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Improving Medical Education by Coupling Basic Science Lectures With ICD-10 Codes

Kahley M. Stanco, OMS III; Mary Renee Prater, PhD; Araba Wubah, BS; Cameron Sumpter, BS; Fred Rawlins, DO; Harold R. Garner, PhD

At the Edward Via College of Osteopathic Medicine (VCOM), students are taught through a systems-based block education process organized according to separate organ systems. The block education lectures provide instruction on these various organ systems and their associated diseases and potential for diagnosis and treatment. A curricular initiative implemented at VCOM incorporates *International Classification of Diseases, 10th Revision* (ICD-10) codes into the preclinical curriculum to enhance student learning and recall of basic science information and to prepare them for patient encounters during clinical rotations. In constructing this curricular initiative, diseases and procedures mentioned in all lectures during the first 2 years were evaluated and matched with their corresponding ICD-10 diagnostic and procedural codes to illustrate to students how this information would be used in a clinical setting. Of 994 lectures with 36,105 slides, 4331 opportunities to associate ICD-10 codes were identified. Information was given to instructors to update their future lectures. This initiative aims to enhance the preclinical educational experience and prepare preclinical students for documenting patient care. After students have been fully exposed to this new learning component, a study is planned to analyze the effects of the curriculum.

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**Keywords:** diagnostic codes, electronic medical records, ICD-10 codes, medical curriculum annotation, procedural codes

The preclinical curriculum provides medical students with fundamentals in biomedical sciences, diagnoses, and treatments through evidence-based principles and practice. Students at the Edward Via College of Osteopathic Medicine (VCOM) in Blacksburg, Virginia, are taught through a systems-based block education process organized by separate organ systems. The block education lectures provide instruction on various organ systems and their associated diseases and potential for medical diagnosis and treatment. Along with lecture-based learning, VCOM students take part in standardized patient encounters and manikin simulations and are responsible for proper diagnosis, treatment, and documentation. One objective in designing this curriculum...
was to provide students with the fundamentals that underlie clinical decision-making.\textsuperscript{3,4} Therefore, enhancements that can better link and reinforce early fundamental knowledge with specific diagnoses and procedures encountered during the clinical years will make more knowledgeable and confident physicians.

**International Classification of Diseases, 10th Revision Codes in Medical School**

To accomplish this learning paradigm, it is first necessary to identify all opportunities for incorporating pairs of associated diagnoses and procedures and their codes into lectures, which is the major goal of the curricular initiative at VCOM. Incorporating the World Health Organization’s *International Classification of Diseases, 10th Revision* (ICD-10) codes,\textsuperscript{5} which are required for documentation and reimbursement in medical practice, is one aspect of learning and documentation that has previously been neglected, to our knowledge.\textsuperscript{6} By infusing ICD-10 or billing code concepts into the curriculum early, student learning is enhanced through paired-associate learning, as pioneered by Professor Mary Whiton Calkins in the late 1890s.\textsuperscript{7} Recall of ICD-10 codes can be enhanced from clinical rotations to residency and into practice by incorporating pairs of associated diagnoses and procedures and their codes into repeated lectures in the early block-based learning during the preclinical years.\textsuperscript{8}

The ICD-10 codes are a documentation tool consisting of a standardized series of code databases that are used in the clinical setting to identify the prevalence of diseases, symptoms, or injuries. The use of ICD-10 codes also enables monitoring the general health status of a population and defines treatment procedures and statistical data concerning health care reimbursement.\textsuperscript{5} Medical students are not exposed to ICD-10 codes (and other billing codes) and electronic medical record systems until after they graduate and begin their residency, where they are expected to not only treat patients but also document appropriately to receive reimbursement.\textsuperscript{9,11}

**Incorporating ICD-10 Codes: Initial Steps**

The diseases and treatments mentioned during 6 lecture blocks were evaluated and matched with their corresponding ICD-10 diagnostic and procedural codes to illustrate to students how this information would be used in a clinical setting in the future. The use of ICD-10 codes provides a common framework to associate diseases and procedures regardless of how they are encountered in the learning process—in lectures, readings, and clinical settings.

The lecture materials were available in PowerPoint (Microsoft Corporation) format and organized into Blocks 1 through 6 and further divided into their respective subjects. PowerPoint files, (994 files, which contained 36,105 slides) were reviewed for any content that described a diagnosis or treatment procedure. Slides describing a diagnosis or treatment procedure were logged into an Excel spreadsheet (Microsoft Corporation) with the corresponding lecture number and slide number along with any additional notes elaborating on the definition of the diagnosis or procedure. The ICD-10 logger application called Clinical Rotation Evaluation and Documentation Organizer (CREDO) was used to search keywords taken from the PowerPoint slides and matched to their respective ICD-10 code.\textsuperscript{12} For bilateral structures, such as the extremities, the code was truncated at an appropriate resolution or the term “unspecified” was used for the site of the condition. Certain conditions and treatments can be described by a range of appropriate ICD-10 codes, which were documented using the first code and the last code associated with the diagnosis. To further support the decision for choosing appropriate ICD-10 codes in the CREDO application, the same keywords were used to search website resources using Google to identify or confirm the correct ICD-10 code.

**ICD-10 Codes in Courses by Block**

Of the 994 PowerPoint files reviewed, 4331 distinct ICD-10 codes were identified that could be incorporated into lectures. As shown in Table 1, the total number and...
average number of codes per lecture identified for each block varied considerably. The breakdown of courses taught during each block and the corresponding number of opportunities for an ICD-10 code to be associated with each course within each block is shown in Table 2. Microbiology, genetics, and immunology courses were specific to the Block 1 curriculum. However, Block 1 curriculum omitted pharmacology and clinical medicine courses, which were incorporated into subsequent blocks. In Block 3, the neuroscience course was defined as a combination of neuroanatomy and physiology, which are represented as a combined category in Table 2. The frequency of ICD-10 codes per course allows us to examine the areas of medical education that have the biggest impact on diagnostic and procedural instruction. The courses containing the most ICD-10 codes are clinical medicine, with a total of 1868 codes, and pathology, with a total of 1026 codes.

The ability to break the lectures down into their components and observe the frequency of disorders or procedures within a subject is recorded in an Excel spreadsheet, a portion of which is shown in Figure 1. As an example, in the clinical medicine course from Block 2, the same ICD-10 code that encompassed various types of muscular dystrophy outlined in the lecture material was observed in subsequent slides and lectures. The consecutive use of codes was apparent not only within the same subject but among other subjects, as well as among each block. As a result, it was possible to use previously determined codes for disorders to match to the same diagnosis taught in subsequent lectures, and it gives a measure of the amount of repetition and redundancy experienced by medical students during lectures.

All procedure codes have 7 digits, which are used to obtain the maximum specificity for a procedure or treatment, usually required for proper reimbursement. For example, in Block 2 musculoskeletal system lectures, the osteopathic manipulative medicine (OMM) codes for both upper and lower extremities are shown in Figure 2. A difference can be seen between the codes varying by 1 number, which distinguishes between either the upper or lower extremity. Therefore, documenting a diagnosis for certain procedures in an

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Table 1.
Preclinical Lecture Material Contains Many Diagnostic and Procedure Mentions That Are Annotated With ICD-10 Codes

<table>
<thead>
<tr>
<th>First-Year Curriculum</th>
<th>Lectures (n)</th>
<th>Diagnostic ICD-10 Codes, No.</th>
<th>Procedural ICD-10 Codes, No.</th>
<th>Total Codes, No.</th>
<th>Codes per Lecture, Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1 – Foundations of Medicine</td>
<td>176</td>
<td>401</td>
<td>4</td>
<td>405</td>
<td>2.3</td>
</tr>
<tr>
<td>Block 2 – Musculoskeletal System</td>
<td>130</td>
<td>525</td>
<td>31</td>
<td>556</td>
<td>4.3</td>
</tr>
<tr>
<td>Block 3 – Nervous System</td>
<td>166</td>
<td>964</td>
<td>13</td>
<td>977</td>
<td>5.9</td>
</tr>
<tr>
<td>Block 4 – Cardiopulmonary System</td>
<td>180</td>
<td>719</td>
<td>43</td>
<td>762</td>
<td>4.2</td>
</tr>
<tr>
<td>Block 5 – Gastrointestinal and Renal Systems</td>
<td>174</td>
<td>830</td>
<td>5</td>
<td>835</td>
<td>4.8</td>
</tr>
<tr>
<td>Block 6 – Endocrine and Reproductive Systems</td>
<td>168</td>
<td>779</td>
<td>17</td>
<td>796</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Abbreviation: ICD-10, International Classification of Diseases, 10th Revision.
extremity requires knowing the 1 numerical code variance for either upper or lower. For example, within the OMM codes, there are differences between techniques used for treatment, such as indirect, fascial release, and muscle energy. A total of 11 indirect, 11 muscle energy, 5 fascial releases, 2 general mobilizations, and 2 other methods were correlated with the osteopathic manipulative treatment (OMT) techniques taught during Block 2.

The majority of codes related to OMT and the diagnosis of somatic dysfunctions were found during Block 2 because of the systems-based focus on musculoskeletal conditions. As more systems are added, it is postulated that more OMT codes will emerge in conjunction with the findings of somatic dysfunctions in the diagnostic criteria taught to accompany specific treatment options.

The ICD Logger application and standard Google web searches for keywords are essential to thoroughly correlate every ICD-10 code appropriately. Both search tools enabled us to identify diagnoses and procedures by their formal ICD-10 name or a variety of synonyms, including their generic or trade names.

### Integrating ICD-10 Codes in Lectures

The spreadsheet of ICD-10 codes associated with specific lectures was distributed to VCOM first-year lecturing faculty so that they could incorporate the codes into their lectures. Instructors determined how and to what extent they wished to incorporate the information into their lectures. The effect will be quantifiable after the next full year, when we plan to survey the faculty and students on how this information was used and the information’s perceived value.

Qualitatively, faculty who embraced the concept have commented on the ease of incorporating the information into their lectures and have indicated that they specifically inform students that this new material is for familiarization, and it is not required that any specific codes be memorized. In general, the students’

### Table 2.

ICD-10 Annotations Spanning Basic Science Disciplines Taught in the First Year of Medical School

<table>
<thead>
<tr>
<th>First-Year Curriculum</th>
<th>Cell Biology/Physiology</th>
<th>Anatomy</th>
<th>Principles of Primary Care-OMM</th>
<th>Pathology</th>
<th>Clinical Medicine</th>
<th>Pharmacology</th>
<th>Microbiology</th>
<th>Genetics</th>
<th>Immunology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1 – Foundations of Medicine</td>
<td>43</td>
<td>12</td>
<td>11</td>
<td>58</td>
<td>NA</td>
<td>NA</td>
<td>139</td>
<td>87</td>
<td>55</td>
</tr>
<tr>
<td>Block 2 – Musculoskeletal System</td>
<td>16</td>
<td>71</td>
<td>102</td>
<td>125</td>
<td>232</td>
<td>10</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Block 3 – Nervous System</td>
<td>64*</td>
<td>123</td>
<td>180</td>
<td>558</td>
<td>52</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Block 4 – Cardiopulmonary System</td>
<td>66</td>
<td>67</td>
<td>46</td>
<td>236</td>
<td>312</td>
<td>35</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Block 5 – Gastrointestinal and Renal Systems</td>
<td>45</td>
<td>73</td>
<td>39</td>
<td>264</td>
<td>378</td>
<td>30</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Block 6 – Endocrine and Reproductive Systems</td>
<td>48</td>
<td>NA</td>
<td>72</td>
<td>163</td>
<td>388</td>
<td>121</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

* The neuroscience course is represented as a combination of both cell biology/physiology and anatomy.

**Abbreviations:** ICD-10, International Classification of Diseases, 10th Revision; NA, not applicable (discipline not taught during block); OMM, osteopathic manipulative medicine.
initial perception was that it was beneficial to have a precise code that would orient them early during pre-clinical training to prepare for what they will encounter during clinical rotations. Students also indicated that an introduction by faculty would help them cope with more specificity in the future.

Discussion

Approximately 4331 distinct ICD-10 codes from Blocks 1 through 6 were identified and compiled into an Excel spreadsheet for faculty lecturers to incorporate these codes into their future lectures. Ultimately, this curricular initiative will expose medical students to more than 5000 distinct ICD-10 codes by the end of their second year. Medical students should then become more comfortable with the use of ICD-10 codes, which will be valuable to their future practice.

The ICD Logger application will also serve as a board preparation modality by merging the ICD-10 codes found throughout the preclinical curriculum with the relevant content found from the annotated slides. Students who then log an ICD-10 code for a specific diagnosis or procedure receive a pop-up window within the Logger that provides a key factor high-yield concept pertaining to their documentation. With the ICD application, third- and fourth-year students can review board-relevant material while they are seeing patients in clinics.
Throughout this curricular initiative, we identified areas that required ancillary resources to choose the most appropriate ICD-10 codes that correspond to lecture material. The need for ancillary resources was predominantly seen in (1) genetic disorders that require knowing inheritance patterns that specified the underlying cause, such as arthritis or osteoporosis, and (2) OMT, which requires knowing the type of technique performed for proper documentation with an ICD-10 code, such as using direct vs indirect muscle energy. Some identified codes that were less descriptive or specific were found to more closely match the more generalized diagnosis. Therefore, we identified a range of specificity in code use opportunities, reflecting what is encountered in practice, which could require understanding more detail and diagnostic criteria beyond the scope of first-year medical education.

Currently, the overall impact of the curricular initiative is unknown, although anecdotal information from faculty and students has been positive. We plan to have quantified, reportable statistics in approximately 1 year, after students have been fully exposed to this new learning component. In addition to the planned survey instrument, this dataset of lectures and associated codes have afforded us the opportunity to create other learning opportunities. Our plan is to install lecture content into our CREDO application so that throughout clinical rotations, residencies, and practices. Undoubtedly, students who are exposed to ICD-10 codes and understand their clinical context for use will be better physicians and more equipped to improve the quality of health care.

Conclusion

The overall objective of the medical school curriculum is to develop critical thinking skills and clinical medicine foundations to treat real patients with the same standard of care across the nation. We identified many opportunities to incorporate universal ICD-10 codes into faculty lectures that will provide students with more exposure to this tool before their clinical rotations, residencies, and practices. We plan to have a range of specificity in code use opportunities, reflecting what is encountered in practice, which could require understanding more detail and diagnostic criteria beyond the scope of first-year medical education.

Acknowledgments

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References