001 Jul;21(5):409-16
13. Gathercoal P, Love D, Bryde B, McKean G. Web-based electronic portfolios. *Educause Q* 2002;25(2):29-37
14. Grant J, Ramsay A, Bain J. Community hospitals and general practice: extended attachments for medical students. *Med Educ* 1997 Sep;31(5):364-8
15. Jasper M. The portfolio workbook as a strategy for student-centred learning. *Nurse Educ Today* 1995 Dec;15(6):446-51
16. Karłowicz KA. The value of student portfolios to evaluate undergraduate nursing programs. *Nurse Educ* 2000 Mar-Apr;25(2):82-7
17. Lau A, Balen RM, Lam R, Malyuk DL. Using a personal digital assistant to document clinical pharmacy services in an intensive care unit. *Am J Health Syst Pharm* 2001 Jul 1;58(13):1229-32
18. Speer AJ, Elnicki DM. Assessing the quality of teaching. *Am J Med* 1999 Apr;106(4):381-4
19. Thompson R, Farrow T. The Workbook Portfolio: facilitating undergraduate student learning in the mental health clinical area. *Nurs Prax N Z* 1999 Jul;14(2):21-30
20. Wenzel LS, Briggs KL, Puryear BL. Portfolio: authentic assessment in the age of the curriculum revolution. *J Nurs Educ* 1998 May;37(5):208-12
21. Zubizarreta J. Teaching portfolios: an effective strategy for faculty development in occupational therapy. *Am J Occup Ther* 1999 Jan-Feb;53(1):51-5

Timeline

A detailed implementation schedule follows