Challenges and Opportunities with ICD-10-CM/PCS: Implications for Surgical Research Involving Administrative Data

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International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes have been used to describe and justify reimbursement for hospital care for more than 20 years. As a result, these codes have undergirded numerous health services and surgical outcomes analyses using readily available administrative data. On October 1, 2014, the US Department of Health and Human Services plans to require compliance with the next iteration of ICD in the United States, the International Classification of Diseases, 10th Revision, Clinical Modification and Procedure Coding System (ICD-10-CM/PCS). Whereas ICD-9-CM includes approximately 14,000 diagnosis codes and 4,000 procedure codes, ICD-10-CM currently has approximately 79,500 diagnosis codes, and ICD-10-PCS has almost 73,000 procedure codes. ICD-10-CM/PCS also uses entirely new classification approaches that will be unfamiliar to many physicians, researchers, and coding professionals.

In addition to their role in reimbursement, ICD codes are applied ubiquitously to the organization, monitoring, and study of surgical care. The Joint Commission's National Hospital Inpatient Quality Measures and the AHRQ's Quality Indicators monitor inpatient surgical quality of care using ICD coding. Many trauma centers and studies of trauma care use ICDMAP or ICD-9 Injury Severity Score software to score injury severity from ICD-9-CM codes. The American College of Surgeons' Trauma Quality Improvement Program uses ICD coding to facilitate monitoring the quality of trauma care. Because of the vital importance of ICD codes to surgical outcomes and quality-improvement research, we will summarize several considerations for those who intend to use ICD-10-CM/PCS for such purposes.

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HISTORY OF THE ICD

The WHO has maintained the ICD classification since 1948 and developed ICD-9 in 1975, primarily for classifying mortality.[1] In the United States, the National Center for Health Statistics (NCHS) modified ICD-9 for indexing morbidity in the hospital setting as ICD-9-CM. Because the WHO's parent ICD classifications do not address procedures, NCHS added a classification for procedures (volume 3 of ICD-9-CM). Although hospitals only sporadically adopted earlier ICD derivations, the implementation of ICD-9-CM in 1979 established a US standard that hospitals could more easily adopt. By 1989, the Health Care Financing Administration (HCFA) (renamed in 2001 as the Centers for Medicare and Medicaid Services [CMS]) began requiring ICD-9-CM diagnosis and procedure codes for billing of services. However, over time and with the rapid expansion of medical technology, ICD-9-CM could not readily accommodate new diagnoses and procedures without disrupting its existing hierarchy.

In 1993, the WHO developed ICD-10, which the United States adopted for mortality reporting in 1999. However, the adaptation and implementation of ICD-10 for hospital care has been much slower. Shortly after the release of ICD-10, the NCHS began consulting physician groups, professional coders, and other experts to develop ICD-10-CM. The process lasted 9 years, including a lengthy public comment period and pilot testing by the American Health Information Management Association and the American Hospital Association, culminating in annually updated pre-release versions available since 2002.

Because of the limitations of ICD-9-CM's 4-digit procedure code structure and an increase in the variety of procedures being performed across medical specialties (due to advances in technology and information), HCFA began planning a replacement for ICD-9-CM

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Abbreviations and Acronyms
CM = Clinical Modification
CMS = Centers for Medicare and Medicaid Services
GEM = General Equivalence Mapping
HCFA = Health Care Financing Administration
NCHS = National Center for Health Statistics
PCS = Procedure Coding System

volume 3 in 1990. The AMA initially expressed interest in jointly developing a classification to replace both ICD-9-CM volume 3 (used for hospital billing) and the AMA's CPT system (used for physician billing and outpatient procedure coding), but ultimately opted instead to restructure CPT. The HCFA contracted with 3M Health Information Systems to develop ICD-10-PCS in 1995. Using an open process, HCFA convened a Technical Advisory Panel with representatives from numerous specialty organizations, including the American College of Surgeons, as they developed and modified ICD-10-PCS before its release in 1998.[2]

The US Department of Health and Human Services originally planned for ICD-10-CM/PCS to replace ICD-9-CM in 2008, but the conversion was delayed after several impact analyses[3] and requests by physician and other health care provider organizations. The final implementation date is set for October 1, 2014,[4] with many stakeholders already having invested substantially in the conversion process.[5]

STRUCTURE OF ICD-9-CM AND ICD-10-CM/PCS

ICD-9-CM has 3 main components: volume 1 is a tabular list of diagnosis codes; volume 2 is an alphabetical index that includes terms not used in the tabular list; and volume 3 has both a tabular list and alphabetical index of procedure codes. The diagnosis codes are organized into 17 chapters with supplementary classifications for "factors influencing health status and contact with health services" (V codes) and "external causes of injury and poisoning" (E codes) (Fig. 1). Diagnosis codes other than the V and E codes have 3 to 5 numeric characters, with a decimal point always after the third character. V codes always begin with a "V" followed by 2 or 3 numbers, with a decimal after the second number, and E codes always begin with an "E" followed by 3 or 4 numbers, with a decimal after the third number. Procedure codes are usually 4 digits (occasionally 3), all numbers, with a decimal point after the second digit.

ICD-9-CM is primarily a numeric system, but one that effectively treats the numbers as strings. Proper use involves leading zeros before a decimal point and trailing zeros after one. Omission of the decimal point or leading/trailing zeros, as can occur with electronic conversion of data between different software formats, risks substantial confounding of the coded information. Additionally, ICD-9-CM does not specify some important permutations of conditions and procedures and almost never indicates the side of the body or such anatomic details as which digit(s) are involved in a condition/procedure affecting an extremity.

In contrast, ICD-10-CM/PCS offers a standard uniform format and increased specificity when describing diagnoses and procedures. ICD-10-CM only encompasses diagnosis codes (including external causes and other factors) organized into 21 chapters (Fig. 1). The codes have 3 to 7 alphanumeric characters, with the first always being a letter and the decimal point after the third character (Fig. 2). The "external causes of morbidity" are represented by a first character "V," "X," "W," or "Y," and "factors influencing health status and contact with health services" with a first character "Z" (formerly E and V codes, respectively). Because the first character is always a letter, it can be an "I" or an "O," which new users might confuse as a "1" or a "0."

ICD-10-PCS procedure codes are organized into 16 sections (Fig. 3), and the codes always contain 7 characters, any of which can be numbers or letters (Fig. 4). No decimal points are used. Because the characters can be either numbers or letters, the developers omitted "I" and "O" from the available characters to avoid confusion with "1" and "0." The first character indicates the section of ICD-10-PCS. Although most codes that apply to surgical care are encompassed within the Medical and Surgical section, users should be aware that other sections might also be relevant. For example, obstetrical procedures, invasive monitoring, hemodialysis, nuclear medicine and radiation oncology treatment, and imaging procedures all are found in other sections; and mechanical ventilation, cardiopulmonary resuscitation, and extracorporeal membrane oxygenation are classified in section 5, Extracorporeal Assistance and Performance (Fig. 3).

The subsequent characters behave semi-independently and each has a particular function, depending on the section. In the Medical and Surgical section (exemplified in Fig. 4), the third character, the "root operation," describes what action was done during the procedure (Table 1). The definitions of the root carry specific language that can make a critical difference in which code most appropriately describes a procedure.

ICD-10-PCS involves a fundamentally different approach to classifying procedures than the approaches used in ICD-9-CM and CPT. Instead of designating one code to encompass the totality of a procedure, ICD-10-PCS captures each distinct portion of a procedure with a different code. For example, a typical pancreaticoduodenectomy (ie,

ICD-9-CM Chapter	Codes	Descriptions	ICD-10-CM Chapter	Codes	Descriptions
1	001-139	Infectious and Parasitic Diseases	1	A00-B99	Certain Infectious and Parasitic Diseases
2	140-239	Neoplasms	2	C00-D49	Neoplasms
3	240-279	Endocrine, Nutritional, and Metabolic Diseases and Immunity Disorders	3	D50-D89	Diseases of the Blood and Blood-forming Organs and Certain Disorders Involving the Immune Mechanism
4	280-289	Diseases of Blood and Blood-Forming Organs	4	E00-E89	Endocrine, Nutritional and Metabolic Diseases
5	290-319	Mental Disorders	5	F01-F99	Mental, Behavioral and Neurodevelopmental Disorders
			6	G00-G99	Diseases of the Nervous System
6	320-389	Diseases of Nervous System and Sense Organs	7	H00-H59	Diseases of the Eye and Adnexa
			8	H60-H95	Diseases of the Ear and Mastoid Process
7	390-459	Diseases of Circulatory System	9	I00-I99	Diseases of the Circulatory System
8	460-519	Diseases of Respiratory System	10	J00-J99	Diseases of the Respiratory System
9	520-579	Diseases of Digestive System	11	K00-K95	Diseases of the Digestive System
10	580-629	Diseases of Genitourinary System	12	L00-L99	Diseases of the Skin and Subcutaneous Tissue
11	630-677	Complications of Pregnancy, Childbirth, and the Puerperium	13	M00-M99	Diseases of the Musculoskeletal System and Connective Tissue
12	680-709	Diseases of Skin and Subcutaneous Tissue	14	N00-N99	Diseases of the Genitourinary System
13	710-739	Diseases of Musculoskeletal and Connective Tissue	15	O00-O9A	Pregnancy, Childbirth and the Puerperium
14	740-759	Congenital Anomalies	16	P00-P96	Certain Conditions Originating in the Perinatal Period
15	760-779	Certain Conditions Originating in the Perinatal Period	17	Q00-Q99	Congenital Malformations, Deformations and Chromosomal Abnormalities
16	780-799	Symptoms, Signs, and Ill-defined Conditions	18	R00-R99	Symptoms, Signs and Abnormal Clinical and Laboratory Findings, Not Elsewhere Classified
17	800-999	Injury and Poisoning	19	S00-T88	Injury, Poisoning and Certain Other Consequences of External Causes
—	V01-V86	Supplementary Classification of Factors Influencing Health Status and Contact with Health Services	20	V00-Y99	External Causes of Morbidity
—	E800-E999	Supplementary Classification of External Causes of Injury and Poisoning	21	Z00-Z99	Factors Influencing Health Status and Contact With Health Services

Figure 1. Overall organization of ICD-9-CM Volume 1 and ICD-10-CM diagnosis codes. Arrows indicate the predominant chapters in ICD-10-CM of ICD-9-CM concepts. All relationships are approximate and some ICD-9-CM codes do not translate perfectly into ICD-10-CM.

Whipple procedure) would require not just 1 code (eg, 52.7 in ICD-9-CM), but 5 or more codes, including "excision of pancreas" (0FBG), "resection of duodenum" (0DT9), "bypass of common bile duct" (0F19), "bypass of stomach" (0D16), and "bypass of pancreas" (0F1D). The ICD-10-PCS Official Guidelines for Coding and Reporting instruct coders to select all applicable codes that constitute the procedure, but components inherent to another procedure already being coded should not be separately coded.[6] For example, if a splenectomy were performed and coded, then the incision to access the spleen should not be separately coded because the splenectomy code encompasses the incision. However, the guidelines also instruct coders to code multiple procedures if the same root operation applies to distinct values of the body part or body site characters, if more than one root operation with distinct objectives is performed on the same body part, or if a root operation applies to an attempted approach but conversion to another approach was necessary. Inherent to these differences, procedure eponyms will no longer apply in ICD-10-PCS.

AVAILABLE TOOLS TO ASSIST IN CONVERTING CODES

Fortunately, users of ICD-9-CM will not be summarily abandoned with the implementation of ICD-10-CM/PCS. With the assistance of 3M, NCHS and CMS have created text files called "General Equivalence Mappings" (GEMs) to optimize the process of forward and backward conversion between the 2 classification systems. The mappings are publicly available from the CMS website.[7] CMS plans to provide the GEM files for 3 years after the implementation of the ICD-10-CM/PCS code sets. Although use of GEMs might not be necessary for investigators attempting to convert

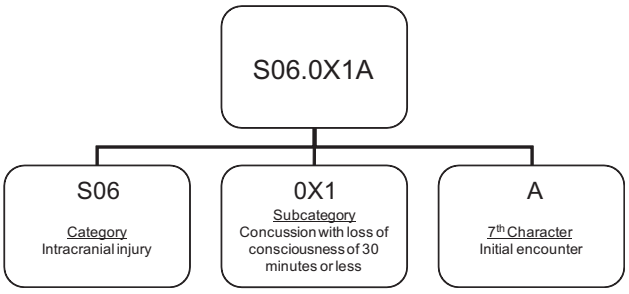

Figure 2. Structure of ICD-10-CM diagnosis codes, using "concussion with loss of consciousness of 30 minutes or less" as an example. The first character designates the chapter, and the first 3 characters together indicate the general category of the diagnosis. The fourth through sixth characters provide additional specification of the diagnosis (eg, cause or anatomic site), and the seventh character qualifies the code according to such characteristics as the type of encounter, the trimester of a pregnancy, or the nature of a fracture. When a seventh character is necessary but a fourth, fifth, or sixth is not, intervening characters are represented by an "X."

a relatively small number of codes, they are an invaluable resource for formally mapping larger or more complex sets of codes, as might be relevant for quality measures, widely used measurement tools (eg, injury classification and scoring), or other large-scale projects that use administrative data.

Conversion using GEMs is not necessarily a simple one-to-one translation, but instead involves "reference mapping." which yields a set of potentially relevant codes that the GEMs user must then evaluate. The mappings address both conversion of ICD-9-CM codes to ICD-10-CM/PCS ("forward mapping") and vice versa ("backward mapping"). Users can evaluate the conversion process by "reverse mapping," using the mapped codes to determine all of the possibilities in the original system: if determining relevant codes in ICD-10-CM/PCS for a given ICD-9-CM code, reverse mapping would take the mapped ICD-10-CM/PCS codes and yield additional ICD-9-CM codes for evaluation. The GEMs also provide flags indicating whether the mapping is approximate or exact, when no code can be mapped, and when codes in one system map to combinations of codes in the other.

The GEM users should carefully consider the output produced by GEM reference mapping rather than blindly accept it.[8] For example, the 540.0 diagnosis code in ICD-9-CM ("acute appendicitis with generalized peritonitis") maps unambiguously to K35.2 ("acute appendicitis with generalized peritonitis") in ICD-10-CM, but 540.1 ("acute appendicitis with peritoneal abscess") maps to K35.3 ("acute appendicitis with localized peritonitis"), which surgeons would consider a quite different entity.

IMPLICATIONS OF THE EXPANSION OF ICD-10-CM

There are 2 main features of ICD-10-CM that merit attention: the classification system is different (ie, ICD-9-CM codes are not retained in the ICD-10-CM framework) and the number of available codes is vastly increased, largely from subspecification of topics already in routine use. With the exception that the chapter for diseases of the nervous system and sense organs is now subdivided into separate chapters for the nervous system, eye and adnexa, and ear and mastoid process, the broad groupings of ICD-10-CM will appear familiar to ICD-9-CM users. Although the codes themselves are different, some—particularly infectious disease, neoplasm, eye, and ear codes—follow the same conceptual patterns as in ICD-9-CM, and others—such as obstetrical codes—differ substantially in their organization.

More noticeably, ICD-10-CM has vastly more options to specify diagnoses. For example, ICD-9-CM offers 60 options for coding diabetes mellitus and ICD-10-CM offers 206. Much of the additional specificity concerns permutations of specific complications and the type of diabetes ("due to underlying condition," "drug or chemical induced," "type 1," "type 2," or "other specified"). Injury diagnoses are particularly specific, accounting for almost 40,000 codes, or approximately 50% of all diagnoses, in ICD-10-CM. Many ICD-10-CM codes can be subspecified as to whether the diagnosis pertained to an "initial encounter," "subsequent encounter," or "sequela" (seventh character "A," "D," or "S," respectively).

CHALLENGES INHERENT TO THE CONSTRUCT OF ICD-10-PCS

Loss of disease-specific procedure codes

ICD-10-PCS codes are essentially agnostic with regard to the underlying disease process. This is often not true in ICD-9-CM, which allows for such procedures as hernia repairs (53.xx), "other repair of aneurysm" (39.25), "other cataract extraction" (13.6x), and "reclosure of postoperative disruption of abdominal wall" (54.61), as well as procedures characterized by the absence of disease, such as "incidental appendectomy" (47.1x). This issue lends ambiguity to procedure coding in that one procedure might be associated with multiple diseases and multiple procedure codes can apply to one disease process. Users will need to rely more heavily on logic that requires a diagnosis code in addition to a procedure code of interest to ensure that they have captured the relevant subset of records.

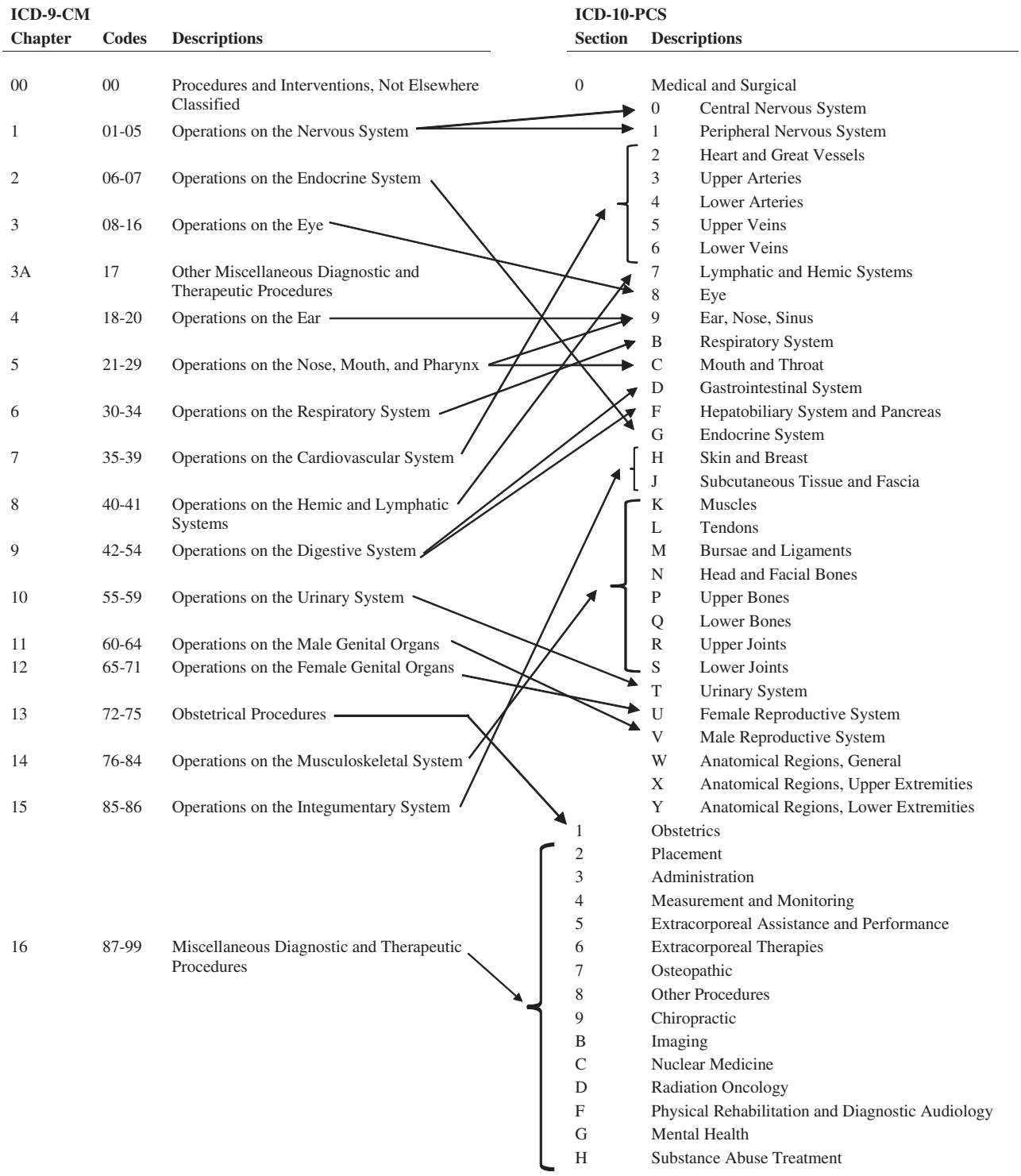

Figure 3. Overall organization of ICD-9-CM Volume 3 and ICD-10-PCS procedure codes. Arrows indicate the predominant section/body system(s) in ICD-10-PCS of ICD-9-CM concepts. All relationships are approximate. Codes from some ICD-9-CM chapters (particularly 00 and 3A) and ICD-10-PCS sections/body systems have multiple locations in the other system, and many codes in ICD-9-CM do not translate perfectly to ICD-10-PCS due to the latter's markedly different structure.

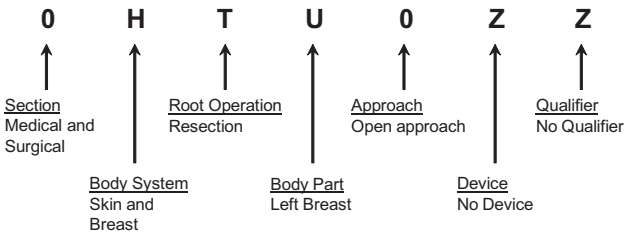

Figure 4. Structure of ICD-10-PCS procedure codes in the Medical and Surgical section using left mastectomy as an example. The first character identifies the relevant part of the overall classification; the second indicates which general system of the body is involved; the third designates the root operation, or action, involved; the fourth specifies which part of the body was involved; the fifth describes the operative approach; the sixth details whether a device was left in the patient (and the type); and the seventh describes additional information, such as the type of graft used or the destination of a bypass.

Capturing the salient elements of a procedure

In some instances, users of ICD-10-PCS will no longer be able to select records on the basis of an all-encompassing single procedure code, such as they could with ICD-9-CM. This difference might best be addressed by focusing on the signature or defining portion(s) of a procedure. For example, allogeneic pancreas transplantation can be captured with the 0FYG0Z0 code independent of whether bladder or enteric drainage of the exocrine secretions is involved, and adhesiolysis for a small bowel obstruction can be captured with the 0DN80ZZ code (perhaps along with the 0DNA0ZZ and 0DNB0ZZ codes specifying release of the jejunum and ileum, respectively) whether or not a segment of bowel is resected.

In other cases, ICD-10-PCS does not readily allow detection of all instances of certain procedures. "Resection of the pancreas" (0FTG) implies removal of the duodenum and distal common bile duct and would identify pancreaticoduodenectomy, but it would only capture the subset of such procedures in which the entire pancreas was resected. Identifying the more typical pancreaticoduodenectomy procedure that involves removal of only the proximal pancreas would require a combination of "excision of the pancreas" (0FBG) and "excision/resection of the duodenum" (0DB9/0DT9), but these codes will not cleanly capture pancreaticoduodenectomy procedures because the 0FBG and 0DB9 codes are not specific to the portions of those organs removed during pancreaticoduodenectomy. Users will need to pay careful attention to the logic of procedure code selection, and it might be worthwhile to petition the ICD-10-CM/PCS Coordination and Maintenance Committee about such problems (eg, to consider separating the head of the pancreas from the remainder of the organ as separate body parts, ie, the fourth character). However, a countervailing advantage is the potential to capture procedures with quite specific characteristics, for example, pylorus-preserving pancreaticoduodenectomy during which no drains are placed.

Importance of the root operation character

Users should familiarize themselves with the specific definitions of the 31 root operations in the Medical and Surgical Section (Table 1) because of their critical role. For example, "excision" specifically refers to the partial removal of a body part and "resection" to the complete removal of a body part. This might lead to confusion on the part of surgeons about how to identify such procedures as "incisional biopsy," which should be coded using the "excision" root. Similarly, both subtotal thyroidectomy and subtotal gastrectomy procedures would be coded as "excisions" rather than "resections." Other counterintuitive examples include tracheostomy, for which the most appropriate root character is "bypass;" colostomy, which can be coded with either "drainage" or "bypass" roots; amputations, which are considered as "detachment;" and vaginal or cesarean delivery, which are coded as "extraction of products of conception."

The Official Guidelines for Coding and Reporting establish that coders are responsible for applying the correct root character independent of the wording the physician uses,[6] which can lead to queries and communication problems between coders and clinicians. In some instances, it might not be clear which aspect of a procedure should prevail in selecting the root operation.[9] For example, repair of an abdominal aortic aneurysm might be interpreted to involve a "bypass," "replacement," or "supplement" root operation. Apparently, the "repair" root should be reserved for circumstances in which none of the other roots apply.[10]

Nuances of the approach character

Coders select from 7 different possibilities for the approach (reduced from 13 in an earlier version of ICD-10-PCS[11]): open, percutaneous, percutaneous endoscopic, via natural or artificial opening, via a natural or artificial opening endoscopic, via natural or artificial opening with percutaneous endoscopic assistance, and external. Most laparoscopic and thoracoscopic procedures would be coded as involving a "percutaneous endoscopic" approach, and most esophagogastroduodenoscopy and colonoscopy procedures would be coded with the "via a natural or artificial opening endoscopic" approach. However, some areas of uncertainty remain, such as whether an incision for an operation constitutes an open or percutaneous approach (eg, incision and drainage

Table 1. Definitions of Root Operations, the Third Character of ICD-10-PCS Procedure Codes in the Medical and Surgical Section

Root operation	Definition	Explanation	Examples
Alteration	Modifying the anatomic structure of a body part without affecting the function of the body part	Principal purpose is to improve appearance	Face lift, breast augmentation
Bypass	Altering the route of passage of the contents of a tubular body part	Rerouting contents of a body part to a downstream area of the normal route, to a similar route and body part, or to an abnormal route and dissimilar body part. Includes one or more anastomoses, with or without the use of a device	Coronary artery bypass, colostomy formation
Change	Taking out or off a device from a body part and putting back an identical or similar device in or on the same body part without cutting or puncturing the skin or a mucous membrane	All CHANGE procedures are coded using the approach EXTERNAL	Urinary catheter change, gastrostomy tube change
Control	Stopping, or attempting to stop, postprocedural bleeding	The site of the bleeding is coded as an anatomical region and not to a specific body part	Control of post-prostatectomy hemorrhage, control of post-tonsillectomy hemorrhage
Creation	Making a new genital structure that does not take over the function of a body part	Used only for sex change operations	Creation of vagina in a male, creation of penis in a female
Destruction	Physical eradication of all or a portion of a body part by the direct use of energy, force, or a destructive agent	None of the body part is physically taken out	Fulguration of rectal polyp, cautery of skin lesion
Detachment	Cutting off all or a portion of the upper or lower extremities	The body part value is the site of the detachment, with a qualifier if applicable to further specify the level where the extremity was detached	Below knee amputation, disarticulation of shoulder
Dilation	Expanding an orifice or the lumen of a tubular body part	The orifice can be a natural orifice or an artificially created orifice. Accomplished by stretching a tubular body part using intraluminal pressure or by cutting part of the orifice or wall of the tubular body part	Percutaneous transluminal angioplasty, pyloromyotomy
Division	Cutting into a body part, without draining fluids and/or gases from the body part, in order to separate or transect a body part	All or a portion of the body part is separated into two or more portions	Spinal cordotomy, osteotomy
Drainage	Taking or letting out fluids and/or gases from a body part	The qualifier DIAGNOSTIC is used to identify drainage procedures that are biopsies	Thoracentesis, incision and drainage
Excision	Cutting out or off, without replacement, a portion of a body part	The qualifier DIAGNOSTIC is used to identify excision procedures that are biopsies	Partial nephrectomy, liver biopsy

(Continued)

Table 1. Continued

Root operation	Definition	Explanation	Examples
Extirpation	Taking or cutting out solid matter from a body part	The solid matter may be an abnormal byproduct of a biological function or a foreign body; it may be imbedded in a body part or in the lumen of a tubular body part. The solid matter may or may not have been previously broken into pieces	Thrombectomy, choledocholithotomy
Extraction	Pulling or stripping out or off all or a portion of a body part by the use of force	The qualifier DIAGNOSTIC is used to identify extraction procedures that are biopsies	Dilation and curettage, vein stripping
Fragmentation	Breaking solid matter in a body part into pieces	Physical force (e.g., manual, ultrasonic) applied directly or indirectly is used to break the solid matter into pieces. The solid matter may be an abnormal byproduct of a biological function or a foreign body. The pieces of solid matter are not taken out	Extracorporeal shockwave lithotripsy, transurethral lithotripsy
Fusion	Joining together portions of an articular body part rendering the articular body part immobile	The body part is joined together by fixation device, bone graft, or other means	Spinal fusion, ankle arthrodesis
Insertion	Putting in a nonbiological appliance that monitors, assists, performs, or prevents a physiological function but does not physically take the place of a body part		Insertion of radioactive implant, insertion of central venous catheter
Inspection	Visually and/or manually exploring a body part	Visual exploration may be performed with or without optical instrumentation. Manual exploration may be performed directly or through intervening body layers	Diagnostic arthroscopy, exploratory laparotomy
Map	Locating the route of passage of electrical impulses and/or locating functional areas in a body part	Applicable only to the cardiac conduction mechanism and the central nervous system	Cardiac mapping, cortical mapping
Occlusion	Completely closing an orifice or the lumen of a tubular body part	The orifice can be a natural orifice or an artificially created orifice	Fallopian tube ligation, ligation of inferior vena cava
Reattachment	Putting back in or on all or a portion of a separated body part to its normal location or other suitable location	Vascular circulation and nervous pathways may or may not be reestablished	Reattachment of hand, reattachment of avulsed kidney
Release	Freeing a body part from an abnormal physical constraint by cutting or by the use of force	Some of the restraining tissue may be taken out but none of the body part is taken out	Adhesiolysis, carpal tunnel release
Removal	Taking out or off a device from a body part	If a device is taken out and a similar device put in without cutting or puncturing the skin or mucous membrane, the procedure is coded to the root operation CHANGE. Otherwise, the procedure for taking out a device is coded to the root operation REMOVAL	Drainage tube removal, cardiac pacemaker removal
Repair	Restoring, to the extent possible, a body part to its normal anatomic structure and function	Used only when the method to accomplish the repair is not one of the other root operations	Colostomy takedown, suture of laceration

(Continued)

Table 1. Continued

Root operation	Definition	Explanation	Examples
Replacement	Putting in or on biological or synthetic material that physically takes the place and/or function of all or a portion of a body part	The body part may have been taken out or replaced, or may be taken out, physically eradicated, or rendered nonfunctional during the Replacement procedure. A Removal procedure is coded for taking out the device used in a previous replacement procedure	Total hip replacement, bone graft, free skin graft
Reposition	Moving to its normal location, or other suitable location, all or a portion of a body part	The body part is moved to a new location from an abnormal location, or from a normal location where it is not functioning correctly. The body part may or may not be cut out or off to be moved to the new location	Reposition of undescended testicle, fracture reduction
Resection	Cutting out or off, without replacement, all of a body part		Total nephrectomy, total lobectomy of lung
Restriction	Partially closing an orifice or the lumen of a tubular body part	The orifice can be a natural orifice or an artificially created orifice	Esophagogastric fundoplication, cervical cerclage
Revision	Correcting, to the extent possible, a portion of a malfunctioning device or the position of a displaced device	Revision can include correcting a malfunctioning or displaced device by taking out or putting in components of the device such as a screw or pin	Adjustment of position of pacemaker lead, recementing of hip prosthesis
Supplement	Putting in or on biological or synthetic material that physically reinforces and/or augments the function of a portion of a body part	The biological material is non-living, or is living and from the same individual. The body part may have been previously replaced, and the Supplement procedure is performed to physically reinforce and/or augment the function of the replaced body part	Herniorrhaphy using mesh, free nerve graft, mitral valve ring annuloplasty, put a new acetabular liner in a previous hip replacement
Transfer	Moving, without taking out, all or a portion of a body part to another location to take over the function of all or a portion of a body part	The body part transferred remains connected to its vascular and nervous supply	Tendon transfer, skin pedicle flap transfer
Transplantation	Putting in or on all or a portion of a living body part taken from another individual or animal to physically take the place and/or function of all or a portion of a similar body part	The native body part may or may not be taken out, and the transplanted body part may take over all or a portion of its function	Kidney transplant, heart transplant

(Reprinted from Averill RF et al[10]).

of a perirectal abscess) and exactly what depth distinguishes an external from an open or via natural or artificial opening approach. The ICD-10-PCS also differs from ICD-9-CM in that when the approach is converted during the same operation, both the intended and actual root operations will be coded separately, although the former might be labeled as an "inspection," and the latter might be labeled as a "resection," "excision," etc.[6]

Unconventional or nonexistent procedures

A perusal of ICD-10-PCS will yield such interesting combinations as percutaneous resection of the pulmonary valve (02TH3ZZ), percutaneous endoscopic resection of the lungs (bilateral) (0BTM4ZZ), reattachment of the gallbladder (0FM4), and destruction of the duodenum (0D59). Although such unlikely procedures stretch the bounds of plausibility, the designers of ICD-10-PCS

explicitly allowed for the possibility that they could occur. The main concern is that such codes might be selected in error by coders. Unless they are ultimately pruned from the classification through the ICD-10-CM/PCS Coordination and Maintenance Committee, users will need to tolerate their presence—and in some cases consider the possibility that procedures truly of interest might be miscoded with them.

UNKNOWN ISSUES

Although hospitals and professional coders have been preparing for ICD-10-CM/PCS implementation for years, these classifications have not yet been put to real-world use. Coders will have many more codes to choose from, but they might not take full advantage of the entire spectrum of codes.[12] First, physician documentation will likely continue to limit the ability of coders to specify diagnoses and procedures. Second, encoding software and other resources, such as training workbooks and texts, as well as reimbursement algorithms, might steer coders to the most commonly used codes and away from others. Third, even with increased assistance from encoding software and electronic health records ("computer-assisted coding"), coders have finite time and incentive to specify codes to the extent possible in ICD-10-CM/PCS. Fourth, although CMS's version 5010 claims form now allows up to 25 diagnoses, 25 procedures, and 12 external causes, the number of code fields for a given hospitalization remains limited in some information systems, which will encourage coders to use one general code even when several specific codes might be preferred. Consistent with these limitations, one comparison of records dually coded in ICD-9-CM and Canada's version of ICD-10 (implemented in 2002) did not demonstrate any substantial improvement in the information content of administrative data,[13] as did another recent analysis of US records using ICD-10-CM.[12] However, both studies evaluated ICD-10 coding before it gained maturity from actual use, so such coding might become more content rich as the code set evolves and as physicians and coders acclimate to its granularity.

If more than one root operation code can apply to a given procedure, users might have to consider all possibilities as they search for what is a single procedure in concept. Users might have to wait for some of these ambiguities to be resolved de facto by coder behavior or more formally adjudicated by the American Hospital Association's Coding Clinic on ICD-10-CM/PCS.

With such uncertainties, ICD-10-CM/PCS portends both challenges and opportunities for surgical researchers and quality-improvement professionals. Reconfiguring the entire disease and procedure classification system will be disruptive and, in particular, studies and programs that use administrative data from both before and after conversion to ICD-10-CM/PCS will be more difficult to conduct and interpret.[14] Investigators and clinicians simply trying to understand new studies will need to appreciate how ICD-10-CM/PCS differs from ICD-9-CM. We encourage all users to explore the official tabular lists and indexes of both ICD-9-CM and ICD-10-CM/PCS—available both in print and electronic format, with some presentations available for free on the internet[7]—to learn how these changes might affect their particular subject area. Certain approaches in the use of ICD-9-CM will have to be abandoned or substantially modified to be applicable to ICD-10-CM/PCS, but ICD-10-CM/PCS will also undoubtedly open up other topics of investigation to new questions as the data accrue.

Author Contributions

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Acquisition of data: Utter, Cox
Analysis and interpretation of data: Utter, Cox, Owens, Romano
Drafting of manuscript: Utter
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