Alignment and Integration
Module for
Undergraduate Medical Education
Program
2019

Medical Council of India
Pocket-14, Sector-8, Dwarka,
New Delhi 110 077
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Foreword

Alignment and Integration

Subject based education has tremendous advantages. It provides learners with the opportunity to dwell deep into the learning matter and acquire strong fundamental concepts and the ability to build on it and attain scholarship. However, the unique needs of medical education necessitate both an understanding of "interconnectedness" between subjects and their ultimate application to the patient. In an attempt to address the need for enhancing the "wholesomeness" of education in the competency based curriculum while retaining the inherent strength and flavour of subject-based instruction, the Expert Group has recommended the use of two strategies: (a) alignment of related subject matter in a temporally coordinated fashion, and (b) use of three integration concepts that will enhance prior recall, application and emphasis of interconnectedness namely sharing, nesting and correlation.

This is a novel and challenging approach that has been suggested to further the goal of the competency driven curriculum that will require considerable planning, collaboration and team work amongst learners, teachers, planners and administrators in institutions. We believe that this investment is necessary to prepare learners to confront, adapt and be successful in the challenging environment of medical care. In addition to meeting the needs outlined, this approach will foster self-directed learning, team work, collaboration and inquiry. Importantly, the patient centricity that this approach will bring into the curriculum from year one will ensure that learners always have a connect with the ultimate goal of the MBBS program.

This booklet is intended to help institutions and teachers to design curriculum incorporating the approach suggested by the Expert Group. It is richly illustrated with examples on how to create an aligned and integrated timetable. We hope that this will be a useful guide.

We are grateful to the members of the Expert Group and the Academic Cell for painstakingly putting this booklet together. We hope that teachers and institutions will benefit from the suggestions provided herein and can successfully adapt and apply them into their own environment. We aspire to learn more and share with the nation the best practices that abound in all the medical colleges across the country. The ultimate aim of this exercise is to create a generation of doctors who will provide standard health care to the nation while becoming excellent scientists and scholars.

Chairman, Board of Governors
Foreword

Alignment and Integration

This booklet provides a suggested pattern for alignment and integration of related competencies encapsulated in different subjects for teaching competency based MBBS program which commenced on August 1, 2019 across the country. Alignment of related topics to the extent feasible is a major thrust of the competency based curriculum. The Regulations in Graduate Medical Education 2019 (GMER 2019) also suggests integration to the extent of 20% of the subject-based curriculum through horizontal and vertical integration. This booklet is in alignment with the GMER 2019 part II document and provides institutions and curriculum planners a step by step approach to create a timetable for teaching, incorporating the principles of alignment and integration.

This booklet has been developed by experts invited by the Board of Governors in supersession of the Medical Council of India and incorporates their vast expertise and experience. The Council acknowledges their time and effort dedicated in creating this guide that can be used by institutions to develop their own learning process and content. Appreciation is also due to the efforts of the Academic Cell of the Council and faculty at the various Regional and Nodal Centres of MCI who worked tirelessly to ensure that the new competency driven curriculum and its various unique components are implemented faithfully and flawlessly across the medical colleges in this country from August 2019.

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Curriculum Implementation Support Program

Module – 4

ALIGNMENT AND INTEGRATION
Alignment and Integration

Introduction

The purpose of the MBBS program is to facilitate the medical student to become a primary caregiver to patients. Learning in the various basic and clinical science subjects is predominantly directed towards achieving this purpose. The volume and details required by the student to master each subject that comprises the overall MBBS program is considerable. Subject based instruction provides an opportunity for the student to acquire both vast and deep knowledge of each subject. This structure of instruction, however, may lead to lack of appreciation by the student of the interconnected nature of knowledge in the various subjects, their relatedness, and importantly their relevance to patient care. Additionally study in silos alone may lead to redundancy in instruction.

Several innovative methods have been developed over the years to address these challenges including various levels of integration of instruction that diminishes and removes boundaries within subjects both horizontally in a phase and vertically across phases. While appreciating the value of these approaches, the proposed Graduate Medical Education Regulations (GMER) 2019 has sought to strike a balance that will retain the strength of traditional subject-based teaching and the reality of subject based assessment while providing the relevance, opportunity to understand the interconnectedness and reduce redundancy in the subjects being taught.

In order to achieve this, the MBBS curriculum will become a) aligned to the extent possible - meaning that as much as possible topics in different subjects in the same phase that have similar threads will be grouped together in the timetable and b) integrated to a limited extent both vertically and horizontally. The purpose of horizontal integration (within a phase) is to remove redundancy and provide interconnectedness. In the earlier phases, the purpose of vertical integration (across phases) is to emphasise the applicative use of the basic science concept taught. In the later phases, its purpose is to utilise and build on prior knowledge and emphasise the foundations of clinical practice.

This document is meant to guide institutions, Curriculum Committee, MEU members, and teachers on how to create a timetable that incorporates the principles that have been laid down above reflecting the spirit of the proposed GMER document 2019.

Objective

The participant must be able to:

Facilitate the development of an aligned and integrated curriculum in his/her institution as envisaged in the GMER 2019 document.
Glossary of terms used

For the purposes of this document:

**Alignment** implies the teaching of subject material that occurs under a particular organ system/disease concept from the same phase in the same time frame i.e., temporally.

**Integration** implies that concepts in a topic/organ system that are similar, overlapping or redundant are merged into a single teaching session in which subject based demarcations are removed. For the purpose of this document, topics from other phases that are brought into a particular phase for the purpose of reinforcement or introduction will also be considered as integrated topics. In the GMER 2019, time for integrated teaching is clearly demarcated.

**Linker** is a session that allows the learner to link the concepts presented in an aligned and integrated topic.

Curricular element or Program addressed

**Alignment and Integration**

<table>
<thead>
<tr>
<th>Relevant Extracts from GMER 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10.1 Preamble</strong>: The salient feature of the revision of the medical curriculum in 2019 is the emphasis on learning which is competency-based, integrated and student-centered acquisition of skills and ethical &amp; humanistic values. Each of the competencies described below must be read in conjunction with the goals of the medical education as listed in items 2 and 3 of the GMER. It is recommended that didactic teaching be restricted to less than one third of the total time allotted for that discipline. Greater emphasis is to be laid on hands-on training, symposia, seminars, small group discussions, problem-oriented and problem-based discussions and self-directed learning. Students must be encouraged to take active part in and shared responsibility for their learning. <strong>10.2 Integration</strong> must be horizontal (i.e. across disciplines in a given phase of the course) and vertical (across different phases of the course). As far as possible, it is desirable that teaching/learning occurs in each phase through study of organ systems or disease blocks in order to align the learning process. Clinical cases must be used to integrate and link learning across disciplines.</td>
</tr>
</tbody>
</table>

Subject specific competencies with appropriate alignment and integration are available in the new competency based UG Curriculum document uploaded in the Medical Council of India website.
Description of the curricular program

Alignment

Teaching related systems or topics from different subjects in the same phase is strongly recommended. This is the principal method to be followed while creating the phase-wise timetable or calendar and is called alignment (see figure 1).

Figure 1: Integration concepts framed in the GMER 2019. Coloured boxes represent subjects. 1a. Alignment - Temporal coordination: The timetable is adjusted so that topics within the subjects or disciplines which are related, are scheduled at the same time. 1b. Sharing: Two disciplines may agree to plan and jointly implement a teaching program. 1c. Correlation: The emphasis remains on disciplines or subjects with subject-based courses taking up most of the curriculum time. Within this framework, an integrated teaching session or course is introduced in addition to the subject-based teaching (green box with red border). 1d. Nesting: the teacher targets, within a subject-based course, skills relating to other subjects (Adapted from Harden R Med Edu 2000. 34; 551).

Alignment is recommended for the majority of the curriculum allowing similar systems or topics in different subjects to be learnt separately but during the same time frame.

Aligning could be done as organ system based (figure 2a) or topic/disease based (figure 2b) or both (figure 2c)

Example: Syllabi in Cardiovascular system or Respiratory system in anatomy, physiology and biochemistry can be scheduled simultaneously in the timetable (figure 2a).

Example: A topic such as acute myocardial infarction or Tuberculosis can be created with the relevant learnings that will lead to the understanding of these topics

If desired, the major alignment can be organ system based with incorporation of some specific topics that will lend itself to integration (see below).
For eg. – In CV organ system the major alignment is with two topics, Acute Myocardial Infarction and Heart failure.

These topics or organ systems that are going to be aligned should be identified by the Curriculum Committee of the teaching institution and must be taught in an aligned fashion in each phase.

The method to derive topic objectives and sessions from competencies is outlined further in this booklet.

![Timetable Image]

Figure 2a: Creating an aligned timetable using organ systems (six hours per day basis)
**Figure 2b:** Creating an aligned timetable using Topics

<table>
<thead>
<tr>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td>An</td>
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<td>An</td>
<td>An</td>
<td>Bi</td>
<td>As</td>
</tr>
<tr>
<td>Ph</td>
<td>Intro</td>
<td>Ph</td>
<td>An</td>
<td>An</td>
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<tr>
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<td>Ph</td>
<td>Ph/Bi</td>
<td>Ph/Med</td>
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<td>An</td>
<td>Bi</td>
<td>Ph</td>
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<td>Ass</td>
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<tr>
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<td>Ph</td>
<td>Ph/Phar</td>
<td>Ph</td>
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</tr>
<tr>
<td>CM</td>
<td>Ph</td>
<td>Bi</td>
<td>AETCOM</td>
<td>An</td>
<td></td>
</tr>
</tbody>
</table>

Representative timetable using showing how alignment can be done using a Aligned and Integrated Topic Based timetable.

**Figure 2c:** Creating an aligned timetable using organ systems and topics

<table>
<thead>
<tr>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro</td>
<td>An</td>
<td>An</td>
<td>An</td>
<td>Bi</td>
<td>As</td>
</tr>
<tr>
<td>Ph</td>
<td>Ph</td>
<td>Intro</td>
<td>An/Rad</td>
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<td>An</td>
<td>SDL</td>
</tr>
<tr>
<td>An</td>
<td>An</td>
<td>Ph/Bi</td>
<td>Ph</td>
<td>Ph</td>
<td></td>
</tr>
<tr>
<td>Ph</td>
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<td>An</td>
<td>Ass</td>
<td>An</td>
<td></td>
</tr>
<tr>
<td>CM</td>
<td>Ph</td>
<td>Bi</td>
<td>AETCOM</td>
<td>An</td>
<td></td>
</tr>
</tbody>
</table>

Representative timetable using showing how alignment can be done using system based timetable with use of topics in each system to improve integration.
Integration

Integration is a learning experience that allows the learner to perceive relationships from blocks of knowledge and develop a unified view of its basis and its application. The GMER 2019 applies these principles to the extent that will retain the strengths of subject based education and assessment while providing experiences that will allow learners to integrate concepts.

Keeping this in mind, the Regulations recommend the adoption of temporal coordination (called alignment in this document) as the major method to be followed allowing similar topics in different subjects to be learnt separately but during the same time frame (Fig 1a).

**Example:** Pancreatic Beta cell anatomy and histology, Pancreatic Beta cell physiology and Insulin structure and synthesis in biochemistry are usually taught at different times of the year. An effort is made to group these related topics in different subjects during the same time frame in the calendar (figure 3a and 3b).

In a small proportion - not to exceed 20% of the total curriculum an attempt can be made to share (figure 1b) topics or correlate (figure 1c) topics by using an integration or linker session. The integration session most preferred will be a case-based discussion in an appropriate format ensuring that elements in the same phase (horizontal) and from other phases are addressed.

**Example:** Since there is significant overlap in liver function in physiology and bilirubin metabolism in biochemistry - two departments could share sessions thereby reducing redundancy in what is being taught. (Note that it is not essential for two teachers to teach but it is important that the session is planned to ensure that the objectives of both subjects are achieved) (figure 3c).

As much as possible, the necessary correlates from other phases must also be introduced while discussing a topic in a given subject - Nesting (figure 1d).

**Example:** In a session on bilirubin metabolism a patient (a paper case is sufficient) with Dubin Johnson syndrome is nested as a short discussion to provide an understanding of what can go wrong, how does it manifest and what is the relevance and future application of learning bilirubin metabolism (figure 3e).

*Care must be taken to ensure that achievement of phase based objectives are given primacy* - the integrative elements from other phases are used only to provide adequate recall and understand the clinical application of concepts. It must be emphasised that integration does not necessarily require multiple teachers in each class. Experts from each phase and subject may be involved in the lesson planning but not it in its delivery unless deemed necessary.

Topics that cannot be aligned and integrated must be provided adequate time in the curriculum throughout the year. These concepts are summarised in table 1 and figure 3 (a-e).
Assessment will continue to be subject based. However, efforts must be made to ensure that phase appropriate correlates are tested to determine if the learner has internalised and integrated the concept and its application.

Table 1. Considerations for using alignment and integration in the curriculum

<table>
<thead>
<tr>
<th>Competency /Objective</th>
<th>Same Phase</th>
<th>Different Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannot be aligned with a similar topic in a different subject</td>
<td>Teach separately</td>
<td>-</td>
</tr>
<tr>
<td>eg. Lower limb anatomy and dissection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be taught together in different sessions in the same topic</td>
<td>Align</td>
<td>-</td>
</tr>
<tr>
<td>eg. Beta Cell histology in anatomy, Beta Cell function in physiology and structure and secretion of insulin, in biochemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be taught in the same session in the same topic</td>
<td>Share</td>
<td>Nest</td>
</tr>
<tr>
<td>eg. Sharing - function of the hepatocyte, in physiology and bilirubin metabolism, in biochemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>eg. Nesting - Present the clinical features and laboratory data of patient with Dubin Johnson syndrome in a session on Bilirubin metabolism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be used to link concepts taught in a particular topic</td>
<td>-</td>
<td>Correlate</td>
</tr>
<tr>
<td>eg. a patient with Type 1 Diabetes is used to understand the functions of the pancreatic islet - secretion and metabolism</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Figure 3:** Pictorial illustration of alignment and integration concepts used in the GMER

Figure 3a: Traditionally topics which have the same core of ideas in different subjects are taught at different times.

Figure 3b: Alignment is teaching these related components of a topic from different subjects at the same time i.e, in a temporally coordinated fashion.
Figure 3c: Redundancy can be reduced by creating a session, merging session objectives from two or more subjects and creating a shared session (Box with red outline).

Figure 3d: Increased correlation can be achieved by using a Linker (Box with purple outline) - usually a case (with sufficient complexity) from the same topic from a higher phase is used to anchor the learning.
Figure 3e: Appropriate concepts from other phases can be brought into a phase: to increase relevance at a lower phase or increase prior recall or reinforce the fundamental basis at a higher phase. This is done by nesting some learning objectives from the topic in other phases into a learning session.
Steps in the development of Aligned and Integrated Topic (AITo) (Figure 4)

**Figure 4:** Overview of process to create an aligned and integrated topic

**Step 1:** Identify a list of topics or organ systems that will be accommodated in the timetable as aligned and integrated topics (AITo). Examples of such topics included: Anemia, Febrile illnesses, Trauma etc. are provided in Appendix 1 of this book. Examples of organ system are Cardiovascular System, Gastrointestinal system, Endocrine system.

**Step 2:** From the subject-wise competency document book developed by the MCI, transfer the competences that address the topic into a template. Arrange these competencies according to phase and subject (see Appendix 3 for an example).

Examples for the topics are available in Appendix 1. A glossary to understand competency is available in Appendix 2. A comprehensive list of competency for the AITo Anemia is available in Appendix 3.

**Step 3:** For each competency, derive learning objectives, learning sessions and assessment methods.
a. A learning session is created by putting together a bunch of objectives that can be accomplished in the allotted time and/or require a similar method of instruction.

b. A bunch of learning sessions that are put together that address the topic from different subjects in the phase form an Aligned and Integrated Topic (AITo).

(See Figures 5-8 extracted from the Competency based UG curriculum document published by the Medical Council of India that illustrates this process).

Step 4: In each AITO of the phase, it is important to review competencies from the previous phase that will bear reinforcement in the current phase. Similarly, it is important to ensure that competencies in the next higher phases are reviewed to explore if some of these require introduction in this phase. Integration sessions allotted in each phase may be used to deliver these competencies.

a. By reviewing objectives / competencies in a phase, redundant ones and those in each subject that can be taught together without a subject demarcation can be identified for horizontal integration (Sharing).

b. Similarly, by reviewing objectives or competencies across phases, those with a common thread can be identified for vertical integration (Nesting and Correlation).

c. Objective writing and session planning must be done with teachers of all subjects involved in the aligned and integrated topic (AITo) and their inputs taken for the integrated session.

d. It is important to remember that the concept and not necessarily teachers have to be integrated. Using different teachers in each integrated session is nice but rarely required.

Step 5: Consider adding a linker to each AITO. A linker, as defined above, is a session that aptly links the various related stand-alone elements represented in an AITO and helps Correlate. In the medical curriculum, the linker is most commonly a case. A case that is creatively written can be used in each phase (often the same case) to allow students to correlate what they have learnt and apply into understanding disease process, diagnosis and care. Using a case-based discussion in small groups will, in addition, encourage collaborative and self-directed learning. Using the case discussion at different time points in AITO, will allow students to reinforce and link concepts appropriately.

An example of creating learning sessions with objectives incorporating principles of alignment, sharing, nesting and correlation is illustrated in figure 9 (1-8).

Step 6: Ensure that adequate time for the AITO is created in the time table. It is important to consider the inclusion of an end of block assessment that will count towards formative/internal assessment.

Important: While creating the timetable ensure that topics in each subject that cannot be aligned are also taught simultaneously in each subject and that the timetable accommodates these topics appropriately.
An example of timetable incorporating an aligned and integrated topic is available in Appendix 4. The functions of the AIT team in collaboration with phase-wise Curriculum subcommittee and Curriculum Committee in creating the AIT is illustrated in figure 11 in the section on governance.

![Diagram of Deriving learning objectives from competencies](image)

**Figure 5 - Deriving learning objectives from competencies**

![Diagram of Deriving learning method from competencies](image)

**Figure 6. Deriving learning methods from competencies**
Deriving assessment method from competencies

Competency: An observable ability of a health professional, integrating multiple components such as knowledge, skills, values and attitudes.

| PA42.3 | Identify the etiology of meningitis based on given CSF parameters | K/S | SH | Y |

Objective: Statement of what a learner should be able to do at the end of a specific learning experience

- **PA42.3.1** At the end of the session the PII student must be able to enumerate the most common causes of meningitis correctly
- **PA42.3.2** At the end of the session the PII student must be able to enumerate the components of a CSF analysis correctly
- **PA4.3.3** At the end of the session the PII student must be able to describe the CSF features for a given etiologic of meningitis accurately
- **PA4.3.4** At the end of the session the PII student must be able to identify the etiology of meningitis correctly from a given set of CSF parameters

Figure 7: Deriving assessment methods from competencies

Competency: An observable ability of a health professional, integrating multiple components such as knowledge, skills, values and attitudes.

| MI2.4 | List the common microbial agents causing anemia. Describe the morphology, mode of infection and discuss the pathogenesis, clinical course, diagnosis and prevention and treatment of the common microbial agents causing Anemia. | K | KH | Y |

Objective: Statement of what a learner should be able to do at the end of a specific learning experience

- **MI2.4.1** Enumerate the common microbial agents causing anaemia
- **MI2.4.2** Describe the morphology of agent (1,2 etc)
- **MI2.4.3** Describe the mode of infection of agent in humans
- **MI2.4.4** Discuss the pathogenesis of anemia caused by agent
- **MI2.4.5** Describe the clinical course of infection by agent
- **MI2.4.6** Enumerate the diagnostic tests to identify the etiology of agent as a cause of anaemia
- **MI2.4.7** Discuss the methods to prevent infection by agent

Figure 8: Marking objectives/competencies for integration
Figure 9 (1-8) has used anemia as an example for creating an Aligned and Integrated topic.

Note: A comprehensive list of competencies for the topic anemia gleaned from the competency booklet is presented in Appendix 3.

For illustrative purposes only

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**Figure 9.1** In this example two related competencies are identified from physiology (purple) and Biochemistry (Green) from the competency booklet

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**Figure 9.2** Session objectives are derived for each competency are identified
### Fig 9.3 Objectives that are similar to both subjects are marked for redundancy and sharing

<table>
<thead>
<tr>
<th>AITO - Anemia</th>
<th>Physiology</th>
<th>Biochemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1 Competencies</strong></td>
<td>Describe and discuss the synthesis and functions of Haemoglobin and explain its breakdown. Describe variants of haemoglobin KH</td>
<td>Describe the functions of haem in the body and describe the processes involved in its metabolism and derangements associated with these. KH</td>
</tr>
</tbody>
</table>

#### Session Objectives

At the end of the session the student must be able to:

a. Enumerate the steps in the synthesis of hemoglobin
b. Enumerate the steps in the breakdown of hemoglobin
c. Describe the functions of hemoglobin
d. Describe the process of oxygen carrying by hemoglobin
e. Enumerate the major variants of hemoglobin
f. Describe the structure function relationship of hemoglobin variants
g. Describe the changes in function consequent to abnormalities in hemoglobin structure
h. Describe the changes in function consequent to abnormalities in hemoglobin function

### Principle: Sharing

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### Fig 9.4 A new shared session is created merging the objectives from both subjects by removing redundancy

<table>
<thead>
<tr>
<th>AITO - Anemia</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>Describe the functions of haem in the body and describe the processes involved in its metabolism and derangements associated with these. KH</td>
</tr>
</tbody>
</table>

#### Shared Session Objectives

At the end of the session the student must be able to:

a. Describe the structure of hemoglobin
b. Enumerate the steps in the synthesis of hemoglobin
c. Enumerate the steps in the breakdown of hemoglobin
d. Describe the functions of hemoglobin
e. Describe the process of oxygen carrying by hemoglobin
f. Enumerate the major variants of hemoglobin
g. Describe the alteration seen in the major variants of hemoglobin
h. Describe the structure function relationship of hemoglobin variants
i. Describe the steps in the metabolism of hemoglobin
j. Describe the changes in function consequent to abnormalities in hemoglobin structure
k. Describe the changes in function consequent to abnormalities in hemoglobin function

#### Principle: Sharing

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If desired, subjects from other phases are reviewed for competencies that will enhance the value of the learning session - in this instance a few competencies from pathology are brought into phase I to enhance the value of learning in the shared session.
### Fig 9.6 Objectives from the pathology (brown) competencies are listed

<table>
<thead>
<tr>
<th>Competencies</th>
<th>Physiology</th>
<th>Biochemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Describe and discuss the synthesis and functions of Haemoglobin and explain its breakdown. Describe variants of haemoglobin KH</td>
<td>Describe the functions of haem in the body and describe the processes involved in its metabolism and derangements associated with these. KH</td>
</tr>
<tr>
<td></td>
<td>At the end of the session the student must be able to:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Describe the structure of haemoglobin</td>
<td>a. Describe the clinical features of sickle cell anaemia</td>
</tr>
<tr>
<td></td>
<td>b. Enumerate the steps in the synthesis of haemoglobin</td>
<td>b. Describe the hematologic indices seen in sickle cell anaemia</td>
</tr>
<tr>
<td></td>
<td>c. Enumerate the steps in the breakdown of haemoglobin</td>
<td>c. Describe the peripheral blood picture in sickle cell anaemia</td>
</tr>
<tr>
<td></td>
<td>d. Describe the functions of haemoglobin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. Describe the process of oxygen carrying by haemoglobin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>f. Enumerate the major variants of haemoglobin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>g. Describe the alteration seen in the major variants of haemoglobin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>h. Describe the structure function relationship of haemoglobin variants</td>
<td></td>
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<tr>
<td></td>
<td>i. Describe the steps in the metabolism of haemoglobin</td>
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<tr>
<td></td>
<td>j. Describe the changes in function consequent to abnormalities in haemoglobin structure</td>
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</tr>
<tr>
<td></td>
<td>k. Describe the changes in function consequent to abnormalities in haemoglobin function</td>
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<tr>
<td>Phase 2</td>
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<tr>
<td></td>
<td>Define and classify haemolytic anaemia</td>
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<tr>
<td></td>
<td>Describe the pathogenesis and clinical features and hematologic indices of haemolytic anaemia</td>
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<tr>
<td></td>
<td>Describe the pathogenesis features, hematologic indices and peripheral blood picture of sickle cell anaemia and thalassemia</td>
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</table>

### Fig 9.7: Selected objectives are “nested” to the shared session
### AITO - Anemia

#### Phase 1 Competencies

**Physiology**
Describe and discuss the synthesis and functions of haemoglobin and explain its breakdown. Describe variants of haemoglobin KH

**Biochemistry**
Describe the functions of haem in the body and describe the processes involved in its metabolism and derangements associated with these. KH

Describe the major types of haemoglobin and its derivatives found in the body and their physiological/pathological relevance. KH

---

#### Shared - nested Session Objectives

At the end of the session the student must be able to:

- a. Describe the clinical features of sickle cell anemia
- b. Describe the structure of hemoglobin
- c. Enumerate the steps in the synthesis of hemoglobin
- d. Enumerate the steps in the breakdown of hemoglobin
- e. Describe the functions of hemoglobin
- f. Describe the process of oxygen carrying by hemoglobin
- g. Enumerate the major variants of hemoglobin
- h. Describe the alteration seen in the major variants of hemoglobin
- i. Describe the structure function relationship of hemoglobin variants
- j. Describe the steps in the metabolism of hemoglobin
- k. Describe the changes in function consequent to abnormalities in hemoglobin structure
- l. Describe the changes in function consequent to abnormalities in hemoglobin function
- m. Describe the hematologic indices seen in sickle cell anemia
- n. Describe the peripheral blood picture in sickle cell anemia

Create a lesson plan based on the shared and nested elements

---

**Principle: Sharing and Nesting**

---

### AITO - Anemia

#### Phase 1 Competencies

**Physiology**
Describe and discuss the synthesis and functions of haemoglobin and explain its breakdown. Describe variants of haemoglobin KH

**Biochemistry**
Describe the functions of haem in the body and describe the processes involved in its metabolism and derangements associated with these. KH

Describe the major types of haemoglobin and its derivatives found in the body and their physiological/pathological relevance. KH

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#### Shared - nested Session Objectives

At the end of the session the student must be able to:

- a. Describe the clinical features of sickle cell anemia
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- h. Describe the alteration seen in the major variants of hemoglobin
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- k. Describe the changes in function consequent to abnormalities in hemoglobin structure
- l. Describe the changes in function consequent to abnormalities in hemoglobin function
- m. Describe the hematologic indices seen in sickle cell anemia
- n. Describe the peripheral blood picture in sickle cell anemia

If needed create a paper case with presentation diagnostic indices etc to allow students to explore it in a small group session.

The case will allow students to correlate the learning better and provide the necessary relevance

---

**Principle: Correlation**

---

### Fig 9.8
A lesson plan is created for the integrated session

---

### Fig 9.9
A paper case is often used as a linker to improve the relevance and allow greater correlation
Figure 10: Steps and oversight required in development of Aligned and Integrated Topic

The development of an aligned and integrated curriculum will require significant collaboration from all stakeholders. In addition, curricular oversight will be required for its smooth implementation.

1. The Dean as the head of the institution and also as the Chairman of the Curriculum Committee will be responsible for the overall development, implementation and oversight of the curriculum.

2. The Curriculum Committee as constituted in accordance with the directives of the MCI will:

   a. Develop a strategy for creating and implementing the curriculum and providing oversight,
   b. Decide if the alignment will be topic or organ system based,
   c. Create a phase-wise Curriculum Subcommittee (PWCSC) to oversee the creation and delivery of aligned and integrated curriculum,
   d. Create and support topic teams which will develop objectives and learning sessions for each topic across the phases,
   e. Approve and release the annual timetable for each phase,
f. Liaise with the Medical Education Unit or Department for required faculty support.

3. The Phase-wise Curricular Sub-committees (PWCSC) may be constituted with heads of Departments or key faculty in each phase with adequate representation from other phases and reporting to the Curriculum Committee. The PWCSC should:

a. Review competencies for each phase and convert them into learning objectives,

b. Align the curriculum as much as possible and enlist help from other phases in creating necessary vertical integration and links,

c. Reduce redundancy across the phase by integrating overlapping teaching elements,

d. Develop learning and assessment methods for each phase,

e. Prepare the timetable for the phase and present it to the Curriculum Committee for approval.

4. If needed, topic teams or Alignment and Integration (AIT) teams may be created. These teams will have at least one member from each department across phases and is responsible for delivery of the topics identified. The AIT team will:

a. Create learning and assessment sessions of the Aligned and Integrated Topics (AITo) identified across phases,

b. Represent the Aligned and Integrated Topic (AITo) to the phase-wise Curricular subcommittee and/or Curriculum Committee,

c. Review competencies and develop learning objectives for the topic,

d. Assign learning objectives to each phase and teaching session,

e. Develop learning and assessment methods for the AITo,

f. Help faculty with delivering session appropriately and in a collaborative manner across phases,

g. Collect feedback for the AITo, and

h. Provide student support.
Further reading

Required Reading


2. Alam Sher Malik & Rukhsana Hussain Malik, Universiti Teknologi MARA, Malaysia Twelve tips for developing an integrated curriculum". Medical Teacher 2011; 33: 99–104.

3. David G. Brauer & Kristi J. Ferguson 1, Washington University School of Medicine, USA, University of Iowa, USA; The integrated curriculum in medical education: AMEE Guide No. 96.


Additional reading

Appendix 1

Examples of aligned and integrated topics (indicative)

Anemia
Jaundice
Diabetes
Thyroid Diseases
Nutrition
Febrile Illness
Tuberculosis
Malaria
Diarrhoea
Ischemic Heart Disease
Polycystic Ovarian Syndrome
Appendix 3

How to choose competencies from different subjects in various phases for a given topic

(illustrative example)

Competencies for the topic anemia from various phases from the competency booklet volumes 1-3

<table>
<thead>
<tr>
<th>Year</th>
<th>No.</th>
<th>Competencies*</th>
<th>No.</th>
<th>Competencies*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Physiology</td>
<td>2</td>
<td>Competencies*</td>
</tr>
<tr>
<td></td>
<td>PY2 .1</td>
<td>Describe the composition and functions of blood components</td>
<td>Biochemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PY2 .2</td>
<td>Discuss the origin, forms, variations and functions of plasma proteins</td>
<td>5. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PY2 .3</td>
<td>Describe and discuss the synthesis and functions of Haemoglobin and explain its breakdown. Describe variants of haemoglobin</td>
<td>6. 11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PY2 .4</td>
<td>Describe RBC formation (erythropoiesis &amp; its regulation) and its functions</td>
<td>6. 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pathology</td>
<td>Competencies*</td>
<td>2</td>
<td>Pharmacology</td>
</tr>
<tr>
<td></td>
<td>PA1 3.1</td>
<td>Describe hematopoiesis and extramedullary hematopoiesis</td>
<td>List the common microbial agents causing anemia. Describe the morphology, mode of infection and discuss the pathogenesis, clinical course, diagnosis and prevention and treatment of the common microbial agents causing Anemia.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pharmacology</td>
<td>Describe drugs used in hematological disorders and discuss mechanism/s of action, types, doses, side effects, indications and contraindications, like 1. Drugs used in anemias 2. Colony Stimulating factors</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Microbiology</td>
<td></td>
<td></td>
<td></td>
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(illustrative example)

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<th>No.</th>
<th>Competencies*</th>
</tr>
</thead>
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<td></td>
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<tr>
<td></td>
<td>Microbiology</td>
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<tr>
<td>PA1 3.2</td>
<td>Describe the role of anticoagulants in hematology</td>
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<tr>
<td>PA1 3.3</td>
<td>Define and classify anemia</td>
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<tr>
<td>PA1 3.4</td>
<td>Enumerate and describe the investigation of anemia</td>
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</tbody>
</table>

### Medicine

| IM9.1 | Describe and classify anemia based on red blood cell size and reticulocyte count |
| IM9.2 | Describe and discuss the morphological characteristics aetiology and prevalence of each of the causes of anemia |
| IM9.4 | Describe and discuss the genetic basis of some forms of anemia |
| IM9.5 | Elicit document and present a medical history that includes symptoms, risk factors including GI bleeding, prior history, medications, menstrual history, and family history |

### Pediatrics

| PE 13 .1 | Discuss the RDA, dietary sources of Iron and their role in health and disease |
| PE 13 .2 | Describe the causes, diagnosis and management of Fe deficiency |
| PE 13 .3 | Identify the clinical features of dietary deficiency of Iron and make a diagnosis |
| PE 13 .4 | Interpret hemogram and Iron Panel |

* List of competencies only representative, not complete.
## Appendix 4

Sample time table with AIT

<table>
<thead>
<tr>
<th>Time</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
<th>Day 8</th>
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<tr>
<td>8-9 am</td>
<td>Blood and its components by a Haematologist Linker Case 1. PY 2.1 Describe the composition and functions of blood and its components</td>
<td>Linker Part A of case 1 addresses PY 2.1 PY 2.2 PY 2.9 small group discussion + Formative assessment</td>
<td></td>
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<td>Written Assessment PY 2.5 PA 13.3</td>
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<tr>
<td>9-10 am</td>
<td>Blood groups, Principles of Blood transfusion and banking PY 2.9 Describe different blood groups and discuss the clinical importance of blood grouping, blood banking and transfusion</td>
<td>Erythropoiesis – Linker part B. PY 2.5 Describe RBC formation (erythropoiesis &amp; its regulation) and its functions PA 13.1 Describe hematopoiesis and extra medullary hematopoiesis</td>
<td>Role of Iron and Vit B12 in Erythropoiesis PA 14.1 Describe iron metabolism PA 15.1 Describe the metabolism of Vitamin B12 and the etiology and pathogenesis of B12 deficiency</td>
<td>Heam synthesis and metab PY 2.3 Describe &amp; discuss synthesis &amp; functions of Hb explain its breakdown. Describe Hb variants PA 6.11 Describe the functions of haem in body and describe the processes involved in its metabolism and derangements associated. Porphyrias</td>
<td>Types of hemoglobin and their clinical significance BI 6.12 Describe the major types of Hb and its derivatives found in body and their physiological/pathological relevance.</td>
<td>Physiology of Hemolysis and Anemia PA 13.3 Define and classify anemia PY 2.5 Describe different types of anemias &amp; Jaundice</td>
<td>Linker Part B of case 1 addresses PY 2.3 , BI 6.12, PY 2.9, PA 13.3, small group discussion + Formative assessment</td>
<td></td>
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<tr>
<td>10 - 11 am</td>
<td>PY 2.9 Group A) Visit to the blood bank Group B) PY 2.11 Blood Grouping cross matching DOAP session</td>
<td>Peripheral smear examination Group B. PY 2.1 Describe the composition and functions of blood and its components OBJ A) Identify RBC, WBC and platelet in normal peripheral smear B) Discuss their functions Group B Visit to Haematology Lab / Or ALC analysis</td>
<td>Physiology practical Group A Physical practical Group B. PY 2.11 Estimate RBC count and interpret normal Group B PY 2.11 Estimate Hb, RBC indices and interpret PA 13.4 Enumerate and describe the normal blood parameters</td>
<td>Physiology practical Group A. Physical practical Group B. PY 2.12 Demonstrate the tests for ESR, Hematocrit. Note the findings and interpret the results Group B PY 2.12 Demonstrate Osmotic fragility test. Note the findings and interpret the results</td>
<td>Physiology practical Group A. Physical practical Group B. PY 2.12 Demonstrate the tests for ESR, Hematocrit. Note the findings and interpret the results Group B PY 2.12 Demonstrate Osmotic fragility test. Note the findings and interpret the results</td>
<td>Skill assessment PY 2.9, PY 2.11, PY 2.1, PA 13.4, PY 2.12</td>
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<tr>
<td>11-12.00</td>
<td>PY 2.9 Group B) Visit to the blood bank Group A) PY 2.11 Blood Grouping cross matching</td>
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<tr>
<td>1-2 pm</td>
<td>Plasma Proteins PY 2.2 Discuss the origin, forms, variations and functions of plasma proteins</td>
<td>Blood groups, Principles of Blood transfusion and banking PY 2.1, 2.2 PY 2.9 Formative Assessment Reflective exercise</td>
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<td>Non Aligned sessions in Anatomy</td>
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<td>Radiological ANATOMY Osteology Remedial</td>
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<td>3-4 pm</td>
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