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# Using systems-based practice to integrate education and clinical services

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**SUMMARY** *The authors describe one institution's strategies to implement the Accreditation Council for Graduate Medical Education's (ACGME) Outcomes Project requirements while simultaneously exploring and implementing standards of quality healthcare as endorsed by the Institute of Medicine's (IOM) Crossing the Quality Chasm (2001). Of real interest, application of the authors' institution's paradigm is identical to many of the parameters for system competence as recommended in the IOM's April 2003 report, Health Professions Education: A Bridge to Quality (2003).*

## Introduction

With the announcement of the Accreditation Council for Graduate Medical Education's (ACGME, 2001) implementation of requirements for the teaching and evaluation of six new curricular competences, the complex world of graduate medical education became bewilderingly more so. What was clear was that our institution was woefully unprepared to implement in any meaningful way these new curricula and then only with the most perfunctory methods for evaluation. And, as important, there was little consensus that there was any need for change. 'What is in fact broken?', became the commonly articulated response to the new requirements.

The Dean and the Associate Dean of Graduate Medical Education recognized that these new requirements would require a fundamental shift in the way graduate medical education is carried out in our institution. 'Wait and see' was not an option. The correct choice was to take the requests seriously and marshal our resources to respond in a meaningful way. An opportunity for synergy emerged in the agenda for quality improvement coming from the OHSU Health System's response to the quality challenge from the Institute of Medicine.

The division of Graduate Medical Education recruited an individual with graduate training and expertise in both education and psychology as Director of Medical Education, Leadership, and Evaluation. Her job was to link educational methodologies with the practical realities of the clinical care setting where training occurs, and to bring together an approach to the core competences that also improved quality care.

The first goal of the Associate Dean of Graduate Medical Education (GME) and Continuing Medical Education (CME) and the newly appointed Director of Education, Leadership and Evaluation (DELE) for both GME and CME was to identify a team of stakeholders throughout

our institution. We wanted to enlist support, expertise and knowledge from institutional leaders to design curricula and evaluation tools for the competences. In keeping with adaptive systems thinking, we believed that our micro system had the potential to create a 'ripple effect' throughout our medical school, hospitals and clinics, which would create positive change in resident education and ultimately in patient care. Our first step was an interactive dialogue with the Dean and senior hospital administrators. The Dean, an author of the Institute of Medicine's (IOM) *Crossing the Quality Chasm* (CQHCA, 2001), and the Vice President for Clinical Programs had already embraced the IOM's six quality aims (safety, effectiveness, patient-centeredness, timeliness, efficiency and equity) and were actively engaged in implementing them in the culture of our hospital. For example, implementation of this paradigm for quality healthcare at OHSU had already been addressed in the contracts between the hospital and school of medicine clinical faculty. The contract identifies the goals for healthcare through a refinement of the IOM aims into five quality principles: (1) improving the patient experience for all patients, (2) making hospitals and clinics safe in the delivery of healthcare, (3) monitoring and improving clinical outcomes, (4) designing better systems to assure timeliness and effectiveness, and (5) assuring quality while maintaining fiscal responsibility. These goals provided a foundation from which to examine the ACGME competences and our leadership recognized and easily concurred with our belief in the major convergence between the ACGME six competences and the IOM six aims as applied to the OHSU quality plan. Thus, developing new curricula and evaluation tools for the competences quickly became endorsed by leadership in the medical school and the hospital system. The 'ripple effect' of integrating resident education into existing and emerging clinical services would be larger than we had earlier envisioned. It would involve OHSU's entire healthcare system.

## Theories and principles for education and system development

Adoption of a common belief system, which identified attitudes and behaviors that we hoped to achieve, provided the foundation for creating cultural change. Several theories

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and principles of education, system growth and system change guided our work. These include problem-based learning, self-directed learning, outcome-based evaluation (ACGME, 2001), the Dreyfus Model (2001), Complex Adaptive Systems (CAS) theory (Lindberg, 1998; CQHCA, 2001), the Satir Model for System Change and the Satir Model for System Congruence (Banmen *et al.*, 1991). The following is a list of objectives distilled from these theories:

- Recognition must exist that the consequences of individual behavior/choices have an impact for the resident, team, patient, program, family, institution, larger healthcare system, etc. (CAS).
- Belief and trust in the process of teamwork (micro systems) must be present to manage and create effective methods of education and clinical care (CAS).
- Effective communication, interpersonal and intrapersonal skills, which adhere to the principles of respect and valuing for self, other and context, are necessary ingredients for the provision of quality resident education and patient healthcare (Satir Model for Systems Congruence).
- Movement through a process of change in any system creates chaos. While this chaos is generally uncomfortable and confusing, it is necessary and it becomes the catalyst for creativity and emergent transforming ideas. These new ideas are subsequently integrated into the existing status quo and then practiced, leading eventually (practice takes work and commitment) to a new, more effective status quo (Satir Model for Change).
- A knowledgeable and connected relationship to context, along with the struggles (pain) inherent in growth, leads to a process of incremental development with goals of achievement for each stage. These stages are: novice, beginner, competent, proficient, expert, and master (Dreyfus Model).
- Learning and understanding information is not enough. The learner must be able to connect ideas, and break down component parts leading to the ability to build and apply models, which can be generalized and applied to other models and practices in medicine. Finally the learner must be able to reflect on and evaluate this process, thus creating a template for self-directed and lifelong learning (problem-based learning, self-directed learning).
- Curricula need to be time limited, specific and with measurable knowledge, attitudes, skills and behavioral objectives (outcome-based education, ACGME).
- Outcome-based (criterion referenced) assessments should be used to evaluate competence. That is, the learner's evaluation is based on the application of knowledge (at his or her stage of development) as demonstrated by others who meet the criteria for novice, beginner, competent, proficient, expert and master in the field of medicine (outcome-based evaluation of Dreyfus Model).
- Mentors and evaluators of residents are expected to demonstrate competence in the ACGME required competences and the IOM Quality Aims (Dreyfus Model/outcome-based evaluation, ACGME).
- Qualitative measures are valid outcome-based evaluators and should be used in conjunction with quantitative measures. Additionally, formative evaluations leading to summative evaluations must guide the process (outcome-based evaluation, Satir Model of System Congruence).

- Healthcare professionals are expected to demonstrate the capacity for both leadership and followership. Professionals will show flexibility in the application of both skills depending on the learning and clinical context (Systems Theory and Satir Model of System Congruence).
- Institutional commitment must be made to practice, application and integration of the competences: patient care, medical knowledge, communication and interpersonal skills, professionalism, systems-based practice, practice-based learning and healthcare aims: patient-centered, safe, efficient, effective, equitable and timely (CAS, Satir Model for Change, Satir Model of Congruence, Dreyfus Model).
- Collaboration and teamwork are the cornerstones for quality healthcare. System error and dysfunction will be tackled with a focus on solutions rather than through assigning blame or through linear cause and effect processes (CAS).
- Professional attitudes and behaviors, as well as effective communication skills (while starting with the individual), are to be reflected in respectful and collaborative relationships among all healthcare providers (healthcare teams), thus exemplifying professionalism and effective communication at the system level as well as the individual level (Satir Model of Congruence).

### Transforming ideas and the process of change

As previously stated, the process of system change almost always involves a struggle with context. Our culture (context) was transforming and it was not an easy process. The ACGME, in addition to the new competences, was also requiring compliance with an 80-hour workweek for residents. Medical faculty was still reeling from the new educational demands to teach the competences and hospital administrators were struggling with strategies to implement quality healthcare improvement in an environment of shrinking resources and expanding regulatory requirements. Both groups experienced even greater chaos when they realized that increased work and decreased financial revenues would be greatly affected as they implemented the 80-hour workweek for residents. In fact, these changes had implications not only for residents, faculty, and administrators but also for all healthcare professionals in other disciplines, healthcare teams, the larger institution and ultimately patient care.

Below are some of the transforming ideas that we have implemented at OHSU to affect system change and create system congruence at the micro (individual), mezzo (team) and macro (medical school and hospital) system levels.

### Educating the faculty

Our first step was to perform a literature review and compile a resource book for program directors. This book contained portfolio assignments for each of the competences, articles for curriculum content and evaluation tools. As part of the educational process, the DELE developed a PowerPoint presentation to discuss the theoretical process models, content and evaluation measures that she had included.

These presentations provided opportunities for interactive discussions and questions from program directors and program coordinators. They were held over the course of several weeks with attention given to learners' schedules. They were sometimes lively and helpful, and as often difficult and frustrating. Creation of a new institutional context was often agonizing but several themes began to emerge: Programs needed institutional support to design curricula and evaluation methods for the competences; trainers did not feel proficient to teach the new competences or to evaluate them; and stress levels and feelings of being overwhelmed were high. We sought another transforming idea to move us from chaos towards integration.

### **Panel of experts**

The creation of a Panel of Experts was the appropriate next step. An interdisciplinary team of executive hospital administrators, including the Dean of the School of Medicine, Senior VP for Clinical Affairs, faculty, nurses, administrators and community leaders were present. Each group member was given a folder containing contact information for other group members, a description of the ACGME competences, and a description of Crossing the Quality Chasm's six aims. We used the Satir Change Process to describe the evolution of our system's plans and to set the tone for the meeting. The model acknowledges that change in any system creates chaos. While this chaos is generally uncomfortable and confusing, it is necessary and it becomes the catalyst for creativity and emergent transforming ideas. These new ideas are subsequently integrated into the existing status quo and then practiced, leading eventually (practice takes work and commitment) to a new, more effective status quo.

The Satir Change Process provided a template for creative brainstorming of transforming ideas. Individuals readily shared their thoughts about resident education and evaluation. The panel members were knowledgeable and forthcoming with suggestions for increasing resident competence and participation at all levels of the system. They generated a list of approximately 20 suggestions, questions and concerns. Examples of these suggestions included investing centrally in faculty development, inviting resident involvement in curriculum design and competence evaluation, and reviewing other successful models for teaching and evaluating the competences, in particular those in the School of Nursing. A majordomo list was created so that group members could continue to dialogue about resident education and quality patient care via email.

### **Training the trainers (Medical Educators' Workshop: Using Systems-based Practice to Teach the ACGME Competences)**

As an institution we recognized the importance of training the trainers of residents. In early fall, 23 medical teams that comprised 75 participants volunteered to participate in a three-day workshop/retreat to train resident trainers/educators. Participants were drawn from the OHSU hospital system as well as community and affiliate hospitals. In keeping with the systems-based practice competence, our institution believed that the changes in graduate medical education would be best achieved through an educational

process that included the entire healthcare system. Further, we hoped that quality improvement projects generated by residents as part of the performance improvement and systems competences would contribute to the quality improvement efforts of the hospitals. The workshop represented a collaborative effort between GME and CME to provide didactic instruction and experiential learning about the ACGME competences and IOM's quality aims. It was underwritten by a partnership among individual programs, the School of Medicine and OHSU Hospital.

Participants were invited to attend as a medical team (*mezzo system*). These teams included faculty and residents from specific hospital or clinic services, as well as hospital administrators, nurses, program administrators and other auxiliary medical staff from that same service.

Faculty for the workshop included those individuals who had been identified through the Panel of Experts for special expertise or mastery in the ACGME competences and/or IOM six aims. Additionally, experts in system dynamics and leadership development were chosen to lead the process.

The curricula focused first on the process of change as it applied to the OHSU system including team dynamics, team building and leadership. The Dean discussed professionalism and this recent historical context of accountability to the public for quality of care. An organizational model, which emphasizes respect and valuing of self, other and context as prerequisites for effective, congruent communication and decision-making, was presented. Patient communication, systems-based practice and practice-based learning were presented in some detail as well as the medical knowledge competence.

Evaluation of the workshop revealed that participants improved their performance on an objective test of the principles taught from  $53.9 \pm 14$  prior to the workshop to  $83.6 \pm 9$  following the workshop ( $p < 0.0001$ ). Additionally, they improved their impressions of awareness with 30 key competence-based elements. Finally, participants rated the overall quality of the workshop a 4 (on a scale of 1 to 5 where, 1 = poor and 5 = excellent).

### **Medical educators' updates**

Participants from the Training the Trainers' Workshop and other interested community and OHSU healthcare professionals, faculty, residents and administrators continue to attend bimonthly updates on the ACGME competences and IOM six aims. These 1½-hour sessions give individuals a chance to brainstorm ideas, develop resources and create a shared vision for best practices in education and quality healthcare.

### **Central and Internet-based data management**

To facilitate communication and assure that innovations became known a centralized process for data management was developed and provided for all graduate medical programs. This data management system needed to be available and easily accessed by all graduate medical programs. Indeed, the Internet was selected as the most effective, efficient and timely process for interactive communication with medical educators and residents. Data management

was conceptualized as having two functions: first as a storehouse for evaluation responses, statistical analysis, demographic data, rotation schedules and work hours; and second to disseminate educational materials and evaluation instruments.

### **Studying stress levels**

Chaos inherent in change creates stress for individuals and the larger system. We believed that it was important to study stress levels in residents and other members of healthcare teams. Thus, our first step was to evaluate levels of stress in residents. This proactive study assesses emotions (anxiety, depression, competence) and attitudes (satisfaction with career choice) as indicators of stress during graduate medical training in residents and career work in faculty.

Participants are asked to complete the questionnaire approximately every six weeks in order to monitor changes in their emotions, attitudes and levels of satisfaction during the residency. Eventually, we shall use the results of this study to make recommendations for the improvement of graduate medical education, faculty development and healthcare teams throughout the institution.

### **Interdisciplinary task force**

Owing to the difficulties programs have had in adapting the competences to practice, complying with the 80-hour work-week requirements and providing quality patient care, an OHSU Interdisciplinary Task Force was formed. A portion of the task force charter follows.

The purpose of the Interdisciplinary Task Force has been to ensure that OHSU and its partners together allocate resources in the most cost-efficient manner to optimize patients' care and the residents' education. Guiding principles for this endeavor include provision of the highest quality patient care with continual improvement; compliance with the work hours regulations; implementation of the competences and their evaluation methods; preservation of faculty balance of time and effort; emphasis on team practice maximizing system efficiencies.

The task force will include representation of all healthcare professionals: Graduate Medical Education; OHSU Hospital Administration; Clinical Faculty (OHSUMG); OHSU Hospital Medical Board; OHSU Hospital Nursing Administration; OHSU Pharmacy; OHSU Physician Assistants; Portland Department of Veteran Affairs.

The Task Force will be responsible to assure that at the same time OHSU Hospital's patient care is preserved and enhanced as the ACGME requirements are implemented; that previously untapped efficiencies evolving through real team practices be introduced; that, where necessary, parent department/divisions and OHSU Hospital identify mutually agreeable new resources to provide clinical services; and finally that the real change will be one of positive change in the OHSU 'culture of practice'.

### **Resident learning groups**

Culture change happens through a dialectical process of exchange among supervisors, colleagues, mentors, teams and subordinates. Interprofessional and interdisciplinary teams

provide an excellent way to engage in this process and learn many of the competences' objectives. Resident learning groups are small groups of approximately five to 10 residents, which are facilitated by interdisciplinary faculty. The foci of these groups are to provide curricula to teach competences such as patient care, professionalism, communication, interpersonal and intrapersonal skills, system-based practice and practice-based learning. They create a context where residents can learn from one another, engage in a reflection process vital to self- and system evaluation and be evaluated formatively by faculty and their peers. For example, residents are taught to describe critical incidents in patient care, followed by a process of system-based analysis and/or practice-based learning to develop plans, strategies and/or protocols to address the incident. They are to implement the new plan or protocol and evaluate its effectiveness or outcome. The learning group offers support, feedback and advice in the conceptual phase and troubleshooting/problem-solving during the implementation and evaluation phases (formative evaluation of the process).

### **Focus groups**

Implementing 'transforming ideas' in the OHSU system is not enough. We need to have an understanding of their impact/outcomes on our system. To this end, we are conducting focus groups to collect qualitative data which will be used to qualify experiences of residents, faculty, healthcare professionals and healthcare teams as they grapple with new educational requirements and new demands, knowledge application (including outcome-based assessment), shorter workweeks, quality healthcare initiatives, shrinking financial resources, and a greater demand for clinical services provided by healthcare professionals other than residents.

### **Patient care and patient complaints**

Healthcare professionals are not the only people affected by these changes. Patients are also integral to this system and will experience the consequences of these new stressors. At one end of the spectrum, we are collecting data on programs receiving frequent patient complaints, and will be able to measure the impact of communication curricula with the intent to provide remediation in areas of deficit. At the other end of the spectrum is the opportunity to contrast change in system-based care, as the OHSU system is now able to accrue data on specific disease care outcomes. We will be able to evaluate the impact of these changes on those parameters.

### **Interactive website: standards of quality healthcare and education at OHSU**

The increasing demand for a centralized location for educational resources led to the creation of a website. This website provides educators with educational resources, suggestions for best practices of quality healthcare, links to related websites and an opportunity to have interactive discussions.

## Future plans

This is not the end of our transforming ideas. As we collect data on the events and actions that are effective as well as the ones that are not, we shall continue to create, adjust, refine, integrate and practice. The hospital and health system are developing substantial new capabilities to provide clinical outcomes data to use for quality improvement and teaching. Present research includes creating models of care designed to improve patient outcomes and simultaneously integrating these models with resident education. It also means improving faculty and healthcare professionals' efficacy through education and training in the OHSU paradigm for quality care. Finally, it is of utmost importance that we develop effective methods for measuring the impact of these care models and educational experiences through collection of system outcome data. Presently we are piloting several programs to develop relevant educational experiences and models of care that include interdisciplinary teams. These teams, which comprise physicians, nurses, residents and other healthcare professionals, will pilot the model in pediatrics, ortho/trauma, diabetes and perioperative services. Eventually, we shall find those events and actions that move us more closely to a new status quo: mastery of the ACGME competences, the IOM quality aims for healthcare, and through this process bridge education with quality system outcome markers.

## Conclusion

In conclusion, the sincere attempt of our GME program to implement the new competences led to a cascade of events at OHSU that institutionally will benefit our resident graduates, our entire team of healthcare professionals and ultimately informed patient care.

The ACGME requirements represent the catalyst for members of our institution to work together as we have never worked before in an interdisciplinary effort to change our culture. Indeed our model is truly to utilize systems-based practice to teach and evaluate all of the competences.

## Notes on contributors

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## Appendix: Description of complex adaptive systems vs. mechanical systems as organizational and educational paradigms

Mechanical Systems thinking evolved as a management strategy during the industrial revolution. It continues to be an effective way to understand and manage organizational problems that are linear and close together in time and space. For example, sending letters to an incorrect zip code interferes with timely delivery of mail. The solution is to send future mail to the correct zip code.

Complex Adaptive Systems (CAS) thinking evolved from research in anthropology and physics and it has been widely adopted as a paradigm for understanding organizational structure, in family therapy and the computer industry. Recently it was recommended as a paradigm for understanding medical organizations in *Crossing the Quality Chasm*. CAS provides an effective way to comprehend and manage complex organizational events that are non-linear and distant in time and space. For example, using pesticides to kill insects that are destroying crops may indeed eliminate the insect destroying the crops only to have another insect more difficult than the first take its place. The pesticides may also pollute the surrounding streams and their inhabitants—fish. Birds and animals that eat the fish may have toxic reactions and/or develop infertility problems, etc. Following is a brief description of the major principles found in each system.

### Mechanical systems

- Behavior of system parts is known and predictable.
- Emergent behavior is problematic and control is high.
- Leadership is hierarchical.
- Complex rules may govern simple tasks.
- Linear relationship between cause and effect.
- System examples: airplanes, elevators.
- Professional examples: architect, engineer, physician.

### Naturally adaptive systems (complex systems)

- Behavioral freedom of system parts.
- Emergent behavior desired.
- Simple rules govern complex systems.

- System actions are interconnected (non-linear, ripple effect).
- Cause and effect are distant in time and space.
- Leadership is dynamic.
- System examples: US healthcare, families
- Professional examples: farmer, inventor, physician.

### **Competence: the baseline criteria for residents (Dreyfus Model)**

Theodore Dreyfus describes his model for learning in a book entitled *On the Internet* and David Leach, Executive Director of the ACGME, recommends the Dreyfus Model as a process for effectively understanding and teaching competency. The Dreyfus Model describes a process of movement through six stages: novice, advanced beginner, competent, proficient, expert and master. (Determining the criteria for assessing each stage evolves into outcome-based education and evaluation.)

Movement through these successive stages of development occurs through a process of attachment to context. Dreyfus believes that it is through a connected and intimate relationship with system context and the individuals included in that system that learners learn. Furthermore, Dreyfus believes that it is only through investing in the system context that the learner will experience the pain associated with bad decisions, as well as the pleasure associated with good decisions. The capacity to feel pain over errors and poor choices and joy over correct decisions is the most effective way for individuals to learn. This connection and relationship with context is often in contrast with the more detached and objective paradigm for learning that has dominated many educational models in medicine.

Referencing the Dreyfus Model in 'Competence is a Habit', Leach states: 'Two paths become apparent when a mistake is made. The first involves detachment and the creation of new rules that will prevent that mistake from recurring. The learner returns to the clinical arena with an even heavier rulebook [Mechanical Systems Model]. That response, according to Dreyfus, arrests development in a cycle between advanced and beginner and competent and back again. The second path, which leads up to and beyond competence, requires a more complete engagement of all human faculties. Involvement not detachment leads to accountability.' An attached relationship to context allows the learner to understand the contextual nuances necessary for well-developed comprehension and increases the likelihood that the learner will feel bad about error and good about correct decisions. This knowledgeable and intimate relationship with context provides the learner with the ability to see patterns and complexities in the context (system) as opposed to simply learning the rules about the context (Complex Adaptive Systems Model).

Attachment to context also implies a connected relationship with a teacher or mentor. It is Dreyfus's assertion that learners need a variety of mentors in order to reach their potential. It is through practice and integration of a variety of styles and techniques that the learner discovers and cultivates his/her unique and individualized style.

Leach contends that competence is a minimal standard for physicians; it is certainly not the end point that is desired.

Through a commitment to and a process of lifelong and self-directed learning, physicians are expected to continue movement through the other stages of development: proficient, expert, and master.

### **Satir model for system congruence**

The Satir Model for System Congruence (SMSC) provides a template for practicing interpersonal and communication skills within the system. It is the structural cornerstone of team development. SMSC means creating a system structure that honors and values the capabilities and needs of one's self, others within the system and the system context. Communications, decisions and negotiations within this structure take all three elements into consideration. It is a model that acknowledges and embraces differences and diversity because it views them as opportunities to learn and grow. Individuals within a congruent system have the freedom to disagree without blaming others or giving up their own position (placating). Additionally, as described in the Dreyfus Model, they are not afraid to develop an attached and intimate relationship with context and thereby accept and acknowledge the feelings associated with contextual issues. Finally, individuals in congruent systems are able to acknowledge and stay present to system and individual errors instead of 'sweeping them under the rug' or fearing blame. Congruent systems produce individuals who are able to acknowledge what is real, take responsibility for individual choices, and create solutions for problems through a process that honors and values the needs and capabilities of self, other and context.

### **Satir model of system change**

Satir, like many Complex Adaptive System thinkers, viewed the chaos associated with change as an opportunity for growth. Growth or change happens when a new element or event causes a disruption in the status quo. This event or element interferes with the system's equilibrium and throws it into chaos. Chaos is generally unsettling as the system (organism) becomes disorganized in its functioning. People and systems that are in chaos feel/are overwhelmed, stressed, anxious, depressed, irritable and do not function optimally. The system frequently desires to return to the status quo where there was familiarity with the process, even if that process was not working. However, once status quo has been changed or disrupted by the intervening element, it will never be quite the same. The best solution for movement out of chaos is to search for transforming ideas to move one/it out of chaos. Eventually these new ideas get integrated into the status quo creating something new or different. This stage can feel awkward and uncomfortable in its unfamiliarity. The next stage, which is practice, is an opportunity to develop comfort with the new status quo. During the practice stage (the novice and beginner stage) the system may also experience chaos and yearn to return to the old status quo. It is through repeated practice and adjustment (this requires an intimate relationship with context) that the system is able to experience competence in its ability to function as a new status quo.

### **Process education vs. outcome-based education**

For most of the last century education in the United States has been based on a linear, cause and effect model. Students have been expected to commit to memory vast amounts of information. The acquisition of this information was then tested through a process of normative evaluation. Individuals were compared with their peers and ranked according to their distribution in a bell-shaped curve. Those individuals scoring above the ninetieth percentile were generally able to pursue academic careers in medicine.

As society has become more complex and diverse, the linear model of education has been insufficient to stay abreast of vast and complex knowledge structures. The information explosion during the last half of the twentieth century has made knowledge acquisition almost impossible. Therefore the paradigm for education has shifted to include an emphasis on knowledge application and the development of higher order analytical, synthesizing and diagnostic skills. Knowledge acquisition has ceased to be the only goal, as knowledge application has become increasingly important. This shift in the educational process requires different processes of evaluation as well as teaching methodologies. Outcome or criterion methods of evaluation are the preferred evaluation tools. This means that medical educators are to identify the criteria for competence in skills, attitudes, knowledge and behavior in specified subject areas (the competences) and develop evaluation tools to measure them.

Understanding the criteria that are to be evaluated drives curricular development and teaching methodologies. The baseline for criteria achievement is described as a goal and the steps to achieve the goal are articulated as objectives. These objectives are operationalized as behaviors, skills, attitudes and knowledge to be obtained and demonstrated in order to signify achievement of the baseline (goal).

Criteria or outcome-based evaluations are used to measure development and eventual final demonstration of a baseline level of functioning (goal). Evaluation is approached as a process for receiving feedback in order to improve

and reach this baseline. Emphasis is not placed on how one ranks in a distribution, but rather on the individual's ability to demonstrate application of the criteria (objectives). Formative evaluations offer feedback on individual progress, thus giving individuals the opportunity to design plans of action with defined timelines to remediate deficiencies and reevaluate their level of improvement. Summative or final evaluation is based on a composite of formative evaluations or may be a separate evaluation following a series of formative evaluations.

### **Problem-based learning (PBL)**

Problem-based learning is an educational paradigm introduced as a model for teaching medical students at McMaster University. It is primarily concerned with teaching students how to solve problems (knowledge application vs. knowledge acquisition). PBL is an integrated approach and is generally taught in small learning groups. One primary goal of PBL is continued and lifelong learning. This is accomplished through teaching students how to solve problems, think critically and reflect on the process as they take responsibility for their own learning. The PBL paradigm requires students to have good interpersonal and communication skills, work collaboratively, provide useful feedback to others and be self-starters as well as investigative problem solvers. The focus on learning is student centered rather than teacher centered and teachers are generally seen as facilitators of the students' learning experience. The problem-solving function of PBL may require students to be able to apply the principles described in Bloom's Taxonomy as a process for problem solving. Briefly, Bloom's Taxonomy states that a learner must be able to connect ideas, and break down component parts leading to the ability to build and apply models, which can be generalized and applied to other models and practices in medicine. Finally the learner must be able to reflect on and evaluate this process. Thus, the template for self-directed and lifelong learning is created.