Imagine a delineation of physician competencies as recently as 25 years ago. Most prominent would have been those related to medical knowledge. Operating in a Flexnerian world, knowledge was valued above all else in evaluating both the learner and the teacher. Hodges articulates this concept well in describing the prevailing competence discourse at the time as knowledge discourse, focusing on facts, foundational knowledge, basic science, and fund of knowledge. The learner was guided by classic textbooks and articles and evaluated through multiple-choice tests. The teacher in this model focused on helping students receive or elaborate knowledge. At the time, a physician was often only as effective as the knowledge he carried with him into the clinical encounter.

Enter the information and Internet age. Suddenly, knowledge is literally at our fingertips—so much of it that we can no longer carry it all with us. The Institute of Medicine report To Err Is Human underscored the conclusion that medical knowledge is no longer enough in highlighting the almost 100,000 preventable deaths due to medical errors annually. Additionally, Hojat et al recently noted that noncognitive factors (eg, empathy and conscientiousness) account for a greater proportion of the variance in physician or resident performance than cognitive abilities. It is not surprising, then, that the domain of medical knowledge is now 1 of 7 domains in our framework rather than “the” domain.

The lost primacy of medical knowledge should not be confused with a lack of importance. Medical knowledge content, the focus of this chapter, remains foundational for the practicing physician. Equally important, however, is the focus on the acquisition and application of knowledge (now part of the domain of practice-based learning and improvement) and how one communicates this knowledge to patients (interpersonal and communication skills and professionalism domains). In the end, medical knowledge will only serve to optimize care when it is integrated with the other domains and their competencies.

Competency 1. Demonstrate sufficient knowledge of the basic and clinically supportive sciences appropriate to pediatrics

Carol Carraccio, MD, MA

**Background:** Bloom’s taxonomy is helpful in thinking about both the types of knowledge and the progression of sophistication by which knowledge can be processed. According to Bloom, there are 4 types of knowledge: factual, conceptual, procedural, and metacognitive.

**Factual Knowledge**

Represents the information that one must know to be acquainted with the discipline. This includes the basic terminology and technical vocabulary and is the kind of knowledge that typically would be taught during a medical school clerkship experience.
**CONCEPTUAL KNOWLEDGE**
Focuses on the relationships between the basic facts. This enables the learner to classify, categorize, synthesize, generalize, and frame knowledge in the context of models and theories.

**PROCEDURAL KNOWLEDGE**
Encompasses the “how to” and includes algorithms and methods as well as criteria for when to use these tools.

**METACOGNITIVE KNOWLEDGE**
Includes knowledge of how one goes about learning information and knowledge of self, including one’s awareness and knowledge of one’s own cognition. A learner with metacognitive knowledge knows what he does not know and also knows the processes and strategies that will work for him to learn new information.

If the types of knowledge described by Bloom are juxtaposed with his hierarchy of complexity in cognitive processing, an integrated developmental progression of gaining and using the basic and clinical knowledge of pediatrics can be observed (Table). Bloom\(^1\) proposes the following order for cognitive processes: remember, understand, apply, analyze, evaluate, and create. As a learner progresses from remember to create, each step requires greater mental effort to achieve.

The 2-dimensional framework shown above with types of knowledge along the y-axis and the stages of cognitive processing along the x-axis illustrates a more integrated progression of the cognitive process. In this graphical representation, the most basic task is remembering factual knowledge, and the most difficult task is creating metacognitive knowledge. An example of the latter is a self-directed learner who is aware of his knowledge gaps and can create a realistic and effective learning plan that is based on knowledge of his learning style, his time management, and the types of resources that are most helpful to him.

The 2-dimensional framework should be used in conjunction with a tool, such as an in-training examination, to judge the breadth and depth of content knowledge. The latter provides for the broad sampling of content that is necessary to make a valid judgment. The typical faculty member does not have the opportunity to sample broadly. Thus, the milestones below are focused more on the types and the facility with which one uses knowledge rather than on the learner’s knowledge bank.

As with other competencies, an individual learner’s level of competence varies with specific content areas, just as it would with specific skills. For example, a given learner may be able to evaluate and apply knowledge about a common disease process, such as streptococcal pharyngitis, but when seeing a child with a rare metabolic disorder for the first time, this same learner may have to review the basic science of the biochemical pathways in order to understand the disease process and the clinical manifestations.

### DEVELOPMENTAL MILESTONES: FACTUAL, CONCEPTUAL, PROCEDURAL, AND METACOGNITIVE KNOWLEDGE

- Does not know or remember the basic content knowledge of common pediatric problems and illnesses.
- Knows the basic content knowledge of pediatrics, but is still learning to apply it to clinical situations.
- Knows the basic content knowledge of pediatric practice, and is able to synthesize and apply it in a clinical situation.
- Analyzes and categorizes knowledge in a way that allows the generation of a meaningful differential diagnosis.
- Evaluates knowledge and uses it appropriately in a given clinical encounter to develop meaningful clinical management plans.
- Learns from experience; analyzes a situation, evaluates what worked well and what did not work well in the past, and creates, adapts, or extrapolates information appropriately to new clinical situations and encounters.

### Table. Matrix of Types of Knowledge

<table>
<thead>
<tr>
<th>Types of Knowledge</th>
<th>Cognitive Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factual</td>
<td>Remember</td>
</tr>
<tr>
<td>Conceptual</td>
<td>Increasing Effort</td>
</tr>
<tr>
<td>Procedural</td>
<td></td>
</tr>
<tr>
<td>Metacognitive</td>
<td></td>
</tr>
</tbody>
</table>

The matrix advances from the lowest (factual) to the highest (metacognitive) and the hierarchy of cognitive processes advancing from the easiest (remember) to the most challenging (create). Adapted from Bloom.\(^1\)

### REFERENCE


Competency 2. Critically evaluate and apply current medical information and scientific evidence for patient care (combined with Practice-Based Learning and Improvement, Competency 6)