

Design and implementation of an integrated medication management curriculum in an entry-to-practice Doctor of Pharmacy programme

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Abstract

Introduction: The design and implementation of the core patient care curriculum (medication management [MM]) in a new Canadian entry-to-practice doctor of pharmacy programme is described.

Curriculum Design: The MM curriculum was designed to span the first three years of the programme and comprise 75% of the programme's coursework. The goal was to achieve "multi-disciplinary" integration of pharmaceutical and clinical sciences. Seventeen modules were created, within which medical conditions were the main unit of organisation. For each condition, the "elements" (or themes) most relevant for pharmacists to develop the knowledge and skills necessary for its management were identified. A quarter of curricular time was dedicated to integration activities (IA) created for students to elaborate and integrate their knowledge and demonstrate competency. The curriculum and IA incorporated a spiral progression of complexity and level of performance across year levels, guided by a programme-level cognitive model.

Evaluation: Approaches to overcoming challenges identified through pilot-testing, faculty, student, and stakeholder feedback are described.

Keywords: *Clinical, Curriculum Design, Implementation, Integration, Medication Management, Pharmacy*

Introduction

Beginning in 2012, the Faculty embarked on the creation of a new entry-to-practice Doctor of Pharmacy (E2P PharmD) degree programme to replace the Baccalaureate of Science in Pharmacy [BSc (Pharm)] credential. The transition was part of a commitment by all pharmacy schools in Canada to establish the PharmD as the entry-to-practice degree by 2020, (Association of Faculties of Pharmacy of Canada, 2010). This was the first new entry-to-practice degree programme the faculty had created since the faculty was founded in 1946, and the first major curriculum redevelopment project since 2003 when the BSc(Pharm) curriculum was redesigned as a learning-centred curriculum, incorporating programme-level learning outcomes (Hubball & Burt, 2007).

The BSc (Pharm) programme was structured traditionally, with foundational pharmaceutical sciences (pharmaceutics, pathophysiology, medicinal chemistry, pharmacology, pharmacokinetics) taught in discreet courses, and pharmacotherapeutics and pharmacy practice skills taught in separate, self-contained lecture, laboratory and/or tutorial courses. After 2003, efforts were made to integrate curricular content across courses and disciplines, particularly therapeutics, pharmacology, and pathophysiology (Pearson & Hubball, 2012). Based on Harden's 11-step curriculum integration ladder describing the continuum from subject-based to integrated teaching

and learning, (Harden, 2000) integration at the "Step 3 Harmonisation" or "Step 5 Temporal Co-ordination" level was achieved amongst these disciplines but excluded others such as pharmaceutics and medicinal chemistry. Echoing faculty and student feedback on the programme, the siloing and lack of integration was identified as a shortcoming of the BSc (Pharm) programme in accreditation reports.

Building on the Faculty's desire to deliver a fully integrated E2P PharmD curriculum, inspiration was drawn from over 20 years of experience delivering a 2-year post-baccalaureate Doctor of Pharmacy (Graduate PharmD) programme. This programme teaches pharmacotherapeutics in a body-systems modular format (e.g., Cardiovascular, Nephrology, Dermatology), albeit with minimal foundational pharmaceutical sciences content (<https://pharmsci.ubc.ca/programs/graduate-pharmd-degree>).

This new E2P PharmD was designed as a four-year professional doctoral programme following two years of pre-pharmacy coursework, meeting the accreditation standards for First Professional Degree Programmes in Pharmacy established by the Canadian Council on Accreditation of Pharmacy Programmes (CCAPP) and the Association of Faculties of Pharmacy of Canada (AFPC). (Accreditation Standards for First Professional Degree Programmes in Pharmacy, 2012) The programme

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contains a blend of coursework and 46 weeks of experiential learning. A 19-member Task Force was created in 2012 and provided input into the programme development. The Task Force was comprised of a broad spectrum of pharmacy practice stakeholders including faculty, hospital, community and primary care pharmacists, students, and pedagogy advisors,

Early in the design process, the programme development leadership team recognised that the magnitude of the task of designing a completely new degree programme and its potential impacts on faculty, students, the profession, and other health professions would require a robust pedagogical framework to guide its design and to situate it rationally within the milieu of existing and future pharmacy education programmes. Curriculum integration, both horizontal (across disciplines) and vertical (progression of level of performance and connection to patient care pharmacy practice skills), was of primary concern in the design process. Generally speaking, curriculum integration means “the intentional uniting or meshing of discrete elements or features [of a planned educational experience” (Case, 1991: p.215) However, curricular integration in health professions training has a broad range of meanings and dimensions.(Hubball & Burt, 2007) Hence, defining and designing intentions regarding curriculum integration was carefully undertaken to ensure inclusion of the full scope of clinical and basic sciences.

The goal was to achieve, at a minimum, Harden’s “Step 9 Multi-disciplinary” level of integration, which is described as follows:

“A multidisciplinary approach brings together a number of subject areas in a single course with themes, problems, topics or issues as the focus for the students’ learning.” “The themes can delineate an area in which practical decisions have to be made and which serve as a focal point of interdisciplinary thinking.”; “...the learning is concerned not only with mastery of the tasks but with learning related to the tasks, including an understanding of the relevant basic and applied medical sciences.”; “The characteristic of multidisciplinary integration is that, whatever the nature of the theme, it is viewed through the lens of subjects or disciplines. The theme or problem is the focus for the student’s learning but the disciplines preserve their identity and each demonstrates how their subject contributes to the student’s understanding of the theme or problem.” and “In the multidisciplinary step on the integration ladder, however, the subjects and disciplines give up a large measure of their own autonomy.” (Harden, 2000: p. 554-555; Harden et al., 2009a; Harden et al., 2009b).

One of the aims was to ensure the curriculum design would not limit even higher levels of integration, such as Harden’s “Step 10 Inter-disciplinary” and “Step 11 Trans-disciplinary” if and when faculty discovered new

synergies between their disciplines that they wished to combine further.

The rationale for choosing extensive integration was five-fold: (1) previous experience with partial integration of content and assessments across courses in the BSc(Pharm) programme were well-received by students who expressed a preference for integrated vs siloed content delivery; (2) based on prior experience of teaching therapeutics in the BSc (Pharm) programme clinical faculty recognised the importance of foundational sciences to patient care problems but found students were frequently unable to see applicability in clinical problem-solving (Bandiera et al., 2013); (3) formal and informal course evaluations by students consistently expressed concerns about the relevance to practice of some foundational sciences such as medicinal chemistry and pharmaceuticals; (4) general and health education scholarship indicates that learning material from various disciplines in an integrated manner enhances student understanding of concepts and their application, engagement, and knowledge retention (Brauer & Ferguson, 2015; Case, 1991; Goldman & Schroth, 2012) and such integration is an accreditation standard for medical programmes in Canada, United States of America, Australia, Sweden, and the United Kingdom (Brauer & Ferguson, 2015); and (5) the current trend in other health professions (e.g. medicine and nursing) is for delivery of curricula focused on clinical skills, humanistic, and social learning outcomes, with de-emphasis on foundational sciences.

While there was an interest in integration across the full scope of clinical and basic sciences disciplines, current Canadian accreditation standards for pharmacy programmes do not prescribe any specific requirements for inclusion of foundational sciences (Accreditation Standards for First Professional Degree Programmes in Pharmacy, 2012). Faculty members felt that pharmacy practice is unique in its everyday reliance on the foundational sciences of pharmaceuticals, pharmacology, and pharmacokinetics and their application to patient care. The decision was made to commit even more fully to developing a curriculum that integrated the relevant foundational pharmaceutical sciences with patient care learning, while also explicitly integrating professional identity, patient preference and socio-cultural aspects of care into the programme. The approach was in keeping with the notion that “true integration demands there never be an absence of the foundational science component at any stage of the medical school curriculum” (Brauer & Ferguson, 2015: p.318) and, “a curriculum as it develops should revisit these basic ideas repeatedly, building upon them until the student has grasped the full formal apparatus that goes with them” (Bruner, 2009: p.13).

An important part of modern conceptions of curricular integration is “spiralling”, which can be thought of as both horizontal (across disciplines) and vertical (across time) integration (Brauer & Ferguson, 2015) Enabling extensive spiralling was an important objective of the curriculum design. Achieving progressively higher levels of performance on competencies requires repeated

exposure to variations on situations with escalating complexity of the problems to be solved. This is the vertical integration aspect of spiralling, and these learning experiences must be deliberately designed into the curriculum. Curricular time is also required for horizontal integration where students reinforce the connections between disciplinary content such as using their knowledge of medicinal chemistry, pharmacology, therapeutics, and their professional role in the care of a patient with, for example, rheumatoid arthritis. Although not a requirement of pharmacy programmes in Canada, medical programmes commonly require that content "... is coordinated and integrated within and across the academic periods of study, *i.e.*, horizontal and vertical integration" (Liaison Committee on Medical Education, 2015: p.14) and for "evidence of purposeful curriculum design which demonstrates horizontal and vertical integration and articulation with subsequent stages of training" (Australian Medical Council, 2012: p.8).

An environmental scan of over 100 Canadian and US E2P PharmD programmes was conducted, and identified that it is uncommon for programme curricula to integrate the full spectrum of foundational sciences with pharmacotherapeutics and pharmacy practice skills.

The primary integrated component of the programme was labeled as "Medication Management" (MM). This echoes the term used by the Canadian Pharmacists Association to involve "patient-centred care to optimise safe, effective and appropriate drug therapy. Care is provided through collaboration with patients and their health care teams." (Medication Management, 2012) and is similar in wording and meaning to "Medication Therapy Management" as coined by the American Pharmacists Association (APhA MTM Central, 2012)

Course, programme and learning activity design was guided by a robust cognitive model, which defined the required level of student performance at each year level. Expectations combined each of the seven role domains for pharmacists articulated by the Association of Faculties of Pharmacy of Canada (AFPC) with the complexity of patients/tasks in which that level of performance must be achieved. The cognitive model was the basis for describing learning objectives for all programme courses, learning activity design and assessment programme benchmarking.

Herein we describe the design and implementation of a multidisciplinary integrated medication management curriculum in a 224-student per year four-year entry-to-practice doctor of pharmacy programme.

Curriculum Design

Eight working groups were established in 2012 to make recommendations on various programme elements such as experiential education, scientific foundations, assessment, prerequisites & admissions and programme evaluation. The MM working group was struck to design the MM curriculum, including its pedagogical model, content, and course structure. The programme's Task

Force engaged with the working group, beginning with a set of guiding questions for the working group to consider. The MM working group had 17 members and was composed of academic pharmacists, practicing pharmacists, foundational scientists, academic programme leaders, students, a project manager, and with support from the university's Centre for Teaching and Learning Technology. Over the course of a year, the group met five times, reporting back to the Task Force. The proposed MM curriculum was reviewed and improved by the other curricular working groups (Experiential Education, Interprofessional Education, Scientific Foundations). The proposed MM curriculum was approved by the Task Force in 2013, and incorporated into the new degree programme proposal for Faculty, university, and provincial government approval, which was received in October 2014. While it is not feasible here to elucidate all nuances of the development process, the curriculum and salient challenges are described. The new programme launched in September 2015 beginning with the Foundations of Pharmacy course. Delivery of the first MM course commenced in January 2016.

It was determined that the MM curriculum should comprise approximately three quarters of the programme's coursework during professional years 1, 2, and 3 (PY1, 2, 3), measured in hours or credits. A modular modified body-systems approach was chosen, and 17 modules were identified (Table I). Some modules deviated from a pure body-systems approach in order to incorporate non body-systems content (*e.g.* Introduction to Infectious Diseases, Toxicology). Additional modules included Special Topics in Infectious Diseases, Toxicology, and Oncology & Palliative Care. The sequencing of the modules was designed to impart clinical skills applicable to introductory PY1 experiential contexts (*e.g.*, managing sprains and other soft tissue injuries), progressing to modules demanding background knowledge required to address more complex conditions (*e.g.* Oncology/Palliative Care). Beyond introductory clinical situations, modules were sequenced pragmatically with structure designed to allow year-over-year adjustments to the sequence and duration of modules. The 17 modules were grouped into five courses, starting in term 2 of PY1 continuing through the second term of PY3. PY4 was entirely composed of experiential learning placements, and PY1 term 1 was focused on a new Foundations of Pharmacy course designed to impart foundational knowledge and skills essential to prepare students for the MM portion of the curriculum.

Within each module, medical condition was determined to be the next unit of organisation. Criteria for inclusion were: (1) being amenable to pharmacotherapy; (2) affecting citizens of our province and country, including Aboriginal peoples; and (3) being encountered by pharmacists in community, primary care, ambulatory care and inpatient contexts. The compendium of conditions was derived from experience in the BSc (Pharm) programme, the Graduate PharmD programme, expert opinion of working group members, pharmacotherapy textbooks, and epidemiological data from Health Canada

and the provincial Ministry of Health on disease prevalence and burden.

Table I: The Modules

Course	Modules	Duration
PHRM 111: Medication Management I 15 credits PY1, Term 2 19h / week	Introduction to Infectious Diseases	4 blocks, ~76 contact h, 4 weeks
	Musculoskeletal	3 blocks, ~57 contact h, 3 weeks
	Dermatology	1 block, ~19 contact h, 1 week
	Fluids & Electrolytes	1 block, ~19 contact h, 1 week
	Head, Eyes, Ears, Nose, Throat	2 blocks, ~38 contact h, 2 weeks
	Hematology	2 blocks, ~38 contact h, 2 weeks
PHRM 211: Medication Management II 15 credits PY2, Term 1 19h / week	Respirology	5 blocks, ~95 contact h, 5 weeks
	Cardiovascular	8 blocks, ~152 contact h, 8 weeks
PHRM 212: Medication Management III 15 credits PY2, Term 2 19h / week	Nephrology	3 blocks, ~57 contact h, 3 weeks
	Endocrinology	5 blocks, ~95 contact h, 5 weeks
	Neurology	5 blocks, ~95 contact h, 5 weeks
PHRM 311: Medication Management IV 12 credits PY3, Term 1 16.5h / week	Psychiatry	4 blocks, ~76 contact h, 4.6 weeks
	Gastroenterology	3 blocks, ~57 contact h, 3.5 weeks
	Obstetrics / Sexual Health / Genitourinary	3 blocks, ~57 contact h, 3.5 weeks
PHRM 312: Medication Management V 12 credits PY3, Term 2 17h / week	Special Infectious Diseases	3 blocks, ~57 contact h, 3.4 weeks
	Toxicology	2 blocks, ~38 contact h, 2.2 weeks
	Oncology / Palliative Care	5 blocks, ~95 contact h, 5.6 weeks

PY = professional year. 1 block = 19 hours of contact time.

The duration of each module was assigned based on the number and complexity of conditions to be covered and expert opinion of the working group members. The length of each module was quantified in blocks, with each block representing 19 hours of class time. This unit of time represented approximately 75% of the total number of programme contact hours per week. In the first two programme years (PY1 & 2), each block was exactly one week, but in PY3 weeks contained only 16 hours of MM as more time was allocated to elective coursework. Hence, a block in PY3 spanned more than one week. It was important to have such a system (rather than a “weeks” system) so duration of modules was based upon

a common language in all years. Modules ranged in duration from 1 to 8 blocks, as shown in Table I.

A framework for the approach to each condition was developed with the intention of accounting for relevant knowledge and skill domains, from pathophysiology through to monitoring of pharmacotherapy for each condition in an individual patient. A careful consultative process of defining the components relevant to making therapeutic decisions for patients was undertaken by the working group, and a list of the primary components of this continuum were identified. Similar to curricular themes, these components were defined as elements and through discussion and consultation the number and nature of the elements was refined (Table II). Consideration was given to disciplines (*e.g.* epidemiology, evidence appraisal, medicinal chemistry) and to the demands of patient care (*e.g.* diagnosis, staging, physical assessment). Some components were aggregated into larger groups. For example, diagnosis, staging, and physical assessment were grouped into the “patient assessment” element; epidemiology and pathophysiology were grouped into a “pathophysiology” element.

To achieve the integration and spiralling goals described above, it was decided by consensus that 25% of MM coursework would be devoted to application of knowledge through “Integration Activities” (IA). The goal of IA was to facilitate learning in the context of patients with multiple disease states and drug therapy issues. The objectives were to (1) integrate knowledge of individual medical conditions with that of other previously encountered conditions in the context of patient cases; (2) deepen knowledge and increase competence by repeatedly encountering similar problems in different contexts (*e.g.* manifestations, populations, health care settings, interactions with other conditions, cultural considerations, interprofessional issues, etc.); (3) foster a progression through the year levels in terms of complexity of problems which can be solved and the level of performance exhibited in doing so; (4) provide a forum for reflection and active authentic problem-solving; and (5) provide time for authentic forms of assessment (*e.g.* clinical competency assessment) to occur. The learning activities in IA were designed to complement and build upon learning in the current and previous MM modules and were guided by the programme’s cognitive model.

With so many courses, modules, and elements encompassing multiple disciplines, it was recognised that defining faculty roles, responsibilities, and interactions was critical for successful planning and delivery of the MM curriculum. No precedent for this form of teaching existed in the Faculty. Development and delivery of each module would require extensive input in order to plan which topics would be covered, in what sequence, to what extent, and by whom. Additional considerations included the time allocation per condition and element, optimal learning activities and contexts (*e.g.* lecture, small group, online, reading, simulation), and the cases students encounter so as to maximally integrate the elements in patient situations. Educators would have to

collaboratively and thoughtfully determine for each condition the relevance of each element and the

Table II: Elements: For each condition in a module, these elements are considered and taught in proportion to their relevance to the condition

Element	Description	Designated Element Leader?
Epidemiology	Populations affected by the condition, and its risk factors	Module leader
Pathophysiology & Diagnostic criteria	Of the condition	Y
Patient assessment	Interview, physical assessment, laboratory and diagnostic testing, severity assessment, staging of the patient for the condition	Y
Medicinal Chemistry	Of the therapeutic options for the condition	Y
Pharmacology	Of the therapeutic options for the condition	Y
Drug delivery/Pharmaceutics	Drug delivery issues relevant to the therapeutics of the condition	Y
Pharmacokinetics	Of the therapeutic options for the condition, particularly where therapeutic drug monitoring is involved	Y
Evidence appraisal	Of the relevant evidence influencing therapeutic decision-making	Y
Therapeutics	Evaluating, implementing, monitoring and modifying pharmacotherapy based on patient needs. Includes non-pharmacologic approaches.	Module leader
Professional identity, role & advocacy	Role of the pharmacist in the management of patients with the condition	Y
Special populations & Patient preferences	Special considerations for pediatrics, aboriginal, elderly, cultural, pregnancy, race, and evidence-based patient-choice issues	Y

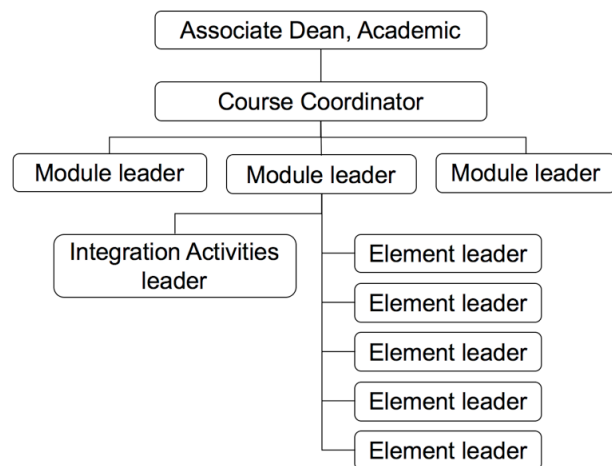
appropriate balance of time between elements. Participation of educators was defined in terms of role, and for each role an identity was defined. Faculty with the three roles described below formed the Module Team, whose task it was to collectively identify the requisite elements, their content, sequence, and time allocation for each module condition and to collaborate in planning the module’s IA. Detailed responsibilities for each role were developed and published on the programme’s website.

Following Faculty-wide debate and consultation, the principle was established that each module would have a Module Leader who would be a clinical expert in the associated area of practice (their identity), with overall responsibility for the MM module (their role). “Element

Leaders” were faculty members with expertise in the content of the associated element (e.g. medicinal chemistry). Their roles were to work with module teams to promote best practices and consistency in how that element would be taught across the modules, lend their own content expertise and/or connect the module team with an appropriate faculty member, and teach. A challenge in identifying element leaders was the lack of a clear discipline for some, such as pathophysiology, or evidence appraisal. This was used as an opportunity to assign faculty with less well-defined disciplinary identities to important curricular roles. “Integration Activities (IA) Leaders” were pharmacy practice experts with skill in designing and leading learning activities that integrate knowledge and skills in the context of patient cases across the spectrum of diseases. The role of IA Leaders was to design, plan, and lead MM learning activities that integrate knowledge and competencies, bridging elements and modules and leading students through the progression of the cognitive model.

Course Coordinators were assigned to each of the MM courses with responsibility for the overall functioning of their course, support of the faculty and students involved, between-module content reconciliation, course budget and assessment. The course coordinators reported to the programme Director, who reported to the Associate Dean Academic. Reporting relationships are depicted in Figure 1.

Figure 1: Reporting relationships within a Medication Management course

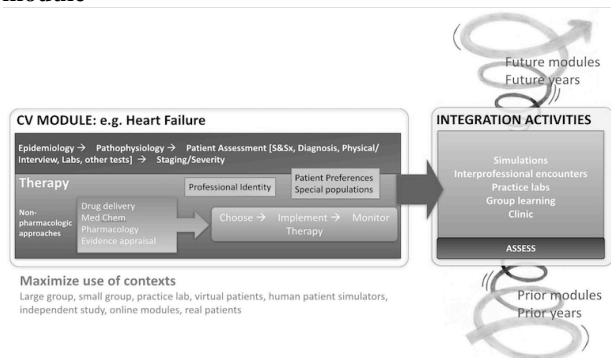


All of components and roles were designed with the primary goal of achieving Harden’s “multi-disciplinary” level of integration or higher in development of outstanding patient care skills in our students.(Harden, 2000) In addition to pedagogy and course design, achieving such integration required significant adaptation and learning by faculty, including understanding their role and identity in the curriculum, interacting with others to negotiate the amount, type, and level of content to teach and how it relates to that of other faculty, the timing of

when they teach, the format (team teaching, lecturing vs. integrated case discussions, etc.), and the student assessment expectations.

The primary graphic used to communicate the structure of a module and its elements is shown in Figure 2.

Figure 2: Anatomy of a medication management module



Implementation

Following approval of the curriculum proposal and the degree programme by the university faculty, senate, board of governors, and provincial government, a series of activities were undertaken commencing 14 months prior to the delivery of the first MM course.

The programme leadership team developed a comprehensive “Guide to Building a Medication Management Module” (“The Guide”) (<http://medman-pharmacy.sites.olt.ubc.ca>) contained detailed information about all aspects of the MM curriculum. Tools to guide module-building teams were developed, including calendar templates for each module, templates for assessment activity types, duration, and schedules, a project management plan including timelines, meeting frequencies, suggested agendas and objectives for each meeting, course-level and module-level learning objectives, and template condition-level learning objectives.

A project manager and administrative assistant coordinated the formation of each consecutive module team and assisted in the planning process, with guidance and oversight from the programme Director, course coordinators, and programme leadership team, who collectively were the architects of the curriculum.

Through a complex process which involved assessing the Faculty’s personnel resources, individual areas of expertise and interest, experience, achieving balance across the Faculty by appointment type (teaching vs. professorial track), and the roles to be filled in the new curriculum, the programme leadership team negotiated with the Faculty’s senior leadership team to determine a proposed roster of MM leadership role assignments. For transparency, it was important that the list be made available to the whole Faculty prior to the leadership team

individually approaching people to explain the request and invite them to take on the roles. This was a dynamic and challenging process for the whole Faculty as individuals determined which roles they would accept or decline, including requesting a role that had been assigned to another Faculty member. Factors contributing to faculty responses to teaching requests included perceived expertise in a clinical or basic science field, calendar timing of teaching responsibilities, perceived importance or recognition of a particular role, and the individual’s other teaching commitments. Additional challenges occurred when faculty who had accepted new roles in the programme sought to relinquish their current roles in the BSc (Pharm) programme. This required negotiation between individual faculty and the administration. Additional faculty were hired to back-fill those roles, with consequent budgetary impacts including diminished support staff funding for the new programme. It took approximately 3 months for the “final” set of assignments to be confirmed so module-building could commence.

The module teams were formed in the sequence they were to be delivered, staggered by two-three months, starting with Introduction to Infectious Diseases approximately 12 months before delivery, and progressing through the subsequent five PY1 modules. The course coordinators, programme administrative assistant, and project manager supported the module teams in the development of the modules and captured lessons learned to propagate through the other modules. The Guide was updated continuously to reflect this learning, which included, for example, updating the template for meetings and objectives, the master schedule, and the assessment schedule and format template.

To help ensure no essential medication content was missed and because many medications are potentially used for many different conditions in different modules, a curriculum-wide medication map was created. This was felt necessary because each module was overseen by a different leader and it was important that each subsequent module leader was aware to what degree and in what respects (e.g. elements, conditions, modules) specific medications had been discussed in earlier modules. The map was intended to be shared among all MM faculty and dynamically updated as drug-specific content was planned and eventually delivered. The map was initially developed by key element leaders proposing where and how best to introduce specific medication classes. This map eventually grew to include roughly 700 individual medications from approximately 125 medication classes and each drug was mapped to nine different categories which included Medicinal Chemistry, Pharmacology, Pharmaceutics-Topical, Pharmaceutics-Inhaled, Pharmaceutics-Oral, Pharmaceutics-Injected (parenteral), Pharmaceutics-Other (special), Therapeutics, Pharmacokinetics. This ongoing mapping project informs individual faculty and module leaders where and what has previously been taught. In addition, from an overall programme perspective this map facilitates the

identification of specific medications or drug classes that are overlooked or duplicated.

Recognising that the MM curriculum would require the involvement of nearly all faculty and many external clinical faculty in order to deliver the content, we regular consultation, dialogue, and faculty development was facilitated through workshops, town hall discussions, and curriculum planning retreats. The content was determined by the stage of development of the programme and feedback received from faculty about their needs and challenges. In addition to extensive consultation about the MM curriculum plan, specific themes of workshops included: interdisciplinary teamwork, fundamentals of competency-based curriculum, planning courses and learning activities guided by the cognitive model, course scheduling strategies, writing and using interdisciplinary cases for teaching, building assessment activities for integrated teaching, technology and formative assessment strategies to facilitate active learning in large classes, and flexible consultation and collaboration sessions. Gradually, over the two years of this process, nearly all faculty members became engaged, even those who traditionally were not active in curriculum discussions and some foundational scientists who had expressed reservations about the curriculum. Through the workshops we witnessed significant shifts in the Faculty's ability to collaborate across disciplines to develop cases integrating multiple elements.

Evaluation

During the MM development process, continuous feedback was solicited from participating faculty and students, and from the faculty at large at regular checkpoints. Feedback was discussed at MM Working Group meetings and decisions regarding revisions made by consensus. Modifications to most aspects of the MM curriculum occurred with group consent. Some key revisions included integration of most infectious disease conditions into body system modules rather than within a dedicated infectious diseases module and creation of criteria for inclusion of some infectious diseases (*e.g.* HIV/AIDS, febrile neutropenia, viral hepatitis) into a Special Infectious Diseases module. Feedback also resulted in distilling the number of elements (Table II) and a decision not to assign a dedicated Element Leader to each element, rather entrusting decisions about some of the more clinically-oriented elements (*e.g.* non-drug therapy) to the Module Leader. This was mainly for pragmatic reasons in order to limit the number of element leaders to ensure their roles were fulsome and their time well utilised.

The concept of clinicians as Module Leaders raised concerns from foundational sciences faculty who were concerned about demotion of their disciplinary content in the curriculum, and by clinical faculty concerned about currency of their patient care experience. Basic science faculty were encouraged to reflect on the relevance of their curricular content to patient care and streamline their

MM content to focus on this, and to create new PY3 elective courses to provide opportunities for interested students to acquire this knowledge. This appeared to be a satisfactory solution. Clinical faculty were encouraged to update their knowledge and skills and, where in-house clinical expertise was determined to be lacking, it was agreed that affiliated clinical faculty would be contracted to provide it.

From the development and consultation stages through to full programme approval key roles were referred to as Module Leader, Learning Activity Manager, and Element Coordinator in order to differentiate titles for clarity. Immediately following the role assignment stage, some faculty expressed dissatisfaction, preferring to be called "Leader", so titles were changed accordingly.

Throughout the process, a number of challenges were identified by faculty. They included:

- understanding the cognitive model,
- working together,
- co-developing authentic case scenarios that integrate multiple elements (*e.g.* pharmacokinetics with medicinal chemistry; pharmaceuticals with professional identity, role and advocacy),
- discomfort with the proposed resolution process when deciding what content to include or exclude,
- loss of independence,
- worries about the shift from a regular teaching schedule contained within a given course to teaching throughout the term(s),
- concerns about whether there was sufficient faculty to teach the planned curriculum and the increased workload for those involved in teaching in both the BSc (Pharm) and the E2P PharmD programmes,
- concerns about the feasibility of non-faculty clinicians with competing patient care or administrative responsibilities taking on significant MM roles,
- desire among those who were assigned roles in PY3 and PY4 to be involved in the programme earlier,
- faculty acceptance of and confidence in their skills to fulfil assigned roles, understanding the differences in curricular concepts between MM and the Foundations of Pharmacy course, which was also divided into "modules", and
- the tendency to seek similarities between the BSc (Pharm) and the new programme (*e.g.* between the BSc (Pharm) practice lab curriculum and MM IA programme) and therefore resist embracing the opportunities the new programme was designed to afford.

A key component of the MM curriculum was the student assessment programme. Because it was planned at the programme level and overlaid all courses, including MM, it will not be described in detail here. The assessment principles and practices used in MM were common to the

entire E2P PharmD programme and intended to be consistent across modules and courses. Module teams were tasked with concentrating mainly on the content of assessments in their module. Decisions about frequency, time devoted to assessment, mix of formative vs. summative assessment, item types, and grade distribution were to be made at the course coordinator, Assessment Director, and Programme Director level with the logistics of assessment to be managed by dedicated assessment coordinator staff. The leadership team anticipated this might be contentious, and throughout programme planning and implementation it was hoped that faculty would be willing to relinquish some control over the logistics of assessment in order to free time for other responsibilities. Striking the appropriate balance between faculty controlling the content of assessment vs. the logistics of assessment remains challenging, and evaluations of the first cycles of course delivery will be informative.

A pilot project involving integrating a limited number of the elements within a BSc (Pharm) programme course into a two-week respiratory module was undertaken 14 months before the first MM course delivery. Many of the concepts, tools, roles, project plans, teaching practices, learning activities, and assessment practices were refined and adapted based on the faculty experiences and student evaluations of this pilot module. (Brady, 2015) Students and faculty evaluated the 2-week pilot integrated respiratory module in the BSc (Pharm) programme which was delivered 14 months prior to the programme start. Evaluation involved interviews with faculty and staff, classroom observations, and student focus groups. Formal qualitative analysis methods were used to catalogue and code the responses in NVivo [www.qsrinternational.com], identify themes and report their frequency of occurrence. The main challenges identified by faculty were difficulty in establishing roles and expectations, need for revision of meeting frequency and agenda template tools, difficulty working with so many people because of disparities in their engagement and/or contributions, adjustments to working with support staff, the need to streamline administrative processes such as a file sharing and organisation, overcoming traditional ideas about curriculum design to progress from simply creating an integrated timetable to actual integration of content, and the need for a dedicated Learning Management System support person. Classroom observation identified that the delivery mainly achieved its integration and spiralling goals but there was a need for more active learning and group facilitation, and for more scheduled breaks to prevent overload. Focus groups revealed that students enjoyed the module overall and wished more of their coursework was organised this way. They also expressed concerns about discrepant messages between instructors, lack of clarity about the purpose of the short pilot, and the difficulty adjusting to this very different format for two weeks in the middle of non-modular term of coursework. This feedback informed the development of the MM curriculum, reinforcing the importance of student orientation in order to clarify the purpose, format, expectations, and logistics, identifying

natural synergies between elements (e.g. pharmacology and therapeutics, pathophysiology and physical assessment) as opportunities for team-teaching, and revision of the project management plans for module teams to use in the module development process.

Future Work

A comprehensive course evaluation process involving students and faculty was implemented for the first MM course being delivered in Spring 2016. Other MM courses will roll out consecutively, with first delivery of the final PY3 course completed in April 2018. Evaluation and outcomes results will be reported when they are available.

Summary

The concept, model, execution and challenges involved in the significant redesign of a curriculum for training pharmacists in an entry-to-practice PharmD programme is described. The new MM curriculum employs an innovative curriculum design ambitiously aimed at achieving “multidisciplinary” integration and comprises 75% of the new degree programme’s curricular time. The MM curriculum design and implementation process revealed many anticipated and unanticipated challenges for faculty in preparation for delivery. The MM curriculum commenced delivery in January 2016, just over three years from the start of planning, and is being intensively evaluated over the next three years as it rolls out and is continuously improved. As with all new curricula it will be iterated upon annually based on feedback, evaluation, personnel changes, technological, and content advances.

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