From Novice to Expert: Problem Solving in ICD-10-PCS Procedural Coding

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Abstract

The benefits of converting to ICD-10-CM/PCS have been well documented in recent years. One of the greatest challenges in the conversion, however, is how to train the workforce in the code sets. The International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) has been described as a language requiring higher-level reasoning skills because of the system's increased granularity. Training and problem-solving strategies required for correct procedural coding are unclear. The objective of this article is to propose that the acquisition of rule-based logic will need to be augmented with self-evaluative and critical thinking. Awareness of how this process works is helpful for established coders as well as for a new generation of coders who will master the complexities of the system.

Keywords: ICD-10-CM/PCS, procedural coding, critical thinking, knowledge acquisition

Introduction

On August 24, 2012, the Department of Health and Human Services announced a new date for implementation of the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) and the International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS). The former compliance date of October 1, 2013, was changed to October 1, 2014. The announcement appeared in the *Federal Register* on September 5, 2012, as a final rule of the Centers for Medicare and Medicaid Services (CMS).[1] Consequently, the US healthcare industry has gained additional preparation time in which to address the financial, technological, and manpower issues that accompany migration to the new code sets.

Discussion over the past five years has centered on the potential benefits of ICD-10-CM/PCS. These benefits include improvements in measurement and delivery of healthcare services. Improvements in public health surveillance and international comparison of morbidity data are also foreseen, along with advancement in research due to a reduction in coding errors. Enhanced quality of care through the code sets' increased specificity is another potential benefit. Furthermore, a reduction of healthcare costs is projected for the long term.[2–3]

One key challenge of implementing ICD-10-CM/PCS is how to train the workforce. General articles on the structure and organization of ICD-10-CM/PCS have appeared in the *Journal of AHIMA*. Coding experts have delineated root operation guidelines for ICD-10-PCS. Chapter-specific guidelines have provided ICD-10-PCS coding instructions for fractures, spinal surgeries, injuries, and external causes of morbidity, as well as coding directives for the respiratory, nervous, and circulatory systems.

The problem-solving mechanisms inherent in complex ICD-10-PCS procedural coding have not been established despite robust coverage in the literature. In the present article, a psychological framework is used to differentiate novices from experts. Obstacles that might prevent a beginner from transitioning to an expert level of code construction are identified. A problem-solving model is presented, along with the steps that a coder might use in constructing ICD-10-PCS codes. Psychological theories and research support the concept that an individual must move away from rule-governed, entrenched thinking to become an expert. It is hypothesized that being an expert coder will involve critically evaluating one's choices as one moves through the code-building process.

Background

Understanding thinking and problem-solving steps required to build procedural codes from clinical documentation may be helpful to established coders who must upgrade skills and to novices in the process of acquiring skills. ICD-10-PCS coding takes on added significance when seen in the light of psychological theories of cognition, which attempt to explain problem solving. Research studies have explored strategies that differentiate the novice from the expert.[4–6] Many studies suggest ways in which instructional methods may be designed to facilitate acquisition of new knowledge.[7–10] In the following literature review, the prevailing theories that illuminate learning and problem-solving activities are presented.

Thinking

Thinking leads to many reference points in consciousness, including what we believe. Modern psychology, however, has focused on identifying the role that thinking plays in solving practical problems.[11]

Furthermore, the type of thinking that applies to ICD-10-PCS procedural code construction may be linked to both vertical and convergent thinking. Vertical thinking proceeds in a linear, purposeful fashion from beginning to end, and is limited to a particular problem at hand.[12] The analogue of vertical thinking is convergent thinking, the type of analytic reasoning that facilitates the single best solution to a problem.[13]

Reasoning aims at producing new behavior strategies based on former learning experiences. Problem solving involves a "systematic search through a range of possible actions in order to reach a predefined goal."[14]

ICD-10-PCS procedural coding meets the criteria for well-structured problems because of the logical nature of the code set. The coder has a clear solution path, that is, the coder is capable of readily identifying the steps required to reach a solution. Executing each step, however, is where the challenge lies.

The Transition

Transitioning to the ICD-10-PCS procedural code set will undoubtedly present challenges for all learners, regardless of what level of professional expertise they may have. Sternberg and Ben-Zeev identify four characteristics that distinguish the novice problem-solver from the expert problem-solver.[15] These characteristics are listed in Table 1.

Daley has observed that novices rely on rules they have learned in their education because they have had little practical, real-world experience.[16] In addition, Daley identifies five stages of career development that most professionals pass through: from "novice" to "advanced beginner," "competent," "proficient," and finally "expert."[17]

Researchers in nursing have conducted studies that compare the learning strategies of novices to experts. A common theme in two studies is the important role that critical thinking plays in attaining a state of professional expertise.[18–19]

Daley used interviews and clinical narratives to compare the learning strategies of novice nurses to expert nurses.[20] The nurses were grouped by the number of years of professional experience they had achieved. Findings indicated that novices tended to describe their learning as a process of acquiring new information and then linking it to something they had previously seen, which is termed a “best-fit approach.”[21] They required outside validation and were basically other-directed. Conversely, the experts tended to rely on critical thinking and active assimilation of new knowledge that was essentially self-directed.

Similarly, Forneris and Peden-McAlpine found that critical thinking is more than simple mastery of domain knowledge—it involves broadening of perspectives.[22] Critical thinking can emerge as a result of using what Forneris and Peden-McAlpine term “contextual learning intervention,” which is described as an “intentional thinking process of understanding within context” of caregiving practices.[23] These authors advocate that reflective educational intervention be used as part of nursing education and professional development programs.

Problem-Solving Strategies

In *Complex Cognition,* Sternberg and Ben-Zeev place the issue of problem solving firmly within the context of daily life.[24] They illustrate various problem-solving strategies that individuals use. These strategies include searches through what the authors define as “problem space,” which comprises “symbolic structures” and “operators”—actions that begin with an input and produce an output—as well as the problem itself.[25] The problem is defined through a set of “initial states, a set of goal states, and a set of path constraints.”[26]

Problem-solving strategies include the use of algorithms that lead to a correct response, although algorithms are exhaustive searches and often inefficient. Heuristics, which are prescribed aids to learning, are more commonly used approaches based on trial and error. Examples include the working-forward approach, in which a problem solver attempts to solve a problem from beginning to end, or the working-backward approach, which involves tackling the problem at the end and working back to the beginning. It has been noted that experts tend to favor the working-forward strategy, whereas novices usually select the working-backward approach when solving problems.[27]

Means-end analysis is another example of a heuristic that attempts to reduce the distance between the conditions presented by the current problem and the desired end goal by selecting an action (operator).[28] When an obstacle surfaces before the goal is reached, the problem solver begins to tackle the obstacle, which becomes a subgoal. The subgoal temporarily becomes the new end goal. This procedure repeats itself. The end goal is not reached until all the subgoals have been attained. Sternberg and Ben-Zeev point out that individuals often use subgoaling in problem solving. However, because of its diversionary nature, subgoaling frequently delays attainment of the primary end goal.[29]

Cognitive Load

White explained that cognitive load theory accounts for the limits of working memory.[30] Cognitive load involves transfer of new information in one’s short-term memory to long-term memory. Management of cognitive load has important implications for both clinical instructors and students in clinical settings. Learning occurs whenever new information is linked to existing knowledge in long-term memory. A bottleneck develops, however, when the flow from short-term memory to long-term memory is disrupted. Extraneous cognitive load is caused by anything that diverts the learner’s mental focus away from current problem solving. Poorly designed instructional materials and stress induced through the learning environment itself are two examples.

In the world of clinical coding, involvement of coding supervisors or of trainers approved by the American Health Information Management Association (AHIMA) in providing a supportive, safe learning environment, especially for novice coders, is crucial. Setting realistic time frames for mastery of procedural coding is also important. Ideally, an AHIMA-approved trainer, that is, a proven expert in coding who has reached a level of greater autonomy, could be instrumental in reducing the cognitive load of novices. For example, White indicated that clinical instructors can support novice learners by explaining how the skill fits into the overall delivery of care, creating an image of a successful outcome, describing the process in detail, performing the skill simultaneously with the learner, and then allowing the learner to perform the skill on his or her own, providing coaching and feedback when appropriate.[31]

Boekhout et al. concluded that less cognitive load is imposed on those who have prior knowledge of a task. Through studies with example-based learning in medical education, these authors discovered that second-year medical students required less time to study examples and did not have to invest as much mental effort as novices.[32] This finding raises a question in training ICD-10-PCS coders. Will coders with experience in ICD-9-CM coding make a smoother transition to the new code set?

From these studies, one may reasonably conclude that problem-solving activities occur on a continuous basis in daily life. Learning is circumscribed by conditions that either foster learning or impede it. Moreover, the theory of cognitive load plays a key role in defining how individuals are able to connect new learning with established knowledge structures. In addition, the learning strategies of novices versus experts can be differentiated, especially in clinical practice, where a well-developed awareness of problem solving and critical thinking is crucial.

Knowledge Acquisition

Identifying the knowledge domains that must be mastered in order to produce accurate procedural codes is important. ICD-10-PCS procedural coding may be viewed as “knowledge-rich,” a term used by psychologists to mean that a vast amount of specialized knowledge is necessary for good problem solving in an area.[33] Knowledge must be acquired in three domains:

- **Domain 1: Foundational knowledge.** An extensive medical vocabulary must be acquired in addition to in-depth understanding of the detailed body system subdivisions in ICD-10-PCS. Specific physiological effects will be relevant to certain procedures. General Equivalence Mappings (GEMs) may be used initially to select appropriate tables that match operations performed.[34] Examples of foundation courses include medical terminology, anatomy and physiology, pathophysiology, and mapping in GEMs.

- **Domain 2: Conceptual knowledge.** A solid grasp of the CMS coding guidelines will be essential for making root operation, body part, approach, device, and qualifier assignments. The coder will need to correlate the intent of the procedure with the root operation definitions. In time, familiarity with the tables will lead to bypassing the alphabetic index and going directly to the tables. A grasp of the body part key and device key will facilitate the selection of codes for body parts and devices, especially as new medical devices approved by the Food and Drug Administration (FDA) appear on the market.

- **Domain 3: Interpretative knowledge.** The ability to translate clinical documentation into appropriate root operations will demand careful, detailed reading of operative reports. Furthermore, the coder will need to establish reasons for code construction choices as the reliance on reasoning and logic strengthens. The ability to evaluate and reflect on code construction choices will refine the coder’s self-evaluation as the coder gains intensive practice in problem-solving methods. Lastly, critical thinking will develop in the coder’s discernment, based on clinical documentation, of what was done and not done in the procedure. The coder will become capable of identifying documentation deficiencies and gaps, leading to communication with the provider through appropriate queries.

Computer-Assisted Coding

Computer-assisted coding (CAC) has been identified as a potential solution for healthcare organizations to minimize productivity losses and to augment the shortage of trained coders once ICD-10-CM/PCS is implemented in 2014. The sheer increase in the number of codes in ICD-10-PCS will demand that the coder devote more time to the selection process, thereby reducing productivity. Whereas ICD-9-CM contains only 4,000 procedural codes to consider, ICD-10-PCS has more than 72,000 procedural codes.[35]

As natural language processing (NLP) used in CAC evolves and becomes more sophisticated, healthcare organizations may begin to view CAC as integral to the enterprise. The coder's future role has been identified as a high-level auditor of CAC-generated codes, eliminating the need for the coder to perform routine coding and instead requiring the coder to address more challenging operative scenarios.[36–37] Meanwhile, the cost of CAC software and the probability of contextual coding errors still remain relatively high. Manual coding will therefore continue to be the instructional norm in the early stages of ICD-10-PCS implementation and will involve prescribed aids to learning rather than exhaustive algorithmic searches as part of the code selection process.

Working through Problem Space

In the "problem space," as described above, problem-solving actions are defined as "operators" that transform an input to an output. Solving the problem requires not just the operators themselves but an evaluation of the effectiveness of the operators.[38] For the coder, this process means evaluating all available options. An expert is one who can generate explanations for the steps taken while at the same time evaluating the actions that support these explanations.[39] This process is analogous to the type of deductive reasoning one might use in writing a geometric proof. Postulates and theorems would be used to support each step leading to the conclusion.

In means-end analysis, the individual envisions the goal and then works out the best method for reaching the end goal while minimizing the amount of time required to reach it.[40] In accomplishing this process, the coder is likely to encounter obstacles in working out each character of the ICD-10-PCS code.

For example, in defining the initial root operation, the subgoal becomes the act of differentiating the 31 definitions provided in the code set for the Medical/Surgical section. Once the initial step is resolved, determining the remaining four characters involves additional subgoals that must be attained. The remaining subgoals are identification of the correct characters for the body part, the approach, the device, and the qualifier.

Obstacles to Effective Coding

Several obstacles may be identified that could interfere with learning ICD-10-PCS procedural coding, among them entrenchment, extraneous cognitive load, the lack of well-designed instructional materials, and the prevalence of worked-out instructional examples.[41]

Entrenchment

A coder experienced in ICD-9-CM coding may be immersed in habitual patterns of thinking not applicable to ICD-10-PCS. For example, Butler observed that many coders in ICD-9-CM use the procedures that appear in the operative report title as "authoritative" and do not delve into the body of the operative report itself.[42] In ICD-10-PCS, however, this entrenched way of approaching an operation will be untenable. Close reading of the operative details will be necessary to yield accurate surgical codes based on the standardized terminology of the root operations.

Extraneous Cognitive Load

In ICD-10-PCS procedural coding, the cognitive load may increase when the novice learner becomes enmeshed in a set of guidelines and has to decide which resources to devote to solving a given procedural problem or which guideline may be appropriately applied to a coding problem. In the case of a novice coder, a high productivity quota in the department or an organizational expectation that the coder will develop coding expertise within a short period of time (e.g., 50 days) could create undue stress and anxiety, leading to extraneous cognitive load.

Use of Instructional Materials and Learning Styles

The use of visual illustrations and narration as adjuncts to instructional media sometimes enhances learning; this enhancement is referred to as the “modality effect.”[43] The practice of using both visual aids and auditory materials may possibly deepen the amount of information stored in the working memory, which then results in improved learning outcomes. Although not all forms of multimedia instruction are effective, Doube, Tuovinen, and Shaffer state that learning interactivity is a “major advantage of multimedia learning materials for domains requiring procedural knowledge.”[44] Instructional materials in coding currently place more emphasis on narrative descriptions and analysis of coding scenarios without integration of multimedia.

Despite more than 30 years of research, no indisputable, empirical evidence exists that matching learner styles—visual, auditory, and kinesthetic—to instructional methods improves learning and attention. Moreover, even when taking into account individual differences, psychological research indicates that people do not learn differently.[45]

Worked-out Examples

An algorithm may be helpful when illustrating a worked-out example for a given problem.[46] However, what happens when a novice tries to use a worked-out example to solve a similar but different problem, even though instructions may guide the coder through a different problem-solving pathway? When given a choice, most novices will opt to follow an example rather than read instructions, resulting in overgeneralization. Learning might be enhanced if negative examples are provided that demonstrate how an algorithm is no longer applicable.

Worked-out examples are equivalent to a “ready-made recipe people can follow without attention to underlying deep structure.”[47] An expert, on the other hand, relies on deep structural analysis of the problem.

Other studies have demonstrated that instructional materials that use worked-out examples are most effective when presenting an example immediately followed by a practice problem. This format should be followed throughout the material rather than placing a set of examples followed by practice problems at the end of the instructional unit.[48]

Stages in Problem Solving

Problem solving is regarded as a cyclical rather than a linear process because solving one problem often segues into the next. Sternberg has identified seven stages in the problem-solving process: “Problem identification,” “Problem definition,” “Problem allocation,” “Problem representation,” “Strategy construction,” “Monitoring,” and “Evaluation.”[49] These stages are applicable when a coder attempts to construct an ICD-10-PCS code.

To illustrate, the following section demonstrates a step-by-step problem-solving application that uses subgoaling to construct ICD-10-PCS codes for the coding scenario shown in Table 2. Although oversimplified, the seven steps illustrate how the novice coder may become more aware of the problem-solving process itself.

An established coder may have abstracted detailed concepts into higher-level schemas so that the process does not take the form of recognizable steps. The expert can then focus on the more challenging aspects of solving a problem because of the minimal cognitive load.[50]

Problem-Solving Steps Applied to Coding Scenario

Problem Identification

The coder recognizes that an operative procedure must be assigned an ICD-10-PCS code or codes and prepares to read and analyze the operative report and inspect other relevant clinical documentation in the record.

Problem Definition

The coder determines the nature of the operation and defines the operative report as a description of a procedure performed on the female reproductive system.

Resource Allocation

The coder then recalls the nature and extent of resources available in assigning a root operation. The definitions of root operations are highly visible. The coder may decide how much time to devote to using other available resources, including CMS guidelines, to assign the procedure to a root operation. The coder may decide to draw on the expertise of a more experienced coder in the department or ask questions of the supervisor. Time allocation includes careful reading of the operative report, which in this case results in a root operation assignment of excision, which is defined as "cutting out or off, without replacement, a portion of a body part."[51]

Problem Representation

The coder forms a mental framework in the attempt to organize the domain knowledge needed to construct the remainder of the code. After deciding on the root operation, the coder then looks to the appropriate table. The coder recognizes the body part as the vulva and then looks up "excision of vulva" in the index, finding the first four characters: 0UBM.

Strategy Construction

The coder then must decide how to prioritize the resources available and will refer back to the coding guidelines and review the definitions of approach, device, and qualifier. In rereading the operative report, the coder must decide if the approach was open or external because these are the two fifth-character options in the table as the coder follows information across the row. The coder may recall coding guideline B5.3a.[52] According to this coding guideline, since the incision was made on the outside of an orifice that was visible without the use of instrumentation, the coder selects *external* as the approach. The code now becomes 0UBMX. The next character to be selected is the device. Since no device was left inside the patient and the only option is *Z*, the code becomes 0UBMXZ.

Monitoring

The coder next assesses whether the code construction is proceeding according to logic. The coder may be aware that there has to be a diagnostic qualifier other than Z since a biopsy of vulvar tissue was taken and sent to the pathology department. The coder selects X, diagnostic, as the seventh-character qualifier. This step completes the reasoning process that underpins the construction of the first code. The coder then goes back to the operative report and notes that another intent of the procedure was to drain the bladder through insertion of a Foley catheter. The coder selects the root operation of drainage, which is defined as "taking or letting out fluids and/or gases from a body part."[53] The coder represents the problem by choosing 0T9. In the table, the coder selects B, the character for bladder, reasoning that the approach is 7 (via natural or artificial opening). The character 0 represents the drainage device that was left intact at the end of the procedure, and there is no qualifier. The completed code is thus 0T9B70Z.

Evaluation

The coder then evaluates whether the completed code constructions, 0UBMXZX and 0T9B70Z, are correct. The coder may use computer-assisted instruction, an algorithm, or a coding supervisor's feedback to verify the correctness of the codes. If feedback is delayed in this scenario or in more complex scenarios, the coder may have more time in which to reflect on the process and detect possible errors made in constructing the codes, thus enhancing evaluative and self-regulating skills. If feedback is delayed too long, however, it is possible that frustration will result, especially in the case of novice learners.[54]

Conclusion

As the momentum toward ICD-10-CM/PCS compliance strengthens, healthcare organizations need to continue training coding professionals already in the workforce as well as those who have no previous coding experience. Because of its unique structure, ICD-10-PCS levels the playing field for all coding professionals, who must gain additional knowledge and experience before cresting the ICD-10-PCS learning curve.

Mapping and implementing educational strategies appropriate to the transitional phases of learning may be necessary. Choosing realistic training time frames that do not place the novice coder under stressful conditions will help reduce cognitive load and ensure that knowledge acquisition is sound. For example, novice coders may require weeks or months of training to master foundational knowledge before moving on to conceptual knowledge, that is, familiarity with the CMS coding guidelines. Immersion in root operations and clinical documentation may require additional time when rudimentary coding problems are introduced.

Moreover, a supervisor or AHIMA-approved trainer may be capable of reducing cognitive load through close guidance of group processes, along with support and encouragement. Carefully chosen examples from the Medical/Surgical division of ICD-10-PCS may be offered through multimedia instruction. Emphasis must be placed on reading all operative report details rather than relying on operative report titles. The trainer could model code construction to illustrate how specific worked-out examples do not apply to all cases. Complex code constructions might then be broken down into their component parts to clarify subgoaling in code selection.

As the novice coder becomes an advanced beginner, more complex coding problems may be introduced, with emphasis on rich resource allocation, such as the availability of the coding guidelines in various formats, including print, online, and interactive, and the supportive intervention of an AHIMA-approved trainer. The progress of the novice will need to be monitored closely until a rudimentary level of competency has been reached. Data gathered throughout the monitoring process may give rise to future research questions and hypotheses.

Once the novice has phased into a proficient stage and learning structures (schemas) have been firmly established through practice, less monitoring and instructor guidance will be required as the learner refines the problem-solving process. Critical thinking will evolve gradually as the coder gains expertise in navigating the ICD-10-PCS tables and in reasoning through the available code options. Subsequently, the expert coder will require less feedback as part of the evaluative stage of problem solving, in which critical thinking slowly emerges and the coder becomes self-directed. Becoming an expert coder in ICD-10-PCS will therefore entail not only a vast amount of foundational, conceptual, and interpretative knowledge but also a willingness to monitor one’s reasoning as one proceeds through the problem-solving process itself.

After the implementation of ICD-10-PCS in 2014, research will be required to determine how novices and experts in ICD-10-PCS coding describe their own unique learning experiences. Findings from this research may serve as a new paradigm for clinical practice in the health information management profession.

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Notes

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Table 1

Characteristics of Expert Problem-Solvers

1	Experts tend to recall more relevant information from their domain of expertise than novices, although becoming an expert goes beyond mere accumulation of knowledge. Experts are adept at breaking down information into smaller pieces and reorganizing them into meaningful units, which become part of their working memory.
2	Experts are able to use “deep-structural representations”[a] in solving problems, whereas novices tend to remain on the surface of a problem.
3	Experts devote more time to developing a global approach before attempting to sift through the details of the problem. They reflect on the nature of the problem before tackling it and rely on explanation, whereas novices often jump into immediate problem-solving responses without first examining the background or context.
4	Experts perform problem solving faster and more efficiently than novices. Over time expertise builds, and the process of moving through identifiable problem-solving steps accelerates.

Source: Sternberg, Robert J., and Talia Ben-Zeev. *Complex Cognition: The Psychology of Human Thought*. New York: Oxford University Press, 2001.
Sternberg, Robert J., and Talia Ben-Zeev. *Complex Cognition*, p. 156.

Table 2

Coding Scenario: Operative Procedure

Preoperative Diagnosis: Vulvar cellulitis. Rule out necrotizing fasciitis.

Postoperative Diagnosis: Incision of vulva, vulvar biopsy.

Findings: Induration and edema of the left mons with edema of the left labia. No evidence of vaginal or Bartholin gland involvement. A frozen section of the vulvar biopsy revealed acute and chronic inflammation with no evidence of necrotizing fasciitis.

Description of Procedure: The patient was taken to the operating room where general endotracheal anesthesia was obtained without difficulty. The patient was then prepared and draped in the normal sterile fashion in the dorsal lithotomy position. A red rubber catheter was used to drain the bladder, and then a scalpel blade was used to incise the left side of the mons superior to the left labia in a vertical fashion. There was no evidence of any purulent or necrotic tissue, and the vulvar tissue showed good vascularization. Pickups and a scalpel were used to obtain a small, approximately 0.5 cm tissue biopsy, and then the incision base was cauterized with the Bovie. An intraoperative consult with Pathology was obtained, and a frozen section of the biopsy revealed no evidence of necrotizing fasciitis. Excellent hemostasis was noted from the incision. The incision bed was packed with gauze coated in bacitracin ointment. A red rubber Foley catheter was inserted in the patient's bladder. She was extubated in the operating room without difficulty and taken to the recovery room in stable condition. Cultures from the wound were sent for both aerobic and anaerobic cultures as well as for Gram stain. Sponge, lap, needle, and instrument counts were correct × 2.

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