CHAPTER 2

Development of the 3M™ All Patient Refined Diagnosis Related Groups (APR DRGs)

DEVELOPMENT OF THE ALL PATIENT REFINED DRGS (APR DRGS)

Expanding the scope of the DRG system

The original objective of the DRGs was to develop a patient classification system that related the types of patients treated to the resources they consumed. Thus, the DRGs focused exclusively on resource intensity. The CMS DRGs (formerly the HCFA DRGs) and the AP-DRGs have remained focused on this limited objective. As the health care industry has evolved there has been increased demand for a patient classification system that can be used for applications beyond resource use, cost, and payment. In particular, a patient classification system is needed for:

- The comparison of hospitals across a wide range of resource and outcome measures. Such comparisons are typically disseminated to the public by state data commissions
- The evaluation of differences in inpatient mortality rates
- The implementation and support of critical pathways
- The identification of continuous quality improvement projects
- The basis of internal management and planning systems
- The management of capitated payment arrangements

In order to meet these needs, the objective of the DRG system needed to be expanded in scope to address patient severity of illness and risk of mortality as well as resource intensity. As previously defined, these patient attributes have the following meaning:

Severity of illness. The extent of physiologic decompensation or organ system loss of function.

Risk of mortality. The likelihood of dying.

Resource intensity. The relative volume and types of diagnostic, therapeutic, and bed services used in the management of a particular disease.

The APR DRGs expand the basic DRG structure by adding four subclasses to each DRG. The addition of the four subclasses addresses patient differences relating to severity of illness and risk of mortality. Severity of illness and risk of mortality relate to distinct patient attributes. For example, a patient with acute choledocholithiasis (acute gallstone attack) as the highest secondary diagnosis may be considered a major severity of illness but only a minor risk of mortality. The severity of illness is major since there is significant organ system dysfunction associated with acute choledocholithiasis. However, it is unlikely that the acute episode alone will result in patient mortality and thus, the risk of mortality for this patient is minor. If additional, more serious diagnoses are also present, patient severity of illness and risk of mortality may increase. For example, if peritonitis is present along with the acute choledocholithiasis, the patient may be considered an extreme severity of illness and a major risk of mortality. Since severity of illness and risk of mortality are distinct patient attributes, separate subclasses are assigned to a patient for severity of illness and risk of mortality. Thus, in the APR DRG system a patient is assigned three distinct descriptors:

- The base APR DRG (e.g., APR DRG 194 Heart Failure or APR DRG 440 Kidney Transplant)

- The severity of illness subclass
- The risk of mortality subclass

The four severity of illness subclasses and the four risk of mortality subclasses are numbered sequentially from 1 to 4 indicating respectively, minor, moderate, major, or extreme severity of illness or risk of mortality. For applications such as evaluating resource use or establishing patient care guidelines, the APR DRG in conjunction with severity of illness subclass is used. For evaluating patient mortality the APR DRG in conjunction with the risk of mortality subclass is used.

Although the subclasses are numbered 1–4, the numeric values represent categories and not scores. For example, severity subclass 4 congestive heart failure patients are not comparable to severity subclass 4 patients with a fractured leg. Thus, it is not meaningful to average the numeric values (i.e., 1–4) of the severity of illness or risk of mortality subclasses across a group of patients to compute an average severity score. However, the APR DRG severity and risk of mortality subclasses can be used to compute an expected value for a measure of interest (e.g., length of stay, cost, mortality), using statistical techniques such as indirect rate standardization.

The underlying clinical principle of APR DRGs is that the severity of illness or risk of mortality subclass of a patient is highly dependent on the patient's underlying problem and that patients with high severity of illness or risk of mortality are usually characterized by multiple serious diseases or illnesses. In the APR DRGs, the assessment of the severity of illness or risk of mortality of a patient is specific to the base APR DRG to which a patient is assigned. In other words, the determination of the severity of illness and risk of mortality is disease-specific. Thus, the significance attributed to complicating or comorbid conditions is dependent on the underlying problem. For example, certain types of infections are considered a more significant problem in a patient who is immunosuppressed than in a patient with a fractured arm. In APR DRGs, high severity of illness or risk of mortality are primarily determined by the interaction of multiple diseases. Patients with multiple comorbid conditions involving multiple organ systems represent difficult-to-treat patients who tend to have poor outcomes.

The development process

The process used in the development of the APR DRGs involved an iterative process of formulating clinical hypotheses and then testing the hypotheses with historical data. Separate clinical models were developed for each of the base APR DRGs. Once the clinical model for severity of illness and risk of mortality was developed for each base APR DRG, it was evaluated with historical data in order to review the clinical hypotheses. If there was a discrepancy between clinical expectations and the data results, the clinical content of the ICD-9-CM diagnosis and procedure codes was closely examined to determine if ambiguities in the definition or content of the codes could explain the discrepancy. Any discrepancies between clinical expectations and data results were always resolved by using clinical expectations as the basis for the APR DRGs. Thus, the APR DRGs are a clinical model that has been extensively tested with historical data. The historical data used in the development of version 20.0 of the APR DRGs was a nationwide database of 8.5 million discharges, which included all payer discharges from 1,000 general hospitals from 10 states, and all payer discharges from 47 children's hospitals in the United States. For version 24.0, testing of new diagnosis and procedure codes was conducted using Healthcare Cost and Utilization Project (HCUP) 2003 data which contained over seven million discharges.

Development of the base APR DRG

The AP-DRGs (see chapter 1) were initially used as the base DRGs in the formation of the initial APR DRGs. A series of consolidations, additions, and modifications were then made to these initial APR DRGs to create the base APR DRGs. Similar to the Yale research, the first step in forming the APR DRGs was to consolidate all age, CC and major CC splits. The APR DRGs also consolidated all splits based on discharge status of death. This was necessary so that death as an outcome variable could be examined across all the APR DRGs.

In addition to these uniform consolidations, the APR DRG system introduced an extensive set of consolidations, additions, and refinements to the initial APR DRG categories. This includes the diagnoses and procedures and birthweight ranges (for newborns) that define an APR DRG, the procedure codes that are considered OR procedures, and the placement of surgical APR DRGs in their respective MDC surgical hierarchies. The APR DRG system has also introduced numerous changes to the definition of MDCs and the pre-MDC hierarchies and categories. Finally, the APR DRG system has introduced a new kind of logic referred to as "rerouting logic," that reassigns a patient to a new MDC and APR DRG in certain circumstances where the principal diagnosis is overly broad or the sequencing of principal and secondary diagnosis is unclear. Altogether these changes result in a set of base APR DRGs that are very different from those of other DRG classification systems. Following is a summary description of these changes.

Consolidate APR DRGs based on complicated principal diagnosis

APR DRGs that were defined based on complicated principal diagnoses were consolidated. For example, in the initial version of APR DRGs, appendectomies with a complicated principal diagnosis (e.g., appendicitis with peritonitis) were assigned to a different APR DRG than uncomplicated appendectomies. The APR DRGs for appendectomies were consolidated and recognition of the complicated principal diagnosis was subsequently incorporated into the subclass assigned within the APR DRG. Other examples of this kind of consolidation include vaginal delivery with complicating diagnoses and other antepartum diagnoses with complicating diagnoses.

Consolidate APR DRGs based upon complicated OR procedures

The APR DRG system consolidated certain surgical categories that, in both the CMS DRGs and AP-DRGs, are subdivided based upon more complicated types of OR procedures. Examples of surgical category consolidations are cholecystectomy with common duct exploration versus cholecystectomy without common duct exploration, and total mastectomy versus subtotal mastectomy. Surgical procedures were consolidated when the different procedures represented fundamentally the same type of patient and the difference in complexity could be captured through the APR DRG severity of illness and risk of mortality subclasses.

Consolidate APR DRGs based on case volume

The general trend toward outpatient surgery made some of the initial APR DRGs extremely low in volume. Such APR DRGs were consolidated into other similar APR DRGs. For example, carpal tunnel releases are now rarely performed on an inpatient basis. Thus, the APR DRG for carpal tunnel release was consolidated into the APR DRG for nervous system procedures for peripheral nerve disorders, which includes procedures such as tarsal tunnel

release, and, subsequently, all of these procedures were consolidated into the APR DRG for other nervous system and related OR procedures. Since the early 1990's when the APR DRGs were first developed, there have been many areas where hospitalization rates have decreased. This is examined carefully and in each subsequent update of the APR DRG classification system, there have been a number of further consolidations for low volume APR DRG categories for both medical and surgical patients.

Pediatric additions

While the AP-DRGs incorporated some of the pediatric modifications from the PM-DRGs (see chapter 1), the APR DRGs incorporated the remaining significant pediatric modifications in the PM-DRGs. In addition, in conjunction with NACHRI, the APR DRGs were reviewed with a national pediatric database. As a result of this review, additional APR DRGs were created. For example, scoliosis (curvature of the back) is one of the primary reasons spinal fusions are performed on pediatric patients. Spinal fusions for scoliosis tend to be more complex than spinal fusions for other clinical reasons such as a herniated disk. Thus, the APR DRG for spinal fusions was subdivided based on a principal diagnosis of scoliosis. Another example is the creation of an APR DRG for major cardiothoracic repair of heart anomaly.

Restructure newborn APR DRGs

The base APR DRGs for newborns were completely restructured. Age was used instead of principal diagnosis to define the newborn MDC; birthweight ranges were used as the starting point framework for newborn APR DRGs; surgical APR DRGs were created within each birthweight range; and medical hierarchies were created within birthweight ranges that have more than one medical APR DRG. A medical hierarchy is necessary because newborns do not have a principal diagnosis in the usual sense. Most newborns have a live newborn status code as their principal diagnosis. This does not permit assignment to a medical APR DRG based on principal diagnosis. Thus, it was necessary to create a medical hierarchy for newborns.

As in the AP-DRGs, the APR DRG newborn MDC was initially defined to include all neonates, with age 0–28 days at time of admission. For version 20.0 APR DRGs, the age definition for MDC 15 was redefined and narrowed to be more consistent with its title, "Newborns & Other Neonates with Conditions Originating in the Perinatal Period." MDC 15 is now defined to include patients age 0–7 days and a subset of patients age 8–14 days who are low birthweight patients and may still have perinatal complications during this time period necessitating transfer to another hospital. This removes from MDC 15 virtually all readmissions to the hospital for community acquired infections and other problems that occur after the first week of life. The new age definition for MDC 15 increases the clinical similarity of MDC 15 patients, better aligns MDC 15 patients with the organization of patient care units and physician specialties, allows for the elimination of certain low volume APR DRGs in MDC 15, and places the older neonatal patients (8–28 days) in other MDCs where they can be assigned to more disease specific APR DRGs.

Initially, the newborn MDC was organized into six birthweight ranges—the same as in AP-DRGs. For version 20.0 APR DRGs, the number of birthweight ranges was expanded to eight and the number of different APR DRG categories within each birthweight range was decreased. The net effect of all APR DRG category changes in MDC 15 was a reduction in the number of base APR DRGs from 35 in version 15.0 to 28 in version 20.0.

Version 20.0 of APR DRGs also incorporated the use of gestational age codes that were introduced into ICD-9-CM in October 2002. Gestational age is used as part of the severity of illness and risk of mortality subclass assignment for newborns.

Add APR DRGs for mortality

The same base APR DRGs are used in conjunction with both the severity of illness subclasses and risk of mortality subclasses. Thus, some new APR DRGs were necessary in order to reflect differences in mortality. For example, initial APR DRG 45 (Specific Cerebrovascular Disorders Except TIA) was subdivided into APR DRG 45 (CVA With Infarct) and APR DRG 44 (Intracranial Hemorrhage) as a result of the significantly higher mortality rate for intracranial hemorrhage patients. In version 20.0 APR DRGs, neonates <500 grams (1.1 pounds) were placed in a new APR DRG separate from neonates 500–749 grams (1.1–1.6 pounds) because the mortality rates are so much higher for neonates <500 grams.

Other APR DRG additions and refinements

Chapter 1 of the APR DRG Definitions Manual explains that the process of defining the medical and surgical categories in an MDC requires that each category be based on some organizing principle. The end goal is to create categories that are clinically coherent and have sufficient case volume to be useful. Following are examples of ways in which version 20.0 APR DRG modifications improve clinical coherence:

- Consolidate APR DRGs if there aren't meaningful clinical differences; e.g., combine APR DRG 202 Angina Pectoris and APR DRG 198 Coronary Atherosclerosis.
- Improve the clinical distinction between related APR DRGs; e.g., redefine APR DRGs 301 and 302 for joint replacement to be based on the joint replaced (i.e., hip versus knee) instead of the etiology (i.e., trauma versus non trauma).
- For MDC 22 (Burns), re-conceptualize the APR DRGs to give further emphasis to third degree burns.
- For MDC 24 (Human Immunodeficiency Virus Infections), refine the list of major HIV related conditions and significant HIV related conditions.
- For MDC 25 (Multiple Significant Trauma), redefine the APR DRGs giving more emphasis to the surgical categories.
- Throughout the MDCs, consistently define APR DRGs for which the reason for the hospitalization is a complication of treatment. These APR DRGs now exist in MDCs 5, 6, 8, 11, 18, and 21.
- Throughout the MDCs, refine and make more consistent the definition of Other Related OR Procedures APR DRGs.
- Substantially redefine the three APR DRGs for OR Procedures Unrelated to Principal Diagnosis so that each is defined by a distinct level of surgical complexity.

Reclassification of OR Procedures

The APR DRG system has reevaluated the procedure codes considered OR procedures which in turn affects whether a patient will be assigned to a surgical or medical APR DRG.

Version 20.0 APR DRGs removed 62 procedure codes from the APR DRG list of OR procedures, leading to two-and-a-half percent fewer patients classified into surgical APR DRGs. The highest impact reclassified procedure is excisional debridement. Next most common is endoscopic lung biopsy followed by certain other biopsies of bone, soft tissue, blood vessel, cervix, uterus, and bladder. Other reclassified procedures with volume are interruption of vena cava and linear repair eyelid laceration. The APR DRGs most affected by these procedure code reclassifications are the APR DRGs previously defined on the basis of skin graft or excisional wound debridement in MDCs 8, 9, 10, and 21 and the "other OR procedure" APR DRGs throughout the various MDCs.

Revise MDC definitions

The APR DRG system has introduced numerous changes to MDC definitions, especially with version 20.0 APR DRGs.

- The age definition for MDC 15 (Newborns & Other Neonates with Conditions Originating in the Perinatal Period) was narrowed as described previously.
- MDC 25 (Multiple Significant Trauma) was updated with respect to the lists of significant trauma diagnoses and the introduction of OR procedures to clarify whether certain diagnoses represent significant trauma. The net effect was to decrease the number of MDC 25 medical patients and increase the number of MDC 25 surgical patients.
- MDC 24 (Human Immunodeficiency Virus Infections) was updated with respect to the definition of HIV related diagnoses, leading to somewhat fewer patients assigned to MDC 24.
- MDC 21 was redefined and had its title changed from "Injuries, Poisonings & Toxic Effects of Drugs" to "Poisonings, Toxic Effects, Other Injuries and Other Complications of Treatment." The title change reflects that most of the injury diagnoses previously in MDC 21 have been moved to other body system specific MDCs, namely MDCs 1, 3, 5, 8, and 9. "Other Complications of Treatment" was added into the title of MDC 21 since these diagnoses have always been in MDC 21.
- Cranial and face bone diagnoses, previously dispersed across MDCs 3, 8, and 21, were consolidated into MDC 3 which is reflected in the revised title for MDC 3, "Ear, Nose, Mouth, Throat and Craniofacial Diseases and Disorders."
- Prematurity diagnoses (for older neonates and infants) and orthopedic aftercare diagnoses were moved to MDC 23 (Rehabilitation, Aftercare, Other Factors Influencing Health Status & Other Health Service Contacts).

In addition, other individual diagnoses were assigned to different MDCs.

Revise MDC surgical hierarchies

The APR DRG system has introduced a number of changes to the MDC surgical hierarchies. Version 20.0 introduced changes to the surgical hierarchies for MDCs 1, 3, 5, 6, and 8. To illustrate, in MDC 6 (Diseases & Disorders of the Digestive System), APR DRG 224 (Peritoneal Adhesiolysis) was moved lower in the surgical hierarchy following the APR DRGs for appendectomy, anal procedures, and hernia procedures because the peritoneal adhesiolysis is usually adjunct to these procedures and not the patient's primary

surgical procedure. Most of the patients who remain in APR DRG 224 are having peritoneal adhesiolysis performed for intestinal obstruction.

A similar example in MDC 8 (Diseases & Disorders of the Musculoskeletal System and Connective Tissue), is APR DRG 312 Skin Graft, Except Hand for Musculoskeletal and Connective Tissue Diagnoses, which was moved lower in the surgical hierarchy. It now follows the APR DRGs for knee/lower leg procedures, foot & toe procedures, and shoulder, upper arm & forearm procedures because the skin graft is usually an adjunct to these procedures and not the patient's primary surgical procedure. The skin graft procedure is indicative of the complexity of the procedure and is taken into consideration in the severity of illness and risk of mortality logic that deals with select combinations of OR procedures.

Revise Pre-MDC hierarchies and categories

The initial APR DRGs started with the same pre-MDC hierarchies and categories as AP-DRGs: MDC 15 (Newborns & Other Neonates with Conditions Originating in the Perinatal Period), MDC 24 (Human Immunodeficiency Virus Infections), Transplants, two Tracheostomy APR DRGs and MDC 25 (Multiple Significant Trauma). For version 20.0 APR DRGs, this was reordered as follows: Transplants, MDC 15, Tracheostomy APR DRGs, MDC 25, and MDC 24. The reordering of the pre-MDC hierarchies provided a clearer focus for classifying the most defining aspects of the hospitalization for these patients.

Version 20.0 APR DRGs redefined and narrowed the definition of the two pre-MDC Tracheostomy APR DRGs. The previous approach included virtually all tracheostomy patients with separate APR DRGs based on whether the principal diagnosis pertained to the face, mouth, or neck, implying that the tracheostomy was a therapeutic treatment for an upper airway problem versus all other principal diagnoses, which implies that the tracheostomy was performed to allow the patient to be on extended mechanical ventilation. The new approach requires that all patients assigned to the tracheostomy APR DRGs receive mechanical ventilation 96+ hours and subdivides the tracheostomy APR DRGs based on whether there is an extensive OR procedure. The new approach in effect narrows the definition to patients on extended mechanical ventilation and classifies other tracheostomy patients to the regular APR DRG categories—particularly in MDC 3 (Ear, Nose, Mouth, Throat & Craniofacial Diseases and Disorders).

Rerouting logic

The basic organizing approach to classification in the APR DRG system is to first assign a patient to a Major Diagnostic Group (MDC) based upon principal diagnosis, and then to a specific APR DRG category based upon principal diagnosis (if medical) or operating room procedure (if surgical). This works well in the vast majority of cases and results in the patient being assigned to the MDC and APR DRG that best describes the reason for the hospitalization.

There are several different kinds of situations, however, where using the principal diagnosis as the starting point for establishing the MDC and APR DRG needs to be supplemented by additional information to yield the most useful classification of the patient. One such situation occurs when there is a clear patient characteristic that should take priority, such as for a patient with an organ transplant or a tracheostomy in the absence of an ENT problem. This situation is handled by Pre-MDC assignment logic mentioned above. Another situation occurs when the principal diagnosis is overly broad,

or the sequencing of principal diagnosis and secondary diagnosis is unclear, or a surgical procedure provides clarification of the principal diagnosis. These situations are handled through what is referred to as APR DRG "rerouting logic" which considers secondary diagnoses, procedures, and sometimes age, most often in conjunction with the principal diagnosis, to clarify the reason for the hospitalization. The rerouting logic either reassigns the patient to a new APR DRG within the same MDC (Within MDC Rerouting) or to a new MDC and APR DRG (Across MDC Rerouting).

These situations are not unique to the APR DRG classification system. They represent ambiguities that confront any DRG classification system. What is unique to the APR DRG classification system is the rerouting logic developed to assign these patients to the most appropriate and useful category.

An example of a medical rerouting within an MDC is a patient with a principal diagnosis of chest pain and a secondary diagnosis of angina pectoris or coronary atherosclerosis. The chest pain diagnosis is a symptom of the angina or coronary atherosclerosis and should have been recorded as a secondary diagnosis. The rerouting logic will assign this patient to APR DRG 198 Angina Pectoris & Coronary Atherosclerosis instead of APR DRG 203 Chest Pain, and will resequence the diagnosis of angina or coronary atherosclerosis as the principal diagnosis so that these diagnoses do not make a redundant contribution to the severity of illness and risk of mortality subclass assignment.

An example of a medical patient rerouting across MDCs is a patient with a principal diagnosis of hypovolemia (dehydration) and a secondary diagnosis of gastroenteritis. There is some ambiguity in the sequencing of principal and secondary diagnosis, while the patient fundamentally is a gastroenteritis patient who has some level of dehydration. So, in this example there would be a rerouting from MDC 10, APR DRG 422 Hypovolemia to MDC 6, APR DRG 249 Non-Bacterial Gastroenteritis, Nausea & Vomiting.

An example of a surgical patient rerouting across MDCs is amputation. In previous versions of APR DRGs and other DRG systems, there are distinct amputation DRGs in MDCs 5, 8, and 10. Starting with version 20.0, most of these patients are rerouted to MDC 8 (Diseases & Disorders of the Musculoskeletal System and Connective Tissue) and grouped according to the MDC 8 surgical hierarchy. The end result is that clinically similar amputation patients are grouped together rather than dispersed into separate lower volume amputation groups.

The sequencing of principal diagnosis and secondary diagnosis on the patient discharge records is not altered by any of these resequencing processes. Rather, the APR DRG grouper is redesignating principal diagnosis and secondary diagnosis for specified steps that are part of its logic. In the example of principal diagnosis hypovolemia and secondary diagnosis gastroenteritis, the APR DRG grouper resequences principal diagnosis and secondary diagnosis for grouping purposes but when users examine their own discharge records hypovolemia will still be the principal diagnosis. This also means that when users examine their patients in MDC 6 (Diseases & Disorders of the Digestive System) and especially APR DRG 249 Non-Bacterial Gastroenteritis, Nausea & Vomiting, some of the patients will have a principal diagnosis of hypovolemia, which is ordinarily assigned to MDC 10 (Endocrine, Nutritional & Metabolic Diseases and Disorders). A fuller explanation of the APR DRG rerouting logic and a more extensive set of illustrations is in chapter 3.

The end result of the consolidation and refinement process for version 12.0 of the APR DRG classification system released in 1995 was the creation of 382 base APR DRGs (plus two ungroupable or invalid APR DRGs). This was further consolidated to 355 base

APR DRGs for version 15.0 released in 1998 and to 314 base APR DRGs (plus two ungroupable or invalid APR DRGs) for version 20.0 released in 2003. For version 25.0, the base APR DRGs remain at 314. The modifications to the base APR DRGs were sufficiently extensive that a complete renumbering of the base APR DRGs was included as part of the version 15.0 update.

There were many changes to the APR DRG category definitions introduced as part of version 20.0 of the APR DRG system. Overall, this reduced the number of base APR DRGs by 41 from 357 to 316 as a result of the elimination of 55 base APR DRGs and the addition of 14 new base APR DRGs. In addition, 66 base APR DRGs had major definitional changes and 102 base APR DRGs had moderate definitional changes. Version 20.0 reduced the number of final APR DRG severity of illness and risk of mortality subclass categories from 1,422 to 1,258 (including two ungroupable or invalid APR DRGs that do not have subclasses).

Once the definition of the base APR DRGs was completed, four severity of illness subclasses and four risk of mortality subclasses for each of the APR DRGs were evaluated and updated for each new release of the APR DRGs.

Overview of APR DRG subclass assignment

The process of determining the subclasses for an APR DRG begins by first assigning a severity of illness level and a risk of mortality level to each secondary diagnosis. The term "level" is used when referring to the categorization of a secondary diagnosis. The term "subclass" is used when referring to one of the subdivisions of an APR DRG. For secondary diagnoses, there are four distinct severity of illness levels and four distinct risk of mortality levels. The four levels are numbered sequentially from 1 to 4 indicating, respectively, minor, moderate, major or extreme severity of illness or risk of mortality. Each secondary diagnosis is assigned to one of the four severity of illness levels and one of the four risk of mortality levels. The severity of illness level and risk of mortality level associated with a patient's secondary diagnoses is just one factor in the determination of a patient's overall severity of illness subclass and risk of mortality subclass.

The assignment of a patient to a severity of illness or risk of mortality subclass takes into consideration not only the level of the secondary diagnoses but also the interaction among secondary diagnoses, age, principal diagnosis, and the presence of certain OR procedures and non-OR procedures. The subdivision of each of the 314 APR DRGs into the four subclasses, combined with the two error APR DRGs (955, 956), which are not subdivided, results in 1,258 APR DRGs.

The process of determining the severity of illness or risk of mortality subclass of a patient consists of three phases. In Phase I, the level of each secondary diagnosis is determined. Once the level of each individual secondary diagnosis is established, then Phase II determines a base subclass for the patient based on all of the patient's secondary diagnoses. In Phase III, the final subclass for the patient is determined by incorporating the impact of principal diagnosis, age, OR procedure, non-OR procedures, multiple OR procedures, and combinations of categories of secondary diagnoses. A detailed description of the determination of the severity of illness subclass and the risk of mortality subclass will be presented separately.

The three-phase process of determining the severity of illness subclass is summarized in figure 2–1. There are six steps to Phase I, three steps to Phase II, and nine steps to Phase III for a total of 18 steps.

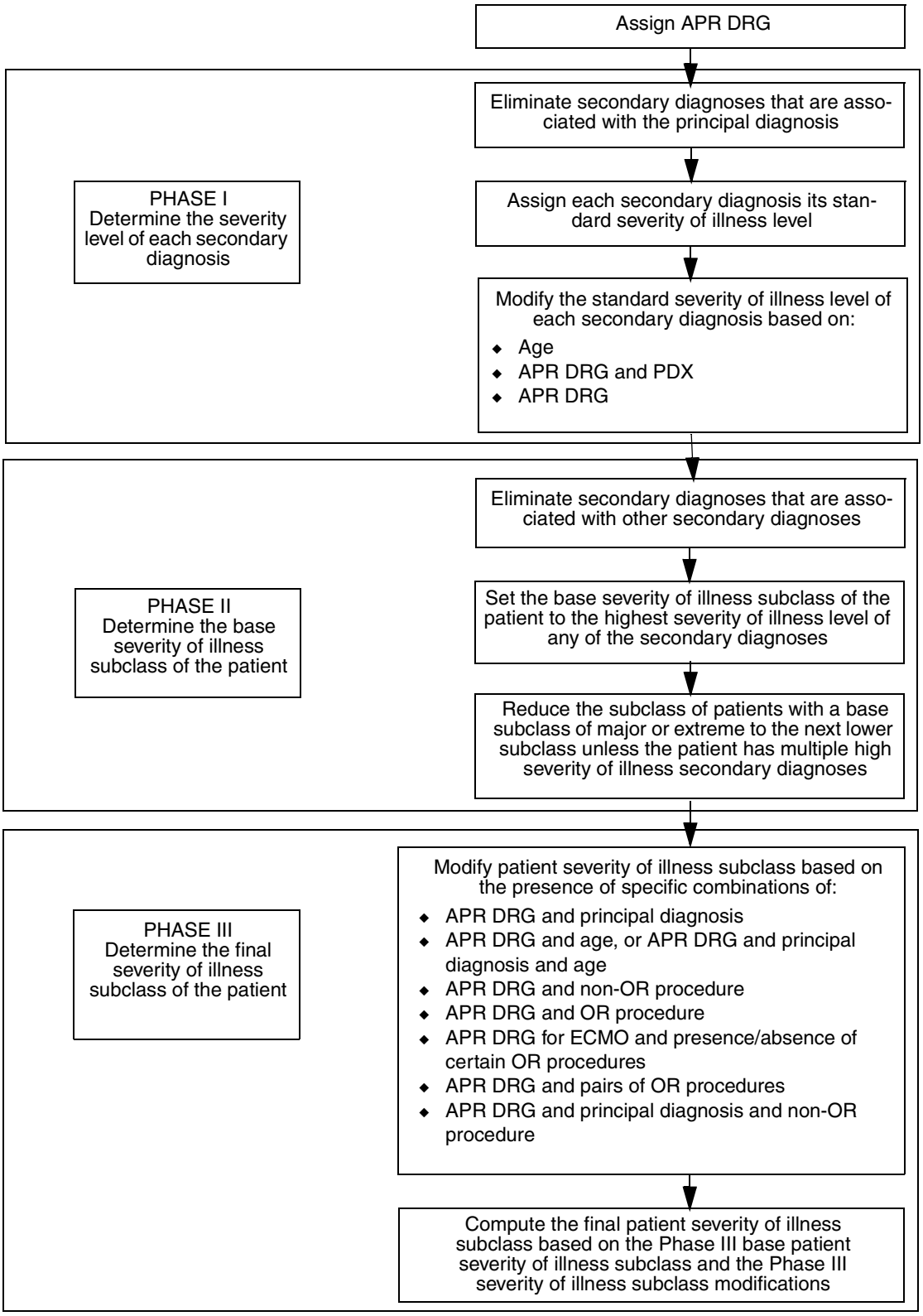

Figure 2–1. Three-phase process for determining patient severity of illness subclass

Phase I—Determining the severity of illness level of each secondary diagnosis

1. Eliminate secondary diagnoses associated with the principal diagnosis

If a secondary diagnosis is closely related to the principal diagnosis and does not add any distinguishing information, the secondary diagnosis is excluded from the determination of the severity of illness subclass. For example, a secondary diagnosis of urinary retention is excluded from the determination of the severity of illness subclass if the principal diagnosis is benign prostate hypertrophy because the urinary retention is caused by the benign prostate hypertrophy and will usually be present for patients hospitalized for benign prostate hypertrophy. For version 20.0 APR DRGs, the secondary diagnosis and principal diagnosis exclusion list was comprehensively reviewed and extensively modified. For version 25.0, the list was only updated.

2. Assign each secondary diagnosis to its standard severity of illness level

Each secondary diagnosis is assigned to one of the four distinct severity of illness levels. Examples of the different severity of illness levels are contained in table 2–1.

Table 2–1. Examples of severity of illness levels

Severity of Illness Level	Examples	
Minor	Uncomplicated Diabetes	Bronchitis
Moderate	Diabetes with Renal Manifestations	Asthma with Status Asthmaticus
Major	Diabetes with Ketoacidosis	Viral Pneumonia
Extreme	Diabetes with Hyperosmolar Coma	Respiratory Failure

The severity of illness level for diabetes progresses from minor for uncomplicated diabetes to extreme for diabetes with hyperosmolar coma. Similarly, the severity of illness level for respiratory diagnoses progresses from minor for bronchitis to extreme for respiratory failure.

For version 20.0 APR DRGs, the standard severity of illness level was comprehensively reviewed for all secondary diagnoses codes. There were a number of revisions introduced—the majority of which were to lower the standard severity of illness level. In situations where there was a great deal of variability within an ICD-9-CM diagnosis code, the approach was to lower the standard severity of illness level and then in later steps of Phase I, consider whether modifications to the standard severity of illness level are indicated based upon specific age ranges, APR DRGs, or non-OR procedures. For example, the secondary diagnosis code 51882 Other pulmonary insufficiency NEC includes a very specific and severe condition such as adult respiratory distress syndrome, but is sufficiently broad to include other much less severe forms of pulmonary insufficiency. Beginning with version 20.0, and continuing with 25.0, the secondary diagnosis lowers from extreme to moderate, but then in a later Phase I step adjusts the severity of illness level up to major if the patient receives mechanical ventilation <96 hours, and up to extreme if the patient receives mechanical ventilation 96+ hours. The mechanical ventilation is an indicator of more severe pulmonary insufficiency and is often needed for patients with adult respiratory distress syndrome.

For version 25.0 APR DRGs there are a total of 13,677 ICD-9-CM diagnoses codes. These codes are assigned to the following severity of illness levels: 8,793 minor, 3,080 moderate, 949 major, 855 extreme.

The relatively large number of diagnoses moved to the minor severity of illness level was in part due to the decision to assign to the minor severity of illness level most secondary diagnoses related to pregnancy that were coded with an unspecified episode of pregnancy care (e.g., ICD-9-CM code 65100 Twin pregnancy without an indication of whether the encounter was for antepartum care, post partum care, or delivery). The only exceptions were diabetes mellitus, venous complications in pregnancy, and obstetrical pyemic and septic embolism, which were assigned to a higher severity of illness level. Another reason is that the APR DRG system has assigned to the minor severity of illness level most diagnoses that are described as complications of treatment. While complications of treatment are sometimes unavoidable and not due to poor quality of care, the APR DRG system has been very conservative in allowing these diagnoses to contribute to the patient's severity of illness level (the same is true for risk of mortality). Most of the ICD-9-CM complications of treatment diagnosis codes in the 990 series and the obstetrical complications of the administration of anesthesia were changed to minor severity of illness level in the version 15.0 APR DRGs. In addition, there are some other complications of treatment diagnosis codes that were changed to minor severity of illness level in version 20.0 APR DRGs (e.g., tracheostomy, gastrostomy, colostomy complications, and iatrogenic pneumothorax).

There are some secondary diagnoses that can have different meanings or implications in different circumstances and these received special attention in version 20.0 APR DRG through the various Phase I steps. To illustrate, there are circumstances where secondary diagnosis code 3481 Anoxic brain damage may be part of the patient's acute presenting condition (e.g., major trauma, poisoning, major neurological, respiratory, cardiac or infectious condition) and an indicator of high severity of illness. There are other instances where anoxic brain damage is not ordinarily expected and may represent the use of code 3481 for long standing anoxic brain damage (from a prior event), or possibly an unexpected complication of treatment. To take into account these different circumstances, version 20.0 APR DRGs lowered the standard severity of illness level for anoxic brain damage from extreme to minor, but then, in a later Phase I step, adjusts the severity level back up to extreme for selected APR DRGs where it is reasonable to expect that the anoxic brain damage may be part of the patient's presenting condition. (This was handled the same way for risk of mortality.)

Another set of secondary diagnoses that received special attention is the secondary diagnoses of cardiac arrest, ventricular fibrillation and ventricular flutter. In version 15.0 APR DRGs, these diagnoses were all assigned a severity of illness level of extreme (likewise for risk of mortality.) These secondary diagnoses unquestionably represent very extreme acute diagnoses. At the same time, there is a unique aspect to these diagnoses in that they can potentially be coded for most patients who die and whose admitting condition is not cardiac or cardiac related. If this was to occur, the subclass assignment logic, especially for risk of mortality, could become somewhat circular. To avoid this possibility, the standard severity of illness level (and standard risk of mortality level) in version 20.0 APR DRGs was changed from extreme to minor, and then for a small subset of APR DRGs adjusted back up to extreme. The subset includes APR DRGs for major neurological, respiratory, cardiovascular, and infectious conditions, and poisonings. For these APR DRGs, the patients are at a clear risk of having a cardiac arrest, ventricular fibrillation, or ventricular flutter and so these secondary diagnoses contribute to the

severity of illness (and risk of mortality) assignment. This is different from other APR DRGs where the patient is not at an apparent risk of a cardiac arrest, ventricular fibrillation, or ventricular flutter. Patients in these other APR DRGs could still have a cardiac arrest, ventricular fibrillation, or ventricular flutter as part of the course of their hospitalization, but since their principal diagnosis is not cardiac or cardiac related, there is the concern for potential overcoding of these secondary diagnoses for patients who die. Versions 20.0 and 24.0 APR DRGs do not let these occurrences contribute to the patient's severity of illness level or risk of mortality level.

The process of determining the severity of illness subclass for a patient begins by assigning each secondary diagnosis its standard severity of illness level. The next step is to modify the standard severity of illness level based on other patient attributes. The patient attributes which can modify the standard severity of illness level of a secondary diagnosis are the age of the patient, the APR DRG and principal diagnosis, the APR DRG, and the presence of certain non-operating room procedures. These potential modifiers are evaluated and applied sequentially through Phase I.

3. Modify the standard severity of illness level of a secondary diagnosis based on age

The age of the patient will modify the standard severity of illness level assignment for some secondary diagnoses. For pediatric patients there are some secondary diagnoses that are modified to a higher level throughout all childhood years. For example, hypertension is modified from minor to major and really represents a different disease in children than adults. There are other secondary diagnoses that are modified only for certain childhood ages, most often early childhood. For example, many congenital anomalies and syndromes have their most difficult presentation in the neonatal time period and the first year of life, and are modified to a higher level for these ages. For example, hypoplastic left heart syndrome and combined immune deficiency are both modified from major to extreme for children less than one year of age. There are also some secondary diagnoses that are modified to a lower level for pediatric patients. For example, thrush is modified from moderate to minor for children less than one year of age.

In general, for elderly patients, for select secondary diagnoses, the severity of illness level is increased. For example, the secondary diagnoses of hypovolemia (dehydration) and chronic bronchitis are modified from minor to moderate and asthma with status asthmaticus is modified from moderate to major for patients age >69 years.

4. Modify the standard severity of illness level of a secondary diagnosis based on the APR DRG and principal diagnosis

The standard severity of illness level for some secondary diagnoses may be modified depending on the APR DRG and principal diagnosis of the patient. In version 24.0, this logic is applied only to APR DRG 190 Acute Myocardial Infarct. In general, secondary diagnoses that are closely related to the principal diagnosis are excluded from the determination of the severity of illness subclass. However, for a patient admitted for an acute anterior wall myocardial infarction, an acute anterolateral myocardial infarction represents an extension of the acute anterior wall myocardial infarction. Therefore, the acute anterolateral myocardial infarction is not excluded and is assigned a severity of illness level of moderate.

5. *Modify the standard severity of illness level of a secondary diagnosis based on the APR DRG*

The standard severity of illness level for many secondary diagnoses may be modified depending on the APR DRG to which the patient is assigned. Altogether, there are 3,787 modifications of the standard severity of illness level of a secondary diagnosis depending upon the APR DRG. The APR DRG specific modifications to the severity of illness level of individual secondary diagnoses reflects the disease-specific nature of the determination of severity of illness.

Some examples of APR DRG modifications are shown in table 2–2. Chronic renal failure significantly increases the severity of illness level for patients with diabetes and, thus, is increased to a major severity of illness for the APR DRG for diabetes. Cardiomegaly is not only common for congestive heart failure patients, but it is also an integral part of the disease and is reduced to a minor severity of illness level for the APR DRG for congestive heart failure. Uncomplicated diabetes is a minor secondary diagnosis, but for a vaginal delivery, represents a more difficult delivery and is therefore increased to a moderate severity of illness level.

Table 2–2. Examples of modification of standard Severity of Illness level based on APR DRG

Secondary Diagnosis	Standard Severity of Illness Level	APR DRG	Modified Severity of Illness Level
Chronic Renal Failure	Moderate	Diabetes	Major
Cardiomegaly	Moderate	Congestive Heart Failure	Minor
Uncomplicated Diabetes	Minor	Vaginal Delivery	Moderate

In general, for surgical APR DRGs, secondary diagnoses that constituted or were associated with the reason for performing the procedure had their standard severity of illness level decreased. In general, for medical APR DRGs, secondary diagnoses that were closely related to the reason for the admission had their standard severity of illness level decreased. In essence, the standard severity of illness level of every secondary diagnosis was reviewed with every APR DRG and modified when appropriate. For version 20.0 APR DRGs, there were a substantial number of additions and modifications made on this basis.

6. *Modify the standard severity of illness level of a secondary diagnosis based on non-OR procedures*

Some secondary diagnoses can vary significantly in terms of their severity and clinical impact on patients. The presence of certain non-OR procedures can indicate a more extensive disease process. This type of modification is applied to only nine sets of non-OR procedure codes and to only a limited number of secondary diagnoses. The most important of these are the procedure codes for mechanical ventilation. Mechanical ventilation <96 hours is used to increase the standard severity level of a secondary diagnosis by an increment of one up to major; e.g., asthma with status asthmaticus would increase from level moderate to major if the patient had mechanical ventilation <96 hours. Mechanical ventilation 96+ hours is used to increase the standard severity level of illness of a secondary diagnosis by an increment of two up to extreme; e.g., other pulmonary insufficiency not elsewhere classified (which includes adult respiratory distress syndrome)

increases the standard severity of illness level from moderate to extreme and a diagnosis such as pneumonia NOS which is already a level of major increases to extreme if the patient had mechanical ventilation 96+ hours. In each of these instances, the need for mechanical ventilation is indicative of a patient with more severe pulmonary illness, especially those who require ventilation for 96+ hours.

Among the other non-OR procedures that are used as part of this step, renal dialysis is used to increase the severity level of nephritis by an increment of one up to a maximum of major; total parenteral nutrition (TPN) is used to increase regional enteritis and ulcerative colitis by an increment of one up to major; and temporary pacemaker is used to increase heart block diagnoses such as trifascicular block by an increment of one up to major. Overall, non-OR procedures as part of this step in the APR DRG severity of illness logic are used more sparingly starting with version 20.0.

Phase II—Determine the base severity of illness subclass for the patient

Once each secondary diagnosis has been assigned its standard severity of illness level and the standard severity of illness level of each secondary diagnosis has been modified based on age, APR DRG and principal diagnosis, APR DRG, and presence of certain non-OR procedures, the Phase II base severity of illness subclass for the patient can be determined. The process of determining the base patient severity of illness subclass of the patient begins with the elimination of certain secondary diagnoses that are closely related to other secondary diagnoses. The elimination of these diagnoses prevents the double counting of clinically similar diagnoses in the determination of the severity of illness subclass of the patient. Once redundant diagnoses have been eliminated, the base severity of illness subclass is determined based on all of the remaining secondary diagnoses. There are three steps to Phase II.

7. Eliminate certain secondary diagnoses from the determination of the severity of illness subclass of the patient

Closely related secondary diagnoses are grouped together with clinically similar diagnoses. If more than one secondary diagnosis from the same secondary diagnosis group is present, then only the secondary diagnosis with the highest severity of illness level is preserved. All other secondary diagnoses in the group have their severity level reduced to minor, virtually eliminating them from contributing to the patient's base subclass determination. There are 289 secondary diagnosis groups defined for this step. For example, the secondary diagnoses of cerebral embolism with infarct and precerebral occlusion are in the same secondary diagnosis group, Cerebrovascular Diagnoses. Since the cerebral embolism with infarct is an extreme severity of illness level, and the precerebral occlusion is a moderate severity of illness level, the cerebral embolism with infarct will be preserved and the severity of illness level of the precerebral occlusion will be reduced to one when they are both present as secondary diagnoses.

8. Combine all secondary diagnoses to determine the base severity of illness subclass of the patient

Once secondary diagnoses that are related to other secondary diagnoses have had their severity levels reduced to minor, the base patient severity of illness subclass is set equal to the maximum severity of illness level across all of the remaining secondary diagnoses. For example, if there are five remaining secondary diagnoses and one is a major severity of

illness level and four are a moderate severity of illness level then the base patient subclass is major.

9. Reduce the base severity of illness subclass of patients with a major or extreme subclass unless the patient has multiple secondary diagnoses at a high severity level

In order to be assigned to the major or extreme severity of illness subclass, a patient must have multiple secondary diagnoses at a high severity of illness level. High severity of illness patients are usually characterized by the presence of multiple high severity of illness secondary diagnoses. Patients with a base severity of illness subclass of extreme must have two or more secondary diagnoses that are an extreme severity of illness level, or one secondary diagnoses at an extreme severity of illness level plus at least two other secondary diagnoses at a major severity of illness level—otherwise the base severity of illness subclass is reduced to major. Patients with a base severity of illness subclass of major must have two or more secondary diagnoses that are a major severity of illness level, or one secondary diagnosis at a major severity of illness level plus at least two other secondary diagnoses at a moderate severity of illness level—otherwise the base severity of illness subclass is reduced to moderate. Thus, a secondary diagnosis of AMI is not sufficient to assign a patient to an extreme severity of illness subclass. In addition to the AMI, there must be at least one additional extreme severity of illness secondary diagnosis (e.g., acute renal failure) or two or more additional major severity of illness secondary diagnoses (e.g., congestive heart failure and diabetic ketoacidosis).

Phase III—Determine the final severity of illness subclass of the patient

Once the base patient severity of illness subclass is computed, the patient severity of illness subclass may be increased or decreased based on specific values of the following patient attributes:

- Combinations of APR DRG and principal diagnosis
- Combinations of APR DRG and age, or APR DRG and principal diagnosis and age
- Combinations of APR DRG and non-OR procedures
- Combinations of APR DRG and OR procedures
- Combinations of APR DRG and pairs of OR procedures
- Combination of APR DRG for ECMO and presence/absence of certain OR procedures
- Combinations of APR DRG and principal diagnoses and non-OR procedures
- Combinations of categories of secondary diagnoses

Phase III examines these eight patient attributes, seven of which are APR DRG specific, and then as its ninth step, computes the patient's final severity of illness subclass assignment.

In Phase I, age and non-OR procedures were used to modify the standard severity of illness level of a secondary diagnosis. However, age and non-OR procedures can also have an impact that is specific to the patient's APR DRG or to a specific principal diagnosis within the APR DRG. Thus, the impact of age and non-OR procedures is reassessed in Phase III as part of the determination of the severity of illness subclass of the patient. Based on the patient attributes listed above, a series of modifications to the base patient

severity of illness subclass are made during Phase III. The final patient severity of illness subclass is computed based on the Phase II base patient severity of illness subclass and the modifications to the base severity of illness subclass made in Phase III.

10. Modify severity of illness subclass for the patient based on combinations of APR DRG and principal diagnosis

This step is used extensively in Phase III to modify a patient's severity of illness subclass. The ICD-9-CM coding system will sometimes include in a single diagnosis code both the underlying disease and an associated manifestation of the disease. For example, if the principal diagnosis code is 25020 Diabetes with hyperosmolar coma, the patient is assigned to the APR DRG for diabetes. Ordinarily, if the patient had no secondary diagnoses then the severity of illness subclass would be minor. Since the principal diagnosis includes not only the underlying diagnosis but also a major manifestation, the diabetic patient with hyperosmolar coma should be assigned to a higher patient severity of illness subclass. In order to accommodate this idiosyncrasy of ICD-9-CM, if the principal diagnosis is an ICD-9-CM diagnosis code that represents multiple diagnoses, or a diagnosis as well as a high severity manifestation, the severity of illness subclass of the patient is increased by a specified increment up to a specified maximum subclass. For example, if diabetes with hyperosmolar coma is the principal diagnosis, the severity of illness subclass of the patient is increased by one up to a maximum subclass of major. Other examples of principal diagnoses that include an important manifestation include: head trauma with prolonged or deep coma, intractable epilepsy, ruptured aortic aneurism, acute stomach ulcer with perforation and obstruction, acute appendicitis with peritonitis, and open fracture of the femur shaft.

Within specific APR DRGs there are also some principal diagnoses that are indicative of higher severity of illness relative to the other principal diagnoses in the APR DRG. For example, the severity of illness subclass of patients in APR DRG 221 Major Small & Large Bowel Procedures with a principal diagnosis of acute vascular insufficiency of the intestine is increased by one up to a maximum subclass of moderate. Relative to the other principal diagnoses associated with the procedures in APR DRG 221 (e.g., diverticulosis of colon, bowel malignancies), acute vascular insufficiency of the intestine represents a more severely ill patient. A medical example is hemophilia factor VIII that is increased by two up to major in APR DRG 661 Coagulation Disorders.

Conversely, within specific APR DRGs some principal diagnoses are indicative of lower severity of illness relative to the other principal diagnoses in the APR DRG. For example, within APR DRG 404 Thyroid, Parathyroid & Thyroglossal Procedures, patients with a principal diagnosis of nontoxic uninodular goiter will have their severity of illness subclass decreased by one if their severity of illness subclass up to this point in the process were major or moderate. Relative to the other principal diagnoses associated with the procedures in APR DRG 404 (e.g., malignant neoplasm of thyroid), nontoxic uninodular goiter represents a less severely ill patient. A medical example is first degree burns, which is decreased from moderate to minor in APR DRG 844 Partial Thickness Burns as these patients are less severely ill than second degree burn patients.

11. Modify severity of illness subclass for the patient based combinations of APR DRG and age, or APR DRG, principal diagnosis and age

For some principal diagnoses in specific APR DRGs, the patient's age essentially represents a complicating factor. For specific principal diagnoses and age combinations in certain

APR DRGs, the severity of illness subclass of the patient is increased by a specified increment up to a specified maximum subclass. For example, for pediatric patients in APR DRG 344 Osteomyelitis, Septic Arthritis & Other Musculoskeletal Infections with bone infection as a principal diagnosis, the severity of illness subclass is increased by one up to a maximum of a moderate subclass. The increase in the severity of illness subclass indicates that bone infection in a pediatric patient represents a more severely ill patient. Elderly patients with certain principal diagnoses have their severity of illness subclass increased by one to a maximum subclass of moderate. For example, patients age >69 years with certain septicemia principal diagnoses in APR DRG 720 Septicemia and patients age >79 years with chronic/unspecified ulcer with hemorrhage without obstruction in APR DRG 241 Peptic Ulcer & Gastritis have their severity of illness subclass increased by one to a maximum of moderate.

For some APR DRGs the patient's severity of illness subclass is modified for all patients in an age range, not just for those certain principal diagnoses. This modification has been applied to just elderly patients and in just two MDC 10 (Endocrine, Nutritional & Metabolic Diseases and Disorders) APR DRGs and five MDC 19 (Mental Diseases & Disorders) APR DRGs. For example, patients age >79 years in APR DRG 421 Malnutrition, Failure to Thrive and Other Nutritional Disorders and APR DRG 422 Hypovolemia & Related Electrolyte Disorders will have their severity of illness subclass increased by an increment of one up to a maximum subclass of moderate.

12. Modify the severity of illness subclass for the patient based upon combinations of APR DRG and non-OR procedures

For some APR DRGs the presence of certain non-OR procedures represents a complicating factor. The most important of these are the codes for mechanical ventilation. For a number of neurological, respiratory, certain cardiovascular, neonatal, burn, and trauma patients, the need for mechanical ventilation indicates a more severely ill patient and the patient's severity of illness subclass is increased most often by an increment of one to a maximum subclass of major. In the same APR DRGs, mechanical ventilation 96+ hours is often used to increase the patient's severity of illness subclass by an increment of two up to a maximum subclass of extreme. The exact amount of the increment will vary according to the APR DRG category. For example, in the instance of neonates the increment varies depending upon birthweight and medical or surgical APR DRG. In the cardiovascular APR DRGs, balloon pulsation device is used to increase the severity subclass by an increment of one to a maximum of major for most surgical categories and by an increment of two to extreme for most medical APR DRGs.

13. Modify the severity of illness subclass for the patient based on combinations of APR DRG and OR procedure

This step is used extensively in Phase III to modify a patient's severity of illness subclass. Within specific APR DRGs, some OR procedures are indicative of higher severity of illness relative to the other OR procedures in the APR DRG. For example, the severity of illness subclass of patients in APR DRG 362 Mastectomy Procedures with an OR procedure of bilateral extended radical mastectomy is increased by one up to a maximum of a moderate subclass. Relative to the other OR procedures in APR DRG 362 (e.g., unilateral simple mastectomy), a bilateral extended radical mastectomy represents a patient that is more severely ill.

Conversely, within specific APR DRGs, some OR procedures are indicative of lower severity of illness relative to the other OR procedures in the APR DRG. For example, the severity of illness subclass of patients in APR DRGs 162 and 163 (Cardiac Valve Procedure With and Without Cardiac Catheterization) with an OR procedure of open heart valvuloplasty, is less complex than patients receiving cardiac valve replacements, and have their severity of illness subclass decreased by one for patients with a severity of illness subclass up to this point in the process that is moderate.

14. Modify the severity of illness subclass for the patient based on combinations of APR DRG and pairs of OR procedures

Within specific APR DRGs some pairs of OR procedures are indicative of higher severity of illness relative to the other patients in the APR DRG. Areas where multiple procedures are a significant determinant of severity of illness include: peripheral bypass surgery plus lower limb amputation or skin graft, cranial procedures plus face bone or jaw procedures, multiple spinal fusion procedures (anterior and posterior), and multiple procedures related to trauma such as multiple limb procedures, limb procedure plus back procedure, and limb procedure plus skin or fascia graft. For example, if a patient in APR DRG 308 Hip & Femur Procedure for Trauma receives both a femur procedure (upper leg) and one of a specified set of tibia/fibula procedures (lower leg) or shoulder/arm procedures, the severity of illness subclass will be increased by one up to a maximum subclass of extreme. Relative to other femur procedure patients, those who also have a procedure for trauma to other extremities have a higher severity of illness.

15. Modify the severity of illness subclass for the patient based upon combination of APR DRG for ECMO and presence/absence of certain OR procedures

This step is specific to the logic of how one APR DRG is defined, APR DRG 583 Neonate With ECMO (Extracorporeal Membrane Oxygenation). All of the patients who receive ECMO are severely ill but there are two subsets of ECMO patients, those who receive ECMO along with a major OR procedure for a congenital diaphragmatic hernia or heart condition and those who receive ECMO because conventional therapy has been unsuccessful at treating pulmonary hypertension and respiratory failure. To distinguish, those neonatal patients who do not have one of the major neonatal surgeries have their severity subclass decreased by one.

16. Modify the severity of illness subclass for the patient based upon combinations of APR DRG, principal diagnosis and non-OR procedure

Specific principal diagnoses within an APR DRG in combination with certain non-OR procedures will increase the severity of illness subclass by a specified increment up to a specified maximum severity of illness subclass. This step applies to a limited number of patients, mostly cancer patients receiving chemotherapy or radiation therapy. For example, patients with a principal diagnosis of malignancy in APR DRG 343 (Musculoskeletal Malignancy and Pathological Fracture Due To Musculoskeletal Malignancy) are increased by one level up to a maximum subclass of major if radiation therapy or chemotherapy is performed.

17. Establish a minimum severity of illness subclass for the patient based on the presence of specific combinations of categories of secondary diagnoses

The presence of certain combinations of secondary diagnoses has great clinical significance. The interaction of specific combinations of secondary diagnoses makes treatment more difficult and typically indicates a more extensive disease process. Therefore, a minimum patient severity of illness subclass greater than minor is established if certain combinations of secondary diagnoses are present. The presence of multiple interacting diagnoses is characteristic of high severity of illness patients. A subset of secondary diagnoses interact with each other causing patient severity of illness to be increased. All of the ICD-9-CM diagnosis codes were classified into either one of the 83 core secondary diagnosis categories applicable to all patients except MDC 15 (Newborns & Other Neonates with Conditions Originating in the Perinatal Period) or to one of the 21 secondary diagnosis categories applicable to a subset of MDC 15. The 83 core secondary diagnosis categories are shown in table 2–3. Each of these categories represents a disease process and is further subdivided by severity of illness level. The full numbering of the categories includes the two digits shown in table 2–3 plus a third digit for the severity of illness level of the secondary diagnoses in the category. To illustrate, secondary diagnosis category 15 Cerebrovascular Diagnoses includes diagnoses that span all four severity levels so the full numbering and titling is: 151 Cerebrovascular Diagnoses (1), e.g., cerebral atherosclerosis; 152 Cerebrovascular Diagnoses (2), e.g., occlusion and stenosis of pre-cerebral artery without cerebral infarction; 153 Cerebrovascular Diagnoses (3), e.g., occlusion and stenosis of pre-cerebral artery with cerebral infarction; and 154 Cerebrovascular Diagnoses (4), e.g., cerebral thrombosis with cerebral infarction. Not all secondary diagnosis categories contain four severity levels. Some describe a disease process that has only three severity levels (e.g., Ear, Nose & Throat; Eye) or only two severity levels (e.g., Asthma; Hypertension). Others describe a more singular disease process that has only one severity level (e.g., Coronary Bypass Graft Status, Acute Myocardial Infarct, Hypovolemia). Altogether, the secondary diagnosis categories together with severity level breakouts contain 240 categories.

Table 2–3. Categories of Secondary Diagnoses

	Secondary Diagnosis Category
01	AMI–Subsequent/Unspecified
02	Abdominal Trauma
03	Abortion
04	Acute Myocardial Infarct
05	Alcohol & Drug Abuse
06	Arteries, Veins & Other Vascular DX
07	Asthma
08	Atrial Fibrillation
09	Bacterial Infections
10	Benign Neoplasm and CA in Situ
11	Brain Malignancy
12	Burn
13	CABG Status
14	Congestive Heart Failure
15	Cerebrovascular Diagnoses

	Secondary Diagnosis Category
16	Cardiac Diagnoses
17	Cardiac & Respiratory Arrest
18	Chest & Respiratory Trauma
19	Cardiovascular Device Malfunction
20	Hypertension
21	Child & Adult Abuse
22	Chronic Renal Failure
23	Cirrhosis
24	Head Trauma W Coma
25	Chromosomal Anomaly/Other Specified Syndromes
26	Decubitus Ulcer
27	Delirium Tremens
28	Dental & Oral Diagnoses
29	Dermatologic Diagnoses

	Secondary Diagnosis Category
30	Diabetes
31	Dialysis Status
32	Dysrhythmia
33	Ear, Nose & Throat Diagnoses
34	Electrolyte Diagnoses Except Hypovolemia
35	Endocrine, Nutritional & Metabolic Diagnoses
38	Eye Diagnoses
39	Gastrointestinal Diagnoses
40	Genitourinary Diagnoses
41	Gynecological Diagnoses
42	HIV
43	Head & Neck Trauma w/o Coma
44	Hematological & Immunological Diagnoses
45	Hematological Malignancy
46	Hemiplegia
47	Hemorrhoids
48	History of Major Organ Surgery
49	History of Malignancy
50	Hypotension
51	Hypovolemia
52	Incidental Signs, Symptoms & Findings
53	Incidental V Codes
54	Fx (Limb), Open Wounds & Other Injuries
55	Iron Deficiency Anemia
56	Kaposi's Sarcoma
57	Lung Malignancy
58	Digestive Malignancy

	Secondary Diagnosis Category
59	Malnutrition
60	Mental Health
61	Multiple Birth
62	Musculoskeletal Diagnoses
63	Neonatal Diagnoses
64	Neurological Diagnoses
65	Obstetrics
67	Osteoarthrosis
68	Ostomy Status - GI & GU
69	Other Complications
70	Other Malignancy
72	Pleural Effusion
73	Poisoning
74	TB, Fungal, Parasitic Infections
75	Pulmonary Diagnoses
76	Acute Renal Failure
77	Respirator Dependence
78	Secondary Malignancy
79	Shock
80	Sickle Cell Anemia
81	Spinal Cord & Vertebral Injuries
82	Surgical & Device Complications
83	Thrombophlebitis
84	Transplant Status
86	Urinary Tract Infection
87	Viral Infections

The secondary diagnosis categories for MDC 15 are shown in table 2–4. These are intended for use with just two groups of MDC 15 patients: APR DRG 626 Neonate BWT 2000 – 2499 Grams, Normal Newborn Or Neonate With Other Problem and APR DRG 640 Neonate BWT >2500 Grams, Normal Newborn Or Neonate With Other Problem. The secondary diagnoses on this list are nearly all diagnoses with a severity of illness level of minor, so no further differentiation based on severity level is necessary. It is their purpose to distinguish newborns with multiple minor or other problems from those who are normal newborns or have a single minor problem. This is an important distinction because there is a very large case volume of these newborn patients.

Table 2–4. Categories of Secondary Diagnoses for MDC 15

MDC 15 Secondary Diagnosis Category	
900	Craniofacial Anomalies
901	Musculoskeletal Anomalies
902	Maternal Infections & Other Maternal Effects Except Noxious Substances
903	Chromosomal Anomaly NOS
904	Perinatal Jaundice from Prematurity/Other Specified Causes
905	Circulatory Disorder Diagnoses
906	Gastrointestinal Disorder Diagnoses
907	Newborn Peripheral Nerve Injury
908	Fetal Malnutrition
909	Newborn Meconium Aspiration
910	Other Newborn Respiratory Problem/Other Asphyxia
911	Newborn Feeding Problem Diagnoses
912	Hypo-Hypertonia/Other Newborn Problem Diagnoses
913	Noxious Influences Affecting Fetus Through Placenta/Breast Milk
914	Infant of Diabetic Mother
915	Hemolytic Disease Due to Isoimmunization
916	Other Hematologic Disorders Except Isoimmunization
917	Dehydration
918	Hypoglycemia
919	Fever
920	Transient Tachypnea

As summarized in table 2–5 there are nine different types of combinations of secondary diagnosis categories that will result in a minimum severity of illness subclass for a patient. For combination types 1 through 5, four significant secondary diagnoses are required in order to increase the severity of illness subclass of a patient. Two of the four secondary diagnoses must constitute one of the secondary diagnosis category combinations and must not have had their standard severity of illness level decreased as part of the Phase I severity level modifications. The addition of the third and fourth secondary diagnoses increases the likelihood that the specific combination of secondary diagnosis categories represents a more extensive and severe disease process.

Table 2–5. Combinations of Secondary Diagnosis Categories

Combination Type	Combination of Categories	Additional Secondary Diagnoses Required	Minimum Severity of Illness
1	Specified combinations of two major categories	At least two additional secondary diagnoses of major or higher	Extreme (4)
2	Specified combinations of a major and moderate category	At least two additional secondary diagnoses of major or higher	Extreme (4)

Table 2–5. Combinations of Secondary Diagnosis Categories

3	Specified combinations of two moderate categories	At least two additional secondary diagnoses of moderate or higher	Major (3)
4	Specified combinations of a moderate and minor category	At least two additional secondary diagnoses of moderate or higher	Major (3)
5	Specified combinations of two minor categories	At least two additional secondary diagnoses of minor or higher	Moderate (2)
6	Specified combinations of two moderate categories	None	Major (3)
11	Specified combinations of two major categories	At least one additional secondary diagnosis of major	Extreme (4)
13	Specified combinations of two moderate categories	At least one additional secondary diagnosis of moderate	Major (3)
15	Specified combinations of two minor categories	At least one additional secondary diagnosis of minor	Moderate (2)

Combination types 11, 13, and 15 only require a total of three significant secondary diagnoses, the two that make up the secondary diagnosis category combination and one additional secondary diagnosis. This reflects that the secondary diagnosis category combination is sufficiently significant that only one additional secondary diagnosis is required. Combination types 11, 13, and 15 are new starting with version 20.0 of the APR DRG system. Previous versions contained only types 1 through 6.

A type 1 combination consists of two secondary diagnosis categories that contain major severity of illness level diagnoses, plus any third and fourth secondary diagnosis that is at least a major severity of illness level. When a type 1 combination occurs, the minimum patient severity of illness subclass is extreme. An example of a type 1 combination is a major bacterial infection (category 9) with a major hematological/immunological diagnosis (category 44). If a diagnosis from both these categories is present plus at least two other secondary diagnoses that are at least a major severity of illness level, then the minimum patient severity of illness subclass will be extreme. A type 2 combination is the same as a type one combination except that the two categories consist of a major severity of illness category and a moderate severity of illness category. An example of a type 2 combination is a major bacterial infection (category 9) and brain malignancy (category 11). A type 3 combination consists of two categories that contain moderate severity of illness level diagnoses plus any third and fourth secondary diagnosis that is at least a moderate level. When a type 3 combination occurs, the minimum patient severity of illness subclass is major. An example of a type 3 combination is a moderate alcohol and drug abuse diagnosis (category 5) and a moderate electrolyte disorder except hypovolemia (category 34).

A type 4 combination consists of a moderate severity of illness category and a minor severity of illness category plus any third and fourth diagnosis that is at least a moderate severity of illness level. When a type 4 combination occurs, the minimum patient severity of illness subclass is major. An example of a type 4 combination is a moderate hematological/immunological diagnosis (category 44) and hypovolemia (category 51). A type 5 combination consists of two categories that contain minor severity of illness level diagnoses plus two additional minor severity of illness level diagnoses. When a type 5 combination occurs the minimum patient severity of illness subclass is moderate. An example of a type 5 combination would be diabetes without mention of complication (category 30) and minor bacterial infection (category 9).

Combination type 6 is a special combination type for APR DRGs 626 and 640 to distinguish neonates with multiple "other problems," i.e., problems that are generally viewed as minor severity of illness but distinguish a neonate from being a normal newborn. An example is a neonate with transient tachypnea (category 920) and newborn feeding problem (category 911). These diagnoses have a minor severity of illness level, but are each increased to moderate for APR DRGs 626 and 640 per an earlier Phase I step, and together, as part of this step, result in the patient's severity subclass being increased to major for APR DRGs 626 and 640.

Combination types 11, 13, and 15 are new to version 20.0 and pertain mostly to multiple trauma patients and a handful of other patients such as transplant status patients. A type 11 combination consists of two secondary diagnosis categories that contain major severity of illness diagnoses, plus any third secondary diagnosis that is at least a major severity of illness. An example is a major severity of illness transplant status diagnosis (category 84) and a major TB, fungal or parasitic infection (category 74). A type 13 combination consists of two secondary diagnosis categories that contain moderate severity of illness level diagnoses, plus any third secondary diagnosis that is at least a moderate severity of illness level. An example is a moderate cardiothoracic trauma diagnosis (category 18) and a moderate head and neck trauma with coma diagnosis (category 24). A type 15 combination consists of two secondary diagnosis categories that contain minor severity of illness level diagnoses, plus any third secondary diagnosis that is at least a minor severity of illness level. An example is a minor severity of illness level head and neck trauma without coma diagnosis (category 43) and a minor severity of illness level pulmonary diagnosis (category 75).

18. Compute the final patient severity of illness subclass

The final patient severity of illness subclass is computed based on the Phase II base patient severity of illness subclass and the Phase III modified patient severity of illness subclasses. If all the Phase III modified severity subclasses are greater than or equal to the Phase II base severity of illness subclass, then the final severity of illness subclass is computed as the maximum of the Phase II and III severity subclasses. If all of the modified Phase III severity of illness subclasses are less than or equal to the Phase II base severity of illness subclass, then the final severity of illness subclass is computed as the Phase II base severity of illness subclass minus one. If the Phase III modified severity of illness subclasses include modified severity of illness subclasses that are both greater and less than the Phase II based severity of illness subclass, then the modified Phase III subclass relating to procedures and combinations of secondary diagnoses will take priority in determining the final severity of illness subclass. The combination of the APR DRG and the final patient severity of illness subclass constitute the complete APR DRG description of the severity of illness of the patient.

Summary of APR DRG severity of illness subclass assignment logic

The following is a summary of the steps involved in computing the APR DRG severity of illness subclass of a patient.

Phase I—Determine the severity of illness level of each secondary diagnosis

1. Eliminate secondary diagnoses that are associated with the principal diagnosis.

2. Assign each secondary diagnosis its standard severity of illness level.

3. Modify the standard severity of illness level of each secondary diagnosis based on the age of the patient.

4. Modify the standard severity of illness level of each secondary diagnosis based on the principal diagnosis and the APR DRG to which the patient is assigned (applicable only to APR DRG 190 Acute Myocardial Infarct).

5. Modify the standard severity of illness level of each secondary diagnosis based on the APR DRG to which the patient is assigned.

6. Modify the standard severity of illness level of each secondary diagnosis based on the presence of certain non-OR procedures.

Phase II—Determine the base severity of illness subclass of the patient

7. Eliminate all secondary diagnoses that are in the same secondary diagnosis group except the secondary diagnosis with the highest severity of illness level.

8. Compute the base patient severity of illness subclass as the maximum of all the secondary diagnosis severity of illness levels.

9. If the base patient severity of illness subclass from Step 8 is major or extreme, then reduce the base patient severity of illness subclass to the next lower severity of illness subclass unless there are multiple secondary diagnoses at a high severity of illness level.

Phase III—Determine the final severity of illness subclass of the patient

10. Modify the patient severity of illness subclass based on the APR DRG and principal diagnosis.

11. Modify the patient severity of illness subclass based on the APR DRG and age of the patient.

12. Modify the patient severity of illness subclass based on a combination of the APR DRG and the presence of certain non-OR procedures.

13. Modify the patient severity of illness subclass based on the APR DRG and OR procedure.

14. Modify the patient severity of illness subclass based on combinations of APR DRGs and pairs of OR procedures.

15. Modify the patient severity of illness subclass based on the APR DRG 583 Neonate with ECMO and the presence/absence of certain OR procedures.

16. Modify the patient severity of illness subclass based on the combination of APR DRG and principal diagnosis and the presence of certain non-OR procedures.

17. Establish a minimum severity of illness subclass for the patient based on the presence of specific combinations of categories of secondary diagnoses.

18. Compute the final patient severity of illness subclass based on the Phase II base patient severity of illness subclass from Step 9 and the modifications of the patient severity of illness subclasses from Steps 10–17.

Determination of the risk of mortality subclass

The three-phase process of determining the risk of mortality subclass is summarized in figure 2–2. This three-phase process parallels the three phases in the determination of the severity of illness subclass. In Phase I, the risk of mortality of each secondary diagnosis is determined. Once the risk of mortality level of each individual secondary diagnosis is established, then Phase II determines a base risk of mortality subclass for the patient based on all of the patient's secondary diagnoses. In Phase III, the final subclass for the patient is determined by incorporating the impact of principal diagnosis, age, OR procedures, certain non-OR procedures, multiple OR procedures, and combinations of categories of secondary diagnoses.

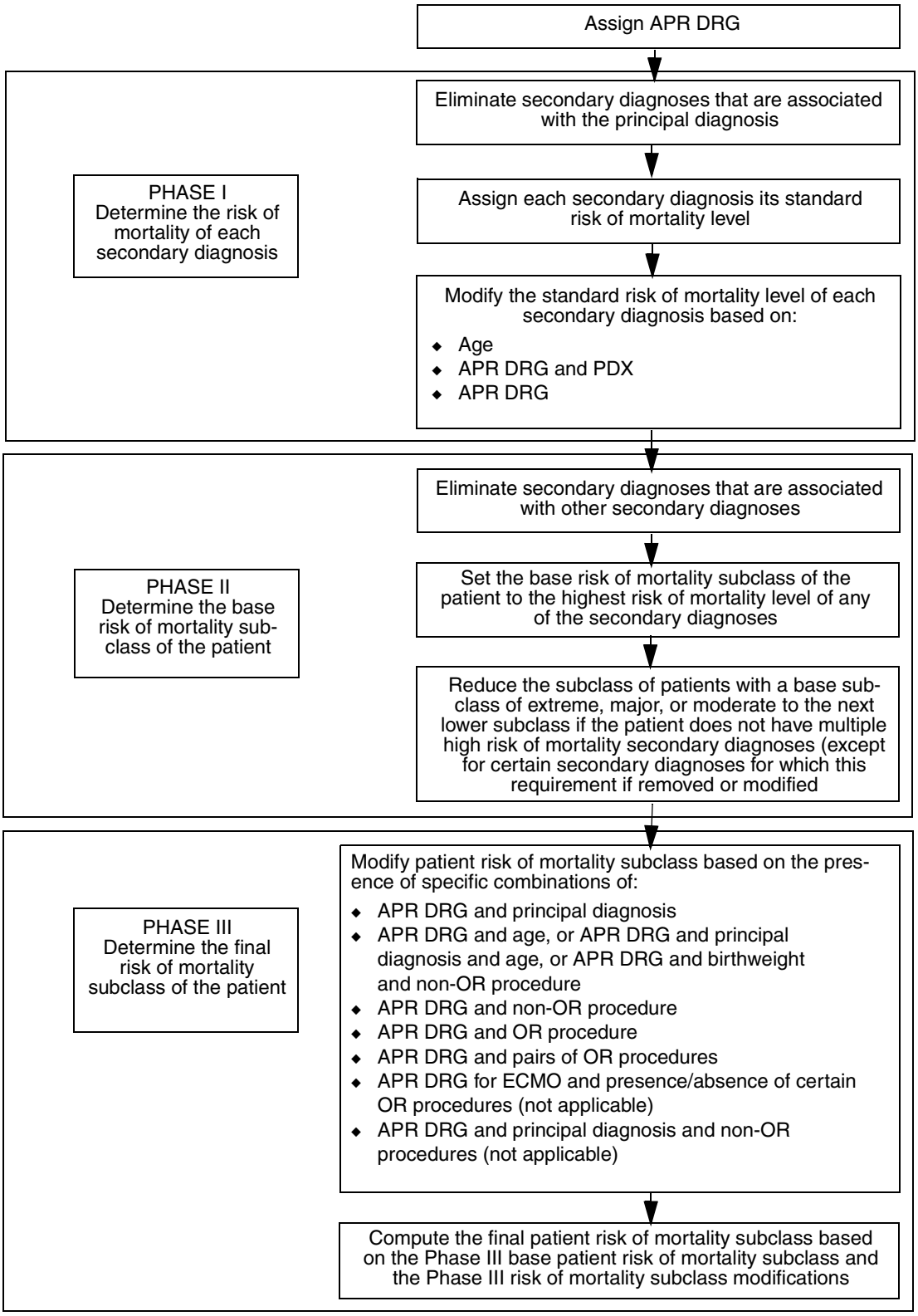

Figure 2–2. Three-phase process for determining patient risk of mortality subclass

Phase I—Determining the risk of mortality level of each secondary diagnosis

1. Eliminate secondary diagnoses associated with the principal diagnosis

This step is identical to the corresponding step in the determination of the severity of illness subclass. If a secondary diagnosis is closely related to the principal diagnosis and does not add any distinguishing information, then the secondary diagnosis is completely excluded from the 18 step process to determine the patient's risk of mortality subclass.

2. Assign each secondary diagnosis its standard risk of mortality level

Each secondary diagnosis is assigned one of four distinct risk of mortality levels. In general, except for malignancies and certain extreme acute diseases such as acute renal failure, the risk of mortality level tends to be lower than the severity of illness level for the same diagnosis. Mortality is relatively rare. There are a limited number of diagnoses that significantly increase the risk of mortality. For example, traumatic amputation of the arm, acute cholecystitis, and acute osteomyelitis are all at a major severity of illness level since they represent serious diseases with significant loss of organ function. However, they present relatively low risk of mortality and therefore are assigned to a minor risk of mortality level. Example of secondary diagnoses that would have an extreme risk of mortality are intracranial hemorrhage, acute vascular insufficiency of intestine, acute myocardial infarct, and acute renal failure.

For version 20.0 APR DRGs, the standard risk of mortality level was comprehensively reviewed for all secondary diagnoses codes. There were a number of revisions introduced, the majority of which were to lower the standard risk of mortality level. In situations where there was a great deal of variability within an ICD-9-CM diagnosis code, the approach was to lower the standard risk of mortality level and then in later steps of Phase I, consider whether modifications to the standard risk of mortality level are indicated based upon specific age ranges, APR DRGs, or non-OR procedures.

For version 25.0 APR DRGs, there are a total of 13,677 ICD-9-CM diagnosis codes. These codes are assigned to the following risk of mortality levels: 10,996 minor, 1,713 moderate, 617 major, 351 extreme. For version 25.0 APR DRGs, there are 2,681 secondary diagnosis codes that are assigned a standard risk of mortality level of moderate, major, or extreme. This is just slightly more than half the 4,884 secondary diagnosis codes that are assigned a standard severity of illness level of moderate, major, or extreme.

3. Modify the standard risk of mortality level of a secondary diagnosis based on age

The standard risk of mortality for certain secondary diagnoses may be modified depending upon the age of the patient. This age modification is applied much more extensively for risk of mortality, than for severity of illness. For pediatric patients, the standard risk of mortality level of secondary diagnoses is often decreased. For example, the risk of mortality level for diabetes with ketoacidosis is lowered from moderate to minor for pediatric patients. It is also lowered for many other secondary diagnoses including infectious illnesses and traumatic injuries. However, for some pediatric diagnoses, mostly congenital anomalies, the risk of mortality level is increased during the neonatal time period and sometimes the first year of life. For example, the risk of mortality level for hypoplastic left heart syndrome is increased from major to extreme during the neonatal period; renal dysphasia is increased from moderate to major during the neonatal period;

and congenital tricuspid atresia/stenosis is increased from moderate to major during the first year of life.

For elderly patients, the standard risk of mortality level is increased to a higher level for many secondary diagnoses. Elderly patients are most often defined as age >65 years or age >69 years but also sometimes for a more narrowly defined subset of elderly patients such as age >79 years. For example, for elderly patients age >65 years the risk of mortality level is increased from minor to moderate for secondary diagnoses such as atrial fibrillation, chronic obstructive lung disease and nephritis, and is increased from moderate to major for acidosis and hypotension. For elderly patients age >69 years, the risk of mortality level is increased from minor to moderate viral pneumonia, mitral valve disorder, and anemia; and from moderate to major for streptococcal, staphylococcal, and other bacterial pneumonias; and from major to extreme for peritonitis. For elderly patients age >79 years, the risk of mortality level is increased from minor to moderate for fracture of femur or pelvis; and from moderate to major for pleural effusion.

4. Modify the standard risk of mortality level of a secondary diagnosis based on the APR DRG and principal diagnosis

The standard risk of mortality level for some secondary diagnoses may be modified depending on the APR DRG and principal diagnosis of the patient. In versions 20.0 and 25.0, this logic is applied only to APR DRG 190 Acute Myocardial Infarct. In general, secondary diagnoses that are closely related to the principal diagnosis are excluded from the determination of the risk of mortality subclass. However, for a patient admitted for an acute anterior wall myocardial infarction, an acute anterolateral myocardial infarction represents an extension of the acute anterior wall myocardial infarction. Therefore, the acute anterolateral myocardial infarction is not excluded and is assigned a risk of mortality level of moderate.

5. Modify the standard risk of mortality of a secondary diagnosis based on the APR DRG

The standard risk of mortality level for many secondary diagnoses is modified depending upon the APR DRG to which the patient is assigned. Altogether, there are 1,474 modifications of the standard risk of mortality level of secondary diagnosis depending on the APR DRG. As with severity of illness, the APR DRG specific modifications to the risk of mortality level of individual secondary diagnoses reflects the disease-specific nature of the determination of risk of mortality.

For example, the risk of mortality level for secondary diagnoses is increased from minor to moderate for the following combinations of secondary diagnoses and APR DRGs: right bundle branch block and APR DRG for acute myocardial infarct; chronic obstructive lung disease and major chest and major cardiovascular surgery; hypovolemia and APR DRGs for cancer, cardiovascular disease, and respiratory failure. The risk of mortality level for secondary diagnoses is increased from moderate to major for the following combinations of secondary diagnoses and APR DRGs: acidosis and APR DRGs for acute myocardial infarct, congestive heart failure, and septicemia; hypotension and APR DRGs for respiratory failure, acute myocardial infarct, and liver and pancreas disorders.

There are also many APR DRGs where the standard risk of mortality level for some secondary diagnoses is decreased, such as for secondary diagnoses that are closely related to the definition of the APR DRG. For example, the risk of mortality level is decreased

from moderate to minor for secondary diagnosis of obstructive hydrocephalus in the APR DRG for ventricular shunt procedures, since the hydrocephalus is the underlying reason for performing the procedure. The risk of mortality level is decreased from extreme to major for secondary diagnosis of cerebral edema in a number of nervous system APR DRGs including craniotomy, cerebrovascular disease, and malignancy. If there is essentially complete overlap between the secondary diagnosis and the APR DRG, the risk of mortality level for the secondary diagnosis may be decreased from extreme or major to minor. For example, acute respiratory failure is decreased from extreme to minor for APR DRGs for respiratory system diagnosis with mechanical ventilation 96+ hours and tracheostomy with mechanical ventilation 96+ hours. There are many secondary diagnoses for which the standard risk of mortality level is lowered to minor for a patient in one of eleven elective, non-extensive surgical APR DRGs. For example, in these APR DRGs, secondary diagnoses of malignant neoplasm are reduced from major or moderate to minor, since the patient would likely not have these surgical procedures performed if the malignancy was at a stage that represented a significant risk of mortality.

6. Modify the standard risk of mortality level of a secondary diagnosis based on non-OR procedure

Certain non-OR procedures will sometimes be used to modify the standard risk of mortality level of some secondary diagnoses. For risk of mortality, this step is just used with one non-OR procedure, pulsation balloon implant. For example, subendocardial infarction has a standard risk of mortality level of moderate but is increased by an increment of two up to extreme if the patient had a pulsation balloon implanted. The need for the pulsation balloon is an indicator of the extent of the subendocardial infarction.

Phase II—Determine the base risk of mortality subclass for the patient

Once each secondary diagnosis has been assigned its standard risk of mortality level and the standard risk of mortality level of each secondary diagnosis has been modified based on the patient's age, APR DRG and principal diagnosis, APR DRG, and certain non-OR procedure, the Phase II base risk of mortality subclass for the patient can be determined. The process of determining the base patient risk of mortality subclass begins with the elimination of certain secondary diagnoses that are closely related to other secondary diagnoses. The elimination of these diagnoses prevents the double counting of clinically similar diagnoses in the determination of the risk of mortality subclass of the patient. Once redundant diagnoses have been eliminated, the base risk of mortality subclass is determined based on all of the remaining secondary diagnoses. There are three steps to Phase II for risk of mortality. The first two are the same as for severity of illness. The third step is similar to severity of illness but has some additional exceptions logic.

7. Eliminate certain secondary diagnoses from the determination of the risk of mortality subclass of the patient

This step is identical to the corresponding step in the determination of the severity of illness subclass. Secondary diagnoses that are related to other secondary diagnoses have their risk of mortality level reduced to minor.

8. *Combine all secondary diagnoses to determine the base risk of mortality subclass of the patient*

Once secondary diagnoses that are related to other secondary diagnoses have their risk of mortality level reduced to minor, the base patient risk of mortality subclass is set equal to the maximum risk of mortality level across all of the remaining secondary diagnoses. This is done the same way as for severity of illness. For example, if there are five remaining secondary diagnoses and one is a major risk of mortality level and four are a moderate risk of mortality level, then the base patient risk of mortality subclass is major.

9. *Reduce the base risk of mortality subclass if the patient does not have multiple secondary diagnoses with a significant risk of mortality, except for certain secondary diagnoses for which this requirement is removed or modified*

In general, high risk of mortality patients are characterized by multiple secondary diagnoses with a significant risk of mortality. In order for the base risk of mortality subclass to be extreme, there must be two or more extreme risk of mortality secondary diagnoses present or a single extreme risk of mortality secondary diagnosis plus two or more major risk of mortality secondary diagnoses. If this multiple criteria is not met, the patient's base risk of mortality subclass is lowered to either major or moderate. If the multiple criteria is not met, but in addition to a single extreme risk of mortality secondary diagnosis there is at least one other major or moderate secondary diagnosis, then the patient's risk of mortality subclass is lowered to major. If there is not at least one other major or moderate secondary diagnosis in addition to an extreme risk of mortality secondary diagnosis, then the patient's base risk of mortality subclass is lowered to moderate. There are, however, two exceptions to these criteria. There is one set of secondary diagnoses that have such an inherent high risk of mortality that no other secondary diagnoses are required for the patient's base risk of mortality subclass to be extreme. Examples include: pulmonary anthrax, ruptured aortic aneurism, hepatorenal syndrome, head trauma with deep coma, and 60-90% body burn/50-59% third degree. There is a second set of secondary diagnoses that also have an inherently high risk of mortality and for which only one other major secondary diagnosis is required for the patient's base risk of mortality to be extreme. Examples included: defibrination syndrome, acute myocardial infarct, intracranial hemorrhage, cerebral thrombosis with infarct, dissection of aortic aneurism, acute respiratory failure, acute renal failure, and shock.

Patients with a base risk of mortality subclass of major are reduced to moderate unless, in addition to the major risk of mortality secondary diagnosis, there is at least one additional major risk of mortality secondary diagnosis or two more additional secondary diagnoses with a moderate risk of mortality. If this multiple criteria is not met then the patient's base risk of mortality subclass is lowered to moderate. There are, however, two exceptions to these criteria. There is one set of secondary diagnoses that have a sufficiently high inherent risk of mortality that no other secondary diagnoses are required for the patient's base risk of mortality subclass to be set at major. Examples include: flail chest, major liver laceration, 40-49% body burns/10-19% third degree. There is a second set of secondary diagnoses that have a significant inherent risk of mortality so that only one moderate secondary diagnoses is required for the patient's base risk of mortality subclass to be set at major. Examples include: food/vomit pneomonitis, acute lung edema, and perforation of intestine.

Patients with a base risk of mortality subclass of moderate are reduced to minor unless there are at least two moderate risk of mortality secondary diagnoses present. There is,

however, one exception to this criteria. These moderate risk of mortality secondary diagnoses do not require any other secondary diagnoses to be present. Examples include: malignant neoplasm diagnoses that are moderate risk of mortality level diagnoses, acidosis, bacterial pneumonia, congestive heart failure, chronic renal failure, Alzheimer's disease, and decubitus ulcer.

Phase III—Determine the final risk of mortality subclass of the patient

Once the base patient risk of mortality subclass is computed then the risk of mortality subclass may be increased or decreased in Phase III based on specific values of certain patient attributes. In Phase III, the risk of mortality algorithm examines six of the eight patient attributes utilized in Phase III of the severity of illness logic. The two that are not used by risk of mortality are only used to a very limited extent in the severity of illness logic. The patient attributes are:

- Combinations of APR DRG and principal diagnosis
- Combinations of APR DRG and age, or APR DRG and principal diagnosis and age, or APR DRG and birthweight and absence of certain non-OR procedures
- Combinations of APR DRG and non-OR procedures
- Combinations of APR DRG and OR procedures
- Combinations of APR DRG and pairs of OR procedures
- Combination of the APR DRG for ECMO and presence/absence of certain OR procedures (not applicable for risk of mortality)
- Combinations of APR DRG and principal diagnoses and non-OR procedures (not applicable for risk of mortality)
- Combinations of categories of secondary diagnoses

In Phase I, age and non-OR procedures were used to modify the standard risk of mortality level of a secondary diagnosis. However, age and non-OR procedures can also have an impact that is specific to the patient's APR DRG or a specific principal diagnosis within an APR DRG. Thus, the impact of age and non-OR procedures is reassessed as part of the determination of the risk of mortality subclass of the patient. Based on the patient attributes listed above, a series of modifications to the base patient risk of mortality subclass are made during Phase III. The final patient risk of mortality subclass will be computed based on the Phase II base patient risk of mortality subclass and the modifications to the base risk of mortality subclass made in Phase III.

10. Modify the risk of mortality subclass for the patient based on the APR DRG and principal diagnosis

Within specific APR DRGs some principal diagnoses are indicative of higher or lower risk of mortality relative to the other principal diagnoses in the APR DRGs. This is one of the most important and extensively used modifications to the patient's base risk of mortality subclass that occurs as part of the Phase III risk of mortality logic. The majority of the modifications are increases to the patient risk of mortality subclass, but there are also some decreases to the patient risk of mortality subclass. Some of the increases are an increment of one up to a maximum subclass of moderate, while others pertain to more dramatic clinical situations and provide greater increases to the patient risk of mortality subclass.

Most of the decreases reduce the patient risk of mortality subclass by one from major or moderate. Following are examples:

- APR DRG 309 Hip & Femur Procedures For Non-Trauma Except Joint Replacement and principal diagnosis of secondary malignancy of bone: increase patient risk of mortality subclass by one up to a maximum of moderate.
- APR DRG 135 Major Chest & Respiratory Trauma and principal diagnosis of flail chest: increase patient risk of mortality subclass by one up to a maximum of major.
- APR DRG 221 Major Large & Small Bowel Procedures and principal diagnosis of perforation of intestine: increase patient risk of mortality subclass by two up to a maximum of major.
- APR DRG 169 Major Thoracic & Abdominal Procedures and principal diagnosis of ruptured abdominal aortic aneurism: increase patient risk of mortality subclass by three up to extreme.
- APR DRG 44 Intracranial Hemorrhage and principal diagnosis of subdural hemorrhage: decrease patient risk of mortality subclass by one from moderate.
- APR DRG 52 Non traumatic Stupor & Coma and principal diagnosis of transient alteration of awareness: decrease patient risk of mortality subclass by one from extreme, major, or moderate.

11. Modify the risk of mortality subclass for the patient based on combinations of the APR DRG and principal diagnosis and age, or APR DRG and age, or APR DRG and birthweight and presence/absence of certain non-OR procedures

For some principal diagnoses in specific APR DRGs, the patient's age essentially represents a complicating factor. For specific principal diagnosis and age combinations in certain APR DRGs, the risk of mortality subclass of the patient is increased by a specified increment up to a specified maximum subclass. For example, elderly patients age >79 years in APR DRG 137 Major Respiratory Infections & Inflammations with a principal diagnosis of staphylococcal pneumonia and elderly patients age >79 years in APR DRG 710 Septicemia & Disseminated Infections with most of the septicemia principal diagnoses, have their risk of mortality subclass increased by one up to a maximum subclass of moderate. Elderly patients age >69 years in APR DRG 44 Intracranial Hemorrhage with a principal diagnosis of intracerebral hemorrhage have their risk of mortality subclass increased by one up to a maximum subclass of moderate. The increase indicates that intracranial hemorrhage in an elderly patient represents a higher risk of mortality.

This step is also sometimes implemented for all patients in a specified age range in an APR DRG rather than just for patients with a particular principal diagnoses. This approach is used for elderly patients age >84 years for 19 APR DRGs involving major surgery. For example, patients age >84 years in APR DRG 120 Major Chest & Respiratory Procedures have their risk of mortality subclass increased by one to a maximum subclass of moderate.

The last part of this step examines the relationship between APR DRG and birthweight and presence/absence of certain non-OR procedures for extremely low birthweight neonates in MDC 15. Many of the neonates at an extremely low birthweight (<750 grams or 1.6 pounds) are non-viable and receive comfort-only care. Nearly all of these newborns die and most of the time this is within a few days of being born. There are no ICD-9-CM diagnosis codes for non-viability due to extreme prematurity, which, if such codes existed,

would allow a risk of mortality subclass of extreme to be assigned. In its place, the APR DRG system has developed logic to identify these cases. Since newborns <750 grams will virtually always receive some therapeutic interventions if the goal is to maintain life (e.g., respiratory therapy, tube feedings), the absence of any of these non-OR procedures can be used to infer the newborn is receiving comfort-only measures and their risk of mortality subclass is increased to extreme for APR DRGs 589 and 591. Without this logic, most of these newborns would be a risk of mortality subclass minor or moderate because of the lack of codes for identifying non-viability.

12. Modify the risk of mortality subclass for the patient based on combinations of APR DRG and non-OR procedure

For some APR DRGs the presence of certain non-OR procedures is indicative of a more extensive disease process with a higher risk of mortality. In these instances, the risk of mortality subclass is increased by a specific increment up to a specified maximum. There are three non-OR procedures used for this step: mechanical ventilation 96+ hours, mechanical ventilation <96 hours, and balloon pulsation device. For example, for patients in APR DRG 194 Heart Failure the risk of mortality subclass is increased by two up to a maximum subclass of extreme if mechanical ventilation 96+ hours is performed and is increased by one up to a maximum subclass of major if mechanical ventilation <96 hours is performed.

13. Modify the risk of mortality subclass for the patient based on combinations of APR DRG and OR procedure

Within specific APR DRGs, some OR procedures are indicative of higher risk of mortality relative to the other OR procedures in the APR DRG. For example, the risk of mortality subclass of patients in APR DRG 443 Kidney and Urinary Tract Procedures for Non-Malignancy, is increased by two up to a maximum of major if the procedure bilateral nephrectomy is performed. Relative to other procedures in DRG 443, a bilateral nephrectomy represents a patient that has a higher risk of mortality.

Within specific APR DRGs, there are also some OR procedures that are indicative of lower risk of mortality relative to other patients in the same APR DRG. For example, a patient in APR DRG 220 Major Stomach Esophageal & Duodenal Procedures who receives a procedure to create esophogastric sphincteric competence has a lower risk of mortality than other surgical patients in APR DRG 220 (e.g., esophagectomy, gastrectomy), and if up to this point in the process their risk of mortality subclass is moderate, it is decreased by 1 to minor.

14. Modify the risk of mortality subclass for the patient based on combinations of APR DRG and pairs of OR procedures

Within specific APR DRGs the presence of certain pairs of OR procedures is indicative of a more extensive disease process and a higher risk of mortality relative to other patients in the same APR DRG. For risk of mortality, this logic is applicable primarily for patients who receive both a peripheral bypass procedure and a lower limb amputation. For example, a patient in either APR DRG 173 Other Vascular Procedures or APR DRG 305 Amputation of Lower Limb who receives both a peripheral bypass procedure and a lower leg amputation has their risk of mortality subclass increased by an increment of one up to a maximum subclass of major.

15. Modify the risk of mortality subclass for the patient based upon combination of the APR DRG for ECMO and presence/absence of certain OR procedures

This step is not applicable to risk of mortality.

16. Modify the patient risk of mortality subclass based on the APR DRG and principal diagnosis and certain non-OR procedures

This step is not applicable to risk of mortality.

17. Establish a minimum risk of mortality subclass for the patient based on combinations of categories of secondary diagnoses

The presence of certain combinations of secondary diagnoses has great clinical significance. The interaction of specific combinations of secondary diagnoses increases the risk of mortality. Therefore, a minimum patient risk of mortality subclass greater than subclass minor is established if certain combinations of secondary diagnoses are present. The presence of multiple interacting diagnoses is characteristic of high risk of mortality patients. A subset of secondary diagnoses will interact with each other causing patient risk of mortality to be increased.

The categories of secondary diagnoses used for this step in risk of mortality are the same 83 core secondary diagnosis categories that are used for severity of illness (see table 2–3). The only difference is that these same 83 secondary diagnosis categories are then subdivided by risk of mortality level, not severity of illness level. The additional 21 secondary diagnosis categories developed for use with neonatal APR DRGs 626 and 640 are not used for risk of mortality. These additional 21 secondary diagnosis categories are intended to differentiate neonates with multiple minor or other problems from those who are normal newborns or who have a single minor problem, which is significant for severity of illness but is not applicable for risk of mortality since these diagnoses do not increase the risk of dying.

All of the secondary diagnosis category combination types for risk of mortality are the same as those defined for severity of illness (see table 2–5). Of the nine possible combination types, six are applicable for risk of mortality. These are combination types 1, 2, 3, 4, 5, and 13.

A type 1 combination consists of two categories that contain major risk of mortality level diagnoses, plus any two additional secondary diagnoses that are at least major level. When a type 1 combination occurs, the minimum patient risk of mortality subclass is extreme. An example of a type 1 combination is a major pulmonary diagnosis (category 75) such as acute pulmonary edema and a major neurological diagnosis (category 64) such as cerebral thrombosis without infarct combined with any other two major secondary diagnoses. A type 2 combination is the same as type 1 except that the two categories consist of a major risk of mortality category and a moderate risk of mortality category. For a type 2 combination, the minimum patient risk of mortality subclass is extreme. An example of a type 2 combination is a major bacterial infection (category 9) such as peritonitis and a moderate level secondary malignancy (category 78) combined with any other two major secondary diagnoses.

A type 3 combination consists of two categories that contain moderate risk of mortality level diagnoses, plus any two additional secondary diagnoses that are at least a moderate

risk of mortality level. For a type 3 combination, the minimum patient risk of mortality is major. An example of a type 3 combination is a moderate bacterial infection (category 9) such as staphylococcal enteritis with chronic renal failure (category 20) combined with any other two moderate secondary diagnoses. A type 4 combination consists of a moderate risk of mortality category and a minor risk of mortality category, plus any two additional secondary diagnoses that are at least moderate. For a type 4 combination, the minimum patient risk of mortality subclass is major. An example of a type 4 combination is a decubitus ulcer (category 26) and hypovolemia (category 51) combined with two other secondary diagnoses that are at least moderate.

A type 5 combination consists of two categories that contain minor risk of mortality level diagnoses, plus any two additional secondary diagnoses that are at least a minor risk of mortality level. For a type 5 combination, the minimum patient risk of mortality is moderate. An example of a type 5 combination is atrial fibrillation (category 8) and hypovolemia (category 51) combined with any other two minor secondary diagnoses.

A type 13 combination consists of two secondary diagnosis categories that contain moderate risk of mortality diagnoses, plus any third secondary diagnosis that is at least a moderate risk of mortality diagnosis. For a type 13 combination, the minimum patient risk of mortality subclass is major. An example of a type 13 combination is cirrhosis (category 23) and hypotension (category 50) combined with any other moderate secondary diagnosis.

18. Compute the final risk of mortality subclass

The final patient risk of mortality subclass is computed based on the Phase II base patient risk of mortality subclass and the Phase III modified patient risk of mortality subclasses. If all the Phase III modified risk of mortality are greater than or equal to the Phase II base risk of mortality subclass, then the final risk of mortality subclass is computed as the maximum of the Phase II and III risk of mortality subclasses. If all of the modified Phase III risk of mortality subclasses are less than or equal to the Phase II base risk of mortality subclass, the final risk of mortality subclass is computed as the Phase II base risk of mortality subclass minus one. If the Phase II modified risk of mortality subclasses includes modified risk of mortality subclasses that are both greater and less than the Phase II base risk of mortality subclass, the modified Phase III subclass relating to procedures and combinations of secondary diagnoses will take priority in determining the final risk of mortality subclass. The combination of the APR DRG and the final patient risk of mortality subclass constitute the complete APR DRG description of the risk of mortality of the patient.

Summary of APR DRG risk of mortality subclass assignment logic

The following is a summary of the steps involved in computing the APR DRG risk of mortality subclass of a patient.

Phase I—Determine the risk of mortality level of each secondary diagnosis

1. Eliminate all secondary diagnoses that are associated with the principal diagnosis of the patient.

2. Assign each secondary diagnosis its standard risk of mortality.

3. Modify the standard risk of mortality level of each secondary diagnosis based on the age of the patient.

4. Modify the standard risk of mortality level of each secondary diagnosis based on the APR DRG and principal diagnosis (applicable only to APR DRG 190 Acute Myocardial Infarct).

5. Modify the standard risk of mortality level of each secondary diagnosis based on the APR DRG to which the patient is assigned.

6. Modify the standard risk of mortality level of each secondary diagnosis based on the presence of certain non-OR procedures.

Phase II—Determine the base risk of mortality subclass of the patient

7. Eliminate all secondary diagnoses that are in the same secondary diagnosis group except the secondary diagnosis with the highest risk of mortality level.

8. Compute the base patient risk of mortality subclass as the maximum of all the secondary diagnosis risk of mortality levels.

9. Reduce the base patient risk of mortality subclass if the patient does not have multiple secondary diagnoses at a significant risk of mortality, except for certain secondary diagnoses for which this requirement is removed or modified.

Phase III—Determine the final risk of mortality subclass of the patient

10. Modify the patient risk of mortality subclass based on the APR DRG and principal diagnosis.

11. Modify the patient risk of mortality subclass based on the APR DRG and age, or APR DRG and principal diagnosis and age, or APR DRG and birthweight and absence of certain non-OR procedures.

12. Modify the patient risk of mortality subclass based on a combination of the APR DRG and certain non-OR procedures.

13. Modify the patient risk of mortality subclass based on the APR DRG and OR procedure.

14. Modify the patient risk of mortality subclass based on the APR DRG and certain pairs of OR procedures.

15. Modify the patient risk of mortality subclass based on the APR DRG 583 Neonate With ECMO and the presence/absence of certain OR procedures (this step is applicable only to severity of illness, not to risk of mortality).

16. Modify the patient risk of mortality subclass based upon the APR DRG and principal diagnosis and certain non-OR procedures (this step applicable only to severity of illness, not to risk of mortality).

17. Establish a minimum risk of mortality subclass for the patient based on the presence of specific combinations of categories of secondary diagnoses.

18. Compute the final patient risk of mortality subclass based on the Phase II base patient risk of mortality subclass from Step 9 and the modifications of the patient risk of mortality subclass from Steps 10–17.

Conclusion

The APR DRGs form a clinically coherent set of severity of illness and risk of mortality adjusted patient groups. The APR DRGs are designed to describe the complete cross-section of patients seen in acute care hospitals.

Through APR DRGs, hospitals, consumers, payers, and regulators can gain an understanding of the patients being treated, the costs incurred, and, within reasonable limits, the services and outcomes expected. Through APR DRGs, areas for improvement in efficiency and areas with potential quality problems can be identified. The classification of patients into APR DRGs is constantly evolving. As the ICD-9-CM coding scheme changes or as medical technology or practice changes, the APR DRG definitions will continue to be updated to reflect these changes.