The Royal College program director's handbook chapter on **how to develop a meaningful curriculum map** is a good resource for the program director who is trying to link national competencies and EPAs with local educational strategies and assessment tools. While this resource is a bit dated because it was written prior to the implementation of Competence by Design (CBD), we feel the underlying principles and best practices of curriculum planning, design and mapping are still applicable and helpful in the context of a CBD system.

Developing a meaningful curriculum map

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Objectives

After reading this chapter you should be able to:

» explain the importance of considering the learner's needs and characteristics when developing a curriculum

» use appropriate national and/or international standards in curriculum design

» create a curriculum map that links competencies and objectives with educational strategies and assessment tools

» locate curriculum management resources

» explain the need for ongoing program evaluation and renewal

Case scenario

You are a new program director. At your program's last accreditation survey, it was suggested that the program should improve its teaching and assessment of professionalism. You have therefore decided to review how your program teaches professionalism and make changes to improve trainees' preparation in this CanMEDS Role. You have a number of questions: "**How do I determine content?**" "**How will that content best be taught?**" "**What is the best way to assess residents' mastery of the content?**" "**How can I communicate the curriculum changes to residents and faculty?**" "**How will I know whether or not the revised curriculum is achieving its objectives?**"

Background and literature scan

Answers to the questions posed in the case scenario can be achieved by systematic mapping of the curriculum. According to current thinking in medical education, optimal curriculum design has the following characteristics: it focuses on student learning rather than the teacher's teaching, it requires that teachers learn how to do their job well, it includes both horizontal

(between different subject areas) and vertical (basic sciences and clinical care) integration, it pays attention to outcomes, it recognizes the profession's responsibility to respond to societal need, and it prepares the student for professional practice.[1]

In 1949 Tyler published *Basic Principles of Curriculum and Instruction*, which focused on the administrative aspects of curricula and advised educators developing any curricular project to apply the following four basic principles[2]:

1. Define appropriate learning objectives.

2. Establish useful learning experiences.

3. Organize learning experiences for maximum cumulative effect.

4. Evaluate the curriculum and revise those aspects not proven effective.

The development of any curriculum using the Tyler method requires that hypotheses be established in direct relation to expected learning outcomes. As the curriculum is implemented, teachers become observers, determining whether or not their curricular hypotheses are in fact supported by student behaviour. After the curriculum has been delivered, educators adjust it as required to ensure that it produces the desired outcomes. In the Tyler method, students do not participate in the planning or implementation of their education; their sole role is as learner. It would be more than a quarter of a century after Tyler introduced his method before any significant criticism was made against it.

In 1975 Mager coined the term **instructional objectives.**[3] He recommended that objectives be expressed in measurable terms. He changed the focus of curriculum development to emphasize student achievement over teacher activity, stressing that these achievements should be described in behavioural, observable terms amenable to assessment. This marked the beginning of our modern view of the curriculum as a foundation for assessment. The teacher's role in shaping behaviour became less central in curriculum development, as the student's responsibility for his or her own learning was increasingly emphasized.

In recent years, competence-based curricula have become increasingly popular. In this type of curriculum, educators first define the competencies they expect their residents to demonstrate by the end of the curriculum and then conduct relevant assessments to ensure that the learners have in fact acquired these competencies.

A curriculum is more than a list of topics or objectives for a course of study. With new teaching, learning and assessment methodologies emerging, a comprehensive method for curriculum implementation is now advocated in medical education. An optimal curriculum lists all the objectives for the learners and itemizes all the experiences that will enable the learners to achieve those objectives. A curriculum map (also known as a curriculum blueprint) is a planning and communication tool that can be thought of as a road map to the curriculum: it guides learners, teachers and educational managers through the elements of the curriculum and indicates how the elements are related. It links each learning objective to one or more instructional methods and assessment tools. It renders transparent for learners, teachers, appraisers and administrators the learner's educational journey. Curriculum maps should be flexible enough that the curriculum can be modified to suit the individual preferences of the teacher and student; of course, such modifications should only take place if both parties are fully aware of what is to be achieved.

Best practices

Curriculum mapping can seem overwhelming at first, but it becomes more manageable when you realize that a common set of principles and practices can be universally applied. This section outlines best practices in systematic map design for all types and sizes of residency program.

The task is analogous to planning a trip with the educational planner as the travel agent designing the learner's educational journey. The journey should meet certain **standards**. The agent may exploit other resources to assist with planning (**curriculum management resources**). The focus must be on the learner and their needs (**learner-focused**). You should answer the following questions about the learner's "journey" through your residency program:

- » Who is the learner? (**trainee characteristics**)

- » Where is the learner going and why? (**mission and rationale**)

- » How will the learner know when the final destination is reached and his or her journey completed? (**learning objectives and outcomes**)

- » By what variety of means will the learner get to the final destination? (**learning and training process**)

- » How will the learner know the journey is unfolding smoothly and on schedule? (**assessment processes**)

- » Who will guide the learner along their way, and what are their training needs and requirements? (**faculty characteristics and development**)

- » How much time and money will the journey cost? (**resources**)

- » What mechanisms are available to the learner to provide feedback to educators on the quality of the journey? (**training process evaluation, revision and renewal**)

Once you have answered these questions, you will have all of the information you need to assemble a curriculum map. In creating the map, think about all of the groups who may use it (including students, teachers and administrators) and consider why they may use it (Table 11.1): what questions will they want answered about the curriculum?[4]

When designing a curriculum map for postgraduate medical education, be mindful that residents have significant clinical responsibilities and most of their learning must occur during their clinical work: there is limited opportunity to fill the days of the postgraduate trainee with formal learning sessions. The curriculum map must be designed to maximize the learning value of clinical experiences and must incorporate opportunities for learners to acquire knowledge and skills independently, according to their individual needs and learning style.

Table 11.1: Users of the curriculum map and their needs and questions[4]

Users	Needs	Sample questions
Curriculum planners	- Overall picture of present curriculum - Working draft of future changes to the curriculum	- What learning outcomes are covered in year 1? - How does course X contribute to the learning outcomes? - What will the curriculum look like if Y is changed?
Teachers	- Ease of access and simplicity of use - General overview of the curriculum with more details relating to the area for which they are responsible - Ability to expand the sections of the map relating to their personal input	- How does my teaching session fit into the curriculum? - What have the students learned before they start my unit? - What should they learn by the end of the unit for which I am responsible? - How is my subject or professional discipline addressed in the curriculum?
Students	- Integration with study guides - A learning tool (e.g., as an advance organizer*) - Self-assessment	- How will a particular learning experience help me? - What is expected of me in a particular course? - Where can I get help if I have a problem?
Examiners	- Identification of learning outcomes to be assessed - Basis for portfolio assessment - Security and selected limited access	- How can we be sure that the assessment reflects the curriculum? - How does this assessment relate to other assessments of the student?

Table 11.1 (Continued)

Users	Needs	Sample questions
Administrators	- Management tool - Teaching activity data - Confidentiality	- What contribution does a particular department make to the curriculum? - Who is responsible for this part of the course?
Accrediting body	- Provision of information at the required level of detail and emphasis	- Does the curriculum meet the requirements?
Potential students and public	- Simple to access - Main features presented with no jargon	- Does this program of studies appeal to me?
Educational researchers	- Detailed information on areas of interest	- What is the role of an intervention in the curriculum? - Who are the stakeholders?

*An advance organizer is a learning tool that helps a student to organize new incoming information (e.g., a case scenario about a child with scarlet fever, with attached references, that is distributed to students before a teaching session on pediatric infectious disease).

Four strategies for success

1. Base your curriculum on relevant standards

Develop your curriculum map around the needs of your learners, using the curriculum standards required for your program. Several international educational bodies have developed standards. All Canadian accredited residency programs must adhere to the Royal College of Physicians and Surgeons of Canada's General Standards of Accreditation (Textbox 11.1).[5,6] The CanMEDS 2005 framework describes the qualities that specialist physicians must possess and that every educational program should inculcate in its trainees[7] In the United Kingdom, the General Medical Council has established standards that medical curricula must meet.[8] Similar standards exist in the United States.[9]

The *Global Standards for Quality Improvement* document published by the World Federation for Medical Education provides a set of international standards organized around nine themes, or elements, which are briefly outlined below.[10] As you develop the content and style of your curriculum, these elements will help you to organize your thinking.

Textbox 11.1: Summary of general standards for programs accredited by the Royal College of Physicians and Surgeons of Canada[5,6]

A1. University structure

» There must be in place within the university a structure suitable for the conduct of postgraduate residency programs.

A2. Sites for postgraduate education

» All sites must demonstrate a major commitment to education and quality of patient care.

A3. Liaison between the university and sites

» There must be appropriate arrangements between the university and all sites involved.

B1. Administrative structure

» There must be an appropriate administrative structure for each residency program.

B2. Goals and objectives

» There must be a clearly worded statement outlining the goals of the residency program and its educational objectives.

B3. Structure and organization of the program

» There must be an organized program of rotations and other educational experiences, both mandatory and elective, designed to provide each resident with the opportunity to fulfill the educational requirements and achieve competence in the specialty or subspecialty.

B4. Resources

» There must be sufficient resources including teaching faculty, the number and variety of patients, physical and technical resources, as well as the supporting facilities and services necessary to provide all residents the opportunity to achieve the educational objectives and receive full training as defined by the specialty training requirements of the Royal College or the College of Family Physicians of Canada.

B5. Clinical, academic and scholarly content of the program

» The clinical, academic and scholarly content of the program must be appropriate for university postgraduate medical education and adequately prepare residents to fulfill all of the CanMEDS or CandMEDS-FM Roles.

» The quality of scholarship in the program will, in part, be demonstrated by a spirit of enquiry during all educational and patient encounters.

» Scholarship implies an in-depth understanding of basic mechanisms of normal and abnormal states and the application of current knowledge to practice.

B6. Evaluation of resident performance

» Mechanisms must be in place to ensure the systematic collection and interpretation of assessment data on each resident enrolled in the program.

Mission and outcomes

State the overarching purpose in a mission statement that will guide the program as well as the objectives and outcomes for the learner. This mission statement can serve as a header for the curriculum map. The objectives should then outline the knowledge, skills and attitudes that the learner must demonstrate at the completion of the curriculum. Programs accredited by the Royal College should set up their objectives according to the CanMEDS competencies, although the precise list of required competencies will vary by specialty or subspecialty.

Training process (program content)

For the enabling competencies of each CanMEDS key competency, list the areas in which learners must acquire expertise and write a corresponding learning objective. Each specialty and subspecialty society in Canada has developed discipline-specific objectives of training.[11]

Plan to deliver content in an integrated fashion, both horizontally (between subject areas) and vertically (between basic and clinical sciences). The sequence of learning should afford increasing independence and responsibility to the progressing learner.

Provide a diversity of learning experiences and locations that includes learning in practice, technical skills learning, interprofessional and peer-associated learning, formal learning activities, and self-study and reflective study.

Assessment of trainees

Determine which assessment tool you will use for each learning objective. Ensure that you employ a diversity of tools, such as written and oral examinations, objective structured clinical examinations and in-training evaluations. Constructive, ongoing feedback is mandatory, as is a well-articulated, easily accessible appeal mechanism.

Trainee characteristics and needs

Establish criteria and processes to determine how many trainees the program should enroll and which ones it should select. Ensure fair working conditions, identify centralized institutional resources for all residents, and develop program-specific resources to address any

residual needs. Chapter 13 in this manual addresses issues associated with international medical graduates.[12]

Staffing

Determine the number of administrative, technical and professional staff needed to deliver the curriculum. Provide opportunities for their continuing professional development and recognize excellent contributions.

Training settings and educational resources

Ensure that the program's learners have a sufficient number of patient encounters in community, ambulatory and in-patient settings. Include experiences with interprofessional teamwork. Ensure that the program has adequate physical and technical resources. Create an environment that fosters scientific inquiry.

Evaluation of training process

Plan recurrent monitoring and evaluation of the program on the basis of trainee feedback and performance and in light of advances in medical education and accreditation standards. Regular monitoring and evaluation processes should be overseen by the residency program committee. In addition, regular reviews of the program by the university PGME office as mandated by accreditation standards should be seen as formative opportunities for improvement.

Governance and administration

Determine the governing body responsible for final documentation and completion of training (e.g., the Royal College). The final in-training evaluation report for each learner completing a residency program in Canada will need to be signed off by the program director on behalf of the residency program committee and also by the postgraduate dean, who must ensure that all necessary processes and procedures have been applied to the resident's training experience.

Continuous renewal

Using data obtained in program evaluations (discussed earlier), update the structure, function and quality of the program as necessary to correct any deficiencies and ensure that the program is addressing societal needs.

2. Represent the elements of the curriculum spatially to show their connections

Once you have decided what your residents need to learn, who will teach them, how and when they will be taught, how they will be assessed, and what resources will be needed, it's time to display the components of the curriculum spatially so that their relationships and connections are clear and the user can get a whole picture of the curriculum. Consider each element as a curriculum "window," and fill each window with specific, nested subcomponents in a Russian-doll type model (Figs. 11.1 and 11.2).[4] It may not be relevant or necessary to map all of the elements discussed in the first strategy. The map can be represented in various ways, from a grid (Table 11.2) to a highly complex and extensive web as described by Harden[4] with the learner at its centre (Fig. 11.3). Popular software offers an electronic grid blueprint that can be installed on a computer or accessed online; it includes convenient drop-down boxes that open new windows (Fig. 11.4).[13]
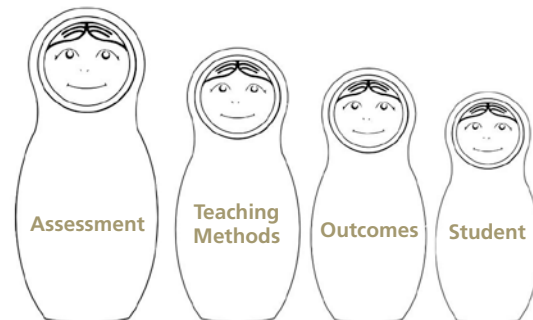
Fig. 11.1: A graphic demonstration of how curriculum components might be stacked, with the student at centre, in the style of Russian matryoshka dolls.
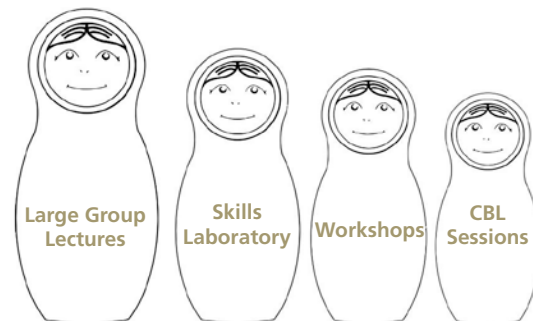
Fig. 11.2: A graphic example of how the curriculum component teaching methods might be subdivided. The methods outlined above can then be applied variably across different years of the curriculum.

Table 11.2: A grid-style curriculum map for the palliative and end-of-life care experience in the Family Medicine Residency Program at the Schulich School of Medicine and Dentistry, University of Western Ontario, created by Dr. Eric Wong and the Postgraduate Education Committee (2008). Reproduced with permission.

1.6 Palliative and end-of-life care			Core rotation	Elective rotation	Academic program
The family physician is a skilled clinician.					
The resident will be able to:					
1.6.1	K/S	Manage common palliative symptoms including pain, nausea and vomiting, dyspnea, skin care, constipation, delirium, terminal agitation, depression and anxiety, feeding and nutrition.	FM, AEM, IM, GM, PC	UC, FMH, ICU	X
1.6.2	K	Describe psychological and spiritual needs of terminally ill patients and their families.	FM, AEM, IM, GM, PC	UC, FMH, ICU	X
1.6.3	K/S	Assist terminally ill patients in decision-making around end-of-life issues (e.g., resuscitation).	FM, AEM, IM, GM, PC	UC, FMH, ICU	
1.6.4	K	Describe an approach to common legal issues in palliative care (e.g., competency, advance directives, pronouncement and certification of death).	FM, AEM, IM, GM, PC	UC, FMH, ICU	X
Family medicine is a community-based discipline.					
The resident will be able to:					
1.6.5	K/A	Describe and appreciate the role of family physicians and palliative care consultants in palliative care.	FM, AEM, IM, GM, PC	UC, FMH, ICU	
The family physician is a resource to a defined practice population.					
The resident will be able to:					
1.6.6	K/S	Identify local resources that can assist in the provision of care to terminally ill patients in various care settings: home, hospital, etc.	FM, AEM, IM, GM, PC	UC, FMH, ICU	
The patient–physician relationship is central to the role of the family physician.					
The resident will be able to:					
1.6.7	K/A	Describe the common physical, psychological, social and spiritual issues of dying patients and their families.	FM, AEM, IM, GM, PC	UC, FMH, ICU	X
1.6.8	S	Communicate effectively with terminally ill patients and their families.	FM, AEM, IM, GM, PC	UC, FMH, ICU	
1.6.9	S	Communicate bad news to terminally ill patients and their families.	FM, AEM, IM, GM, PC	UC, FMH, ICU	

Note: Specific objectives and knowledge/skills/attitudes domains are mapped to different types of learning experiences. Ideally, the map would also include the methods by which each competency is assessed.[11]

K = knowledge, **S** = skills, **A** = attitude, **FM** = family medicine, **AEM** = adult emergency medicine, **IM** = internal medicine, **GM** = geriatric medicine, **PC** = palliative care, **UC** = urgent care, **FMH** = family medicine hospitalist.

Fig. 11.3: A detailed overview of a curriculum map with 10 major windows identified.[4] For clarity the links between the windows are not shown.
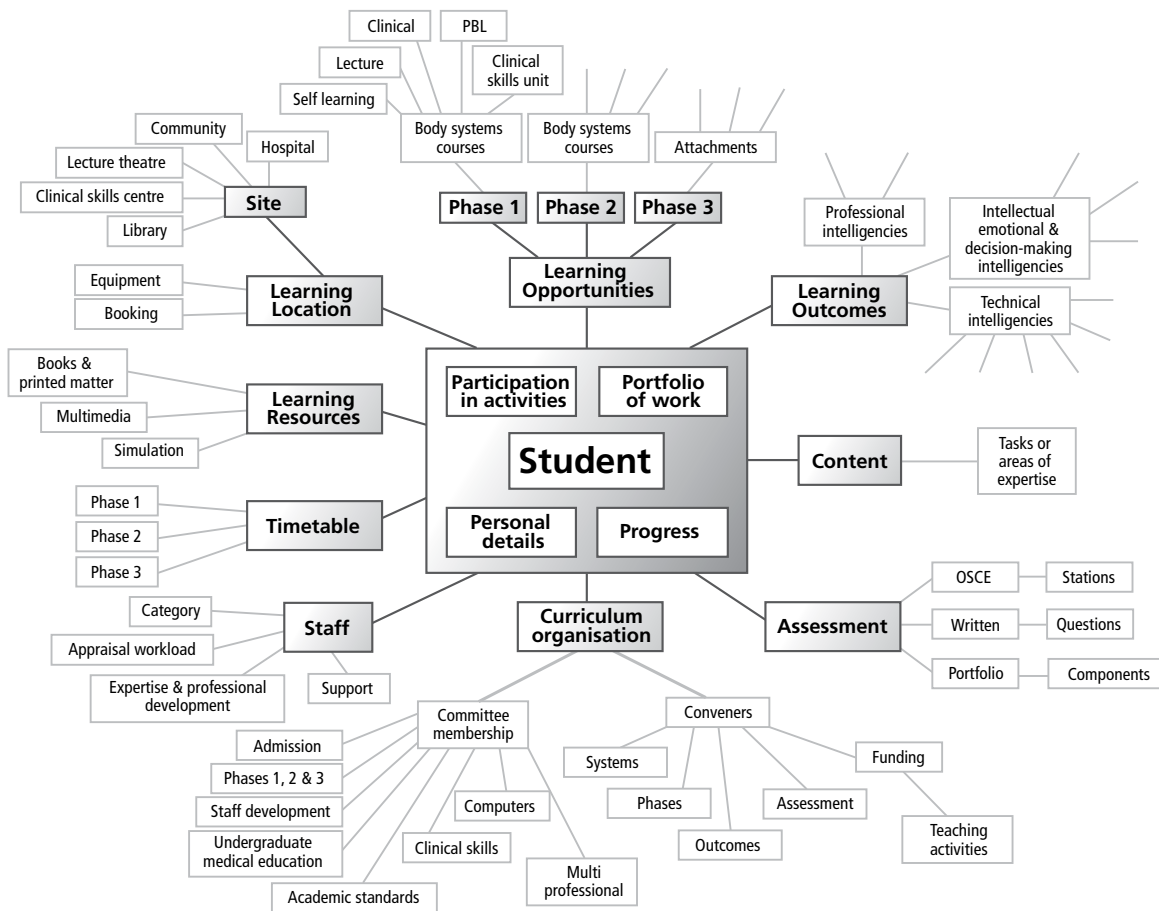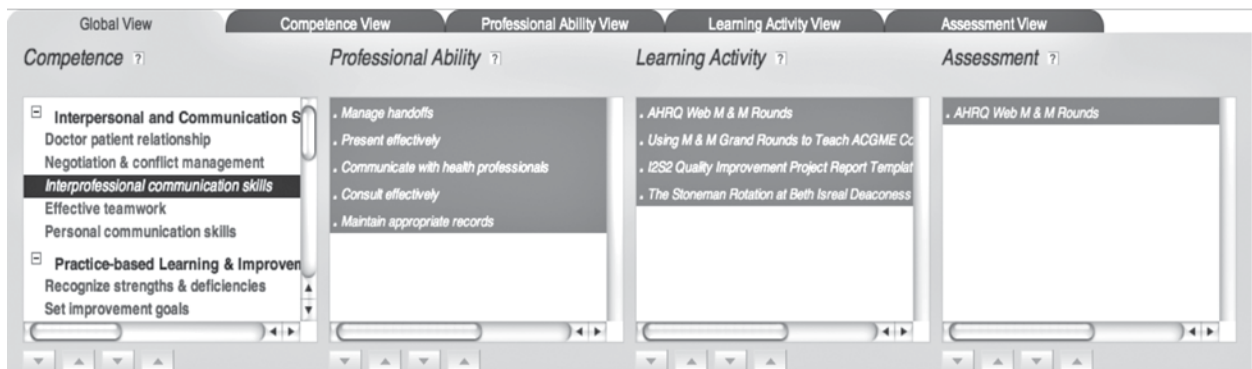

Fig. 11.4: An example of a drop-down curriculum map for the interprofessional communication skills competence at the University of Virginia School of Medicine.[13]

3. Do not reinvent the wheel

Several content management resources available online facilitate curriculum map creation, including open-source (Moodle, Zope) and commercial (Rubicon Atlas, Blackboard, Thinking Cap, Sage ACT!) (Textbox 11.2) options; it should be noted that use of these resources may require registration or fee payment or both. Two of the most popular curriculum management systems among medical educators are one45 (also known as Webeval) and CurrMIT (from the Association of American Medical Colleges). The Medbiquitous Consortium (**www.medbiq.org**) hosts an annual conference on learning technologies.

Textbox 11.2: Websites for commercial products that may be useful in curriculum mapping

» h h h Ž _V%&ŽT˘ ^ žoVRcTYžTf ccZTf]f ^ fI^ RaaZ_X

» www.aamc.org/currmit

» www.moodle.org/

» www.zope.org/

» www.rubicon.com

» www.blackboard.com/

» www.thinkingcap.com

» www.actcurriculum.org/

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4. Regard the curriculum map as a fluid document

The curriculum map is a statement of the curriculum only at one point in time, and it can and must evolve in response to changes in the health needs of society and medical education theory.

Case resolution

After seeking input from all involved stakeholders through your residency program committee, you create a grid-style curriculum map, which targets key and enabling competencies of the CanMEDS Professional Role that pertain to trainees in your program. This map is in part illustrated in Table 11.3. You also create a curriculum subcommittee charged with evaluating and renewing this new curriculum annually. You plan a process for implementing the curricular change and develop learner assessment to match the map.

Tips

» Ensure that your curriculum map is learner centred.

» Involve learners, teachers and educational planners in the planning process.

» Match the curriculum to your program's objectives and societal needs.

» Ensure that your curriculum is flexible enough to address the needs of individual learners.

» Link each competency to a variety of teaching and assessment methods, making use of the unique resources available to your program.

» Consider adopting or adapting strategies used by other programs at your university or within your specialty across Canada.

» Make sure that you pay adequate attention to educating and assessing the individuals who teach the curriculum.

» Your curriculum map should continuously evolve and must be reviewed on an ongoing basis. Include curriculum map review as a standing item on a rotating basis on the agenda for meetings of the residency program committee.

Table 11.3: Part of a curriculum map for the professionalism competency for the first postgraduate year.

Competence	Objective	Teaching methods	Resources required	Assessment methods	Faculty development
PGY1					
Commitment to patients	Deliver high-quality patient care	- Clinical experiences - Experiences with simulated patients - Portfolio for reflection	- Sufficient number of patients - Simulated patients	- In-training evaluation report - Multi-source feedback - Objective structured clinical examination - Portfolio	- Grand rounds - Faculty Development Day
Commitment to profession	Demonstrate maintenance of competence	- Attendance at conferences - Retreat - Web-based modules - Self-study	- Financial resources - Web module developer	- Portfolio for log of mandatory group learning activities - Scores from web-based modules - In-training evaluation report - MCQ/SAQ exams	- Workshop on maintenance of competence - Workshop on web-based learning

Key messages

»   It is possible to design an effective curriculum map for any aspect of a program or any size of program by systematically following a common set of curriculum standards.

»   Do not do this alone. Seek input from faculty, learners and administrators and access web-based software when possible for curriculum development and management.

»   Curriculum mapping is a fluid process. Your curriculum needs to be in a constant state of evolution, reflecting changes in educational theory and societal needs.

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*indicates key resources

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Other resources

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