

An Introduction To ECRs

An episode of medical care is a health care event, whether an illness, an injury, the treatment thereof, or even a routine check-up, that can last a specific period of time or can be of indefinite duration. While clinically, an episode of medical care is simply a distinct health care event, in medical informatics it has to be defined by a set of codes – diagnosis codes that are used to specify the nature of the disease, illness, or injury; and procedure codes that are used to define the types of services or treatments that are provided in the context of a disease, illness, or injury. That’s because accounting for the costs of an episode requires feeding all the claims data generated for any patient into a software application that will group each claim to one or more episodes for which it is relevant. In that sense, an episode will include all clinically related services for a discrete condition or procedure for the entire continuum of care and for a given time period.

As such, generally speaking, defining an episode for the purpose of accounting for its costs of care results in assembling the set of codes that will form its boundaries: what’s in, what’s out, and how long does it last. Defining each boundary is, to an extent, subjective, and therefore requires some overarching principles.

In defining ECRs, we have been guided by the following principles:

- Illnesses, diseases, injuries and treatments should have distinct boundaries when the distinctions are clear, both clinically and analytically.
- Episodes often have sub-types or variants, which are useful to adjust for the severity of that episode, and reduce the need to have multiple episodes of the same type.
- Services that are relevant to an episode are defined as any service that could be used in the care of that episode, whether appropriate or not. Some of those services can be flagged as highly specific, core, potentially avoidable, or indicative of a complication.
- Beyond the base diagnosis codes that define an episode (referred to as “trigger” codes because they unambiguously describe that episode), there are other diagnosis codes that are relevant to an episode and they fall in one of two categories:
 - Typical diagnosis that are often used to describe signs, symptoms, related conditions as part of a differential diagnosis and other associated sequelae of that episode.
 - Complication diagnosis that describe an exacerbation or other potentially avoidable complication of that episode.
- An episode is almost always clinically related to another concurrent episode for a patient. Some episodes are typical treatments for certain condition episodes; others are avoidable complications; yet others are sequential steps in an overall treatment.

Boundaries of ECRs

Episode boundaries are defined by three elements:

- The time window of the episode – how long it lasts – will determine the quantity of services that will be included because the longer an episode stays open, the more services are likely to get included. Determining when to start and end an episode is also, to an extent, subjective, although it can and usually is informed by empirical evidence in addition to clinical guidance. However, the reliance on claims data to trigger an episode requires balancing the sensitivity of the trigger with its specificity. In some instances, the signal provided by one or more claims is clear enough to start a new episode, for example a hospitalization for the delivery of a child. But in other instances, the signals can be weak, for example an office visit and associated lab test coded for diabetes could simply be a “rule-out” by a physician that a patient has that condition. In balancing sensitivity and specificity the goal is to minimize the number of false positives (triggering an episode that isn’t one) and false negatives (not triggering an episode that should be).
- Diagnosis codes on individual services, or as part of inpatient stays, indicate the conditions or reasons why a patient was treated. Defining which diagnosis codes are included in an episode will therefore determine which services get included (depending on the specific rules for such inclusions). The broader the scope of codes, the broader the scope of the episode. For example, the Diabetes ECR includes codes for both types of diabetes as well as for exacerbations of each and some related complications. That’s a choice we’ve made in the design and explain in the following section on sup-types.
- Every health care service delivered and billed has at least one service code. There are many types of service codes and some of them are more or less specific to an episode. For example, a colonoscopy code is clearly specific to a colonoscopy episode, but an office visit code can be for pretty much any condition or injury. In our definitions, when a service can be deemed so specific to an episode that it couldn’t belong to another one, we have tried to label it that way. For some conditions, clinical guidelines or expert opinion recommend a set of core services, and in those instances we have flagged those services.

Taken together, these three boundaries form the shell of the episode, and what goes in depends on the specific rules that have been established for the assignment of services. There again, the choices can seem subjective, and they are, but they can also be informed by empirical evidence – analyzing what’s gotten in and shouldn’t have, or what hasn’t been brought in and should have. The related issue of whether to tightly define an episode or not, what is often described as lumping or splitting, is an important one to understand and addressed in the next section.

ECR Sub-types

Consider the following example: A patient feels ill with a severe cough and persistent fever. The initial physician visit documents the signs and symptoms, and while

pneumonia is suspected, it's not yet confirmed. The initial treatment is ineffective and the patient goes for a second visit at which test results confirm the suspected pneumonia, but with an unclear classification. A new treatment regimen is provided and the patient responds but there continues to be the same signs and symptoms. At a third office visit, a specific sub-type of pneumonia is identified, but the treatment doesn't change and the patient gets better within the following ten days.

This series of visits and tests will manifest in claims as office visits with a variety of diagnosis codes. The illness is pneumonia, but there are many types of pneumonia, each with a particular code, and that's what makes defining episodes a challenge. If they're defined very tightly, for example, every sub-type of pneumonia has its own episode, then it's possible that no pneumonia episode would have been triggered in this example because there weren't enough consecutive physician visits with the same pneumonia code. Or it's possible that one episode would have been opened for a specific sub-type when it should have been for another. Either way, the specificity of diagnosis codes and the medical treatment process aren't always a perfect match. In other words, oftentimes the diagnosis codes for various sub-types of a condition may be used interchangeably until the diagnosis is firmly established for the patient.

The issue for procedures is similar but different. In some instances it's important to "lump" in order to discourage the potential inappropriate overuse of services, and in others it's important to "split". The split can be done for a particular procedure, or a set of related procedures. For example, a coronary artery procedure can be performed by itself or in conjunction with a valve replacement or a valve repair. They're all open-heart surgeries but the intensity of resources used for the patient can vary quite a bit, suggesting that there's a difference between a simple CABG and a more complex one accompanied by additional procedures. On the other hand, there are many instances in which a colonoscopy and an upper endoscopy are performed during the same visit, and splitting them into two episodes might not make sense (and encourage overuse).

As a result, creating separate episodes for each sub-type of a condition, illness, injury or treatment can lead to false positives and false negatives, especially since several combinations of diagnosis and procedure codes may appear in the same patient at different times. Ultimately, the decision to lump sub-types together into a single condition or procedure, or to split, is informed by clinical experts and empirical evidence. And that's what we've done in defining ECRs. Below are some results of analyses to emphasize the decisions on what to lump and split.

In a sample dataset, we identified 3,854 episodes for pneumonia (Table 1a) of which 93.57% (n=3,606) could be grouped to one of the codes for community-acquired pneumonia. This includes pneumonia due to Streptococcus, Chlamydia, Pneumococcus, Hemophilus, Mycoplasma or Other bacterial pneumonia. The remaining pneumonia episodes had other types of pneumonia codes in addition to the codes for community-acquired pneumonia (n=118) or in various combinations (n=130).

Table 1a: Pneumonia Subtypes Summary:

Pneumonia	# Episodes	Avg Costs	% Episodes
Community Acquired Pneumonia (CAP) alone	3,606	\$4,606.93	93.57%
Only one variant of Pneumonia (not-CAP)	118	\$3,681.28	3.06%
More than one Pneumonia type	130	\$11,601.09	3.37%
All Pneumonia Cases	3,854	\$4,814.51	100.00%

In most datasets, the most common diagnosis code seen on claims is for community-acquired pneumonia of unspecified type. There are, however, different costs for the different types and that's an important indicator of the severity of the pneumonia. Sub-classifying the pneumonia based on that sub-type makes sense, but it's not clear that splitting pneumonia into different episodes would accomplish much more. It could, however, be detrimental. In particular, the low sample sizes of the other pneumonia types would likely prevent any possible comparison of costs of those episodes between providers. Our decision, therefore, has been to combine the different types of pneumonia into one episode and to group them into sub-types that can be useful in adjusting for the severity of the episode. Table 1b details the Pneumonia ECR sub-types. The numbers may not appear to add up since sometimes more than one pneumonia subtype was present in the same episode.

Table 1b: Pneumonia Subtype Details:

Pneumonia Common Subtypes	# Episodes	% Episodes	Avg Costs
Viral Pneumonia	149	3.87%	\$7,206.94
Chronic Fungal and Other Pneumonias	19	0.49%	\$2,653.70
Community Acquired Pneumonia	3,733	96.86%	\$4,851.46
Influenza w pneumonia	1	0.03%	\$24,514.20
Gram Negative Pneumonia	72	1.87%	\$9,623.42
MRSA Pneumonia	4	0.10%	\$1,910.23
Other Staph Pneumonia	12	0.31%	\$21,358.94
Lung disease from opportunistic infections	4	0.10%	\$33,559.08
	3,854		\$4,814.51

Table 2a illustrates the significant differences in episode costs between a simple cardiac bypass and one that is accompanied by other related procedures such as valve repair or replacement. However, there was a substantial overlap in concurrent open-heart procedures that were performed along with CABG. In our analysis of 744 CABG and other valve surgery episodes (Table 3a), we found that 63.7% of episodes had CABG performed alone while the remaining patients had valve surgery alone or with CABG or with other major open-heart procedures such as outflow tract reconstruction, surgery for cardiac arrhythmias or ventricular remodeling procedures. We therefore created a single episode of CABG and related procedures and created subtypes to identify the complexity of the surgical procedure.

Table 2a. Coronary Artery Bypass Graft (CABG) and related procedures:

CABG	# Episodes	% Episodes	Avg Costs
CABG alone	474	63.71%	\$40,736.78
Complex CABG, Valve - multiple procedures	270	36.29%	\$60,537.26
All procedures - CABG, valve, multiple	744	100%	\$48,274.60

One associated design decision that merits discussion at this point is the lack of reliance on DRGs as either triggers for episodes or sorting mechanisms for inpatient stays. There are several reasons for that decision that we address in the next section.

The Imprecision of DRGs

DRGs are specific codes that get assigned by hospitals to claims after (or at the same time as) a patient is discharged. The specific assignment is based on the activity that occurred during the hospitalization, whether good or bad, and uses somewhat opaque algorithms to arrive at that assignment. Hospitals use a variety of software applications to determine the DRG and there are instances in which the selected DRG simply reflects the potential for higher reimbursement. In other words, if the activity during the inpatient stay results in a potential for one or more DRGs to be assigned, then the shift or addition in a code could result in the most profitable DRG being assigned. But that's almost a secondary issue. For purposes of our ECRs and the concepts we espouse, there are two main concerns with DRGs:

- potentially avoidable complications become the DRG assigned. There are many instances in which a hospitalized patient may have an infection. In some of those, the DRG assigned to the stay could be Sepsis, suggesting that the infection is the episode, when in fact the reason for the hospitalization is very different and the infection is the result of the stay.

- DRGs lump many diagnoses together – while the very name of a DRG indicates that it's a group of related diagnosis that, presumably, require similar resources, that heterogeneity is quite significant and, in fact, requires a very different set of resources to manage the patient. DRGs were instituted to pay hospitals, not the associated professional services or ambulatory care. As such, what might be a valid premise for facility payment is not a valid premise when looking at the costs of caring for an episode over time and different settings

Tables 3 and 4 illustrate some of the points made above. Table 3 lists the principal diagnosis codes on inpatient stay claims for a sample of Medicare patients, all of which were assigned the same DRG for Psychoses. If we were to lump all psychoses into one episode, then using the DRG code to assign stays would make sense. However, there are significant differences in the costs of treatment for patients with major depressive disorder compared to those with bipolar disorder or paranoid schizophrenia. As such, each one of these important disorders has its own episode type (with sub-types) and inpatient stays are assigned using the principal diagnosis code, not the DRG.

Table 4 shows a list of inpatient stays that resulted in a procedure and for which a procedural episode would likely be triggered. As for Psychoses, using the DRG to trigger the procedural episode would lump episodes that simply can't and shouldn't be lumped. The three DRGs are simply variants of the same – Shoulder, Elbow or Forearm Procedure, excluding Major Joint Procedure. The detailed description of the principal diagnosis code suggests that there are episodes of broken forearms as well a dislocated shoulders each of which requires a different procedure and follow-up care. In these instances, simply triggering a general episode that would lump all these different types of episodes together doesn't make much sense.

Table 3 – Heterogeneity of Patient-episodes With Inpatient Stay Having DRG 885 (Psychoses)

Principal Diagnosis Code Description	Frequency	Percent
Bipolar disorder, unspecified	626	4.8
Bipolar I disorder, most recent episode (or current) depressed, severe, specified as with psychotic behavior	184	1.41
Bipolar I disorder, most recent episode (or current) depressed, severe, without mention of psychotic behavior	237	1.82
Bipolar I disorder, most recent episode (or current) depressed, unspecified	466	3.58
Bipolar I disorder, most recent episode (or current) manic, severe, specified as with psychotic behavior	325	2.49
Bipolar I disorder, most recent episode (or current) manic, unspecified	249	1.91
Bipolar I disorder, most recent episode (or current) mixed, severe, specified as with psychotic behavior	260	2
Bipolar I disorder, most recent episode (or current) mixed, severe, without mention of psychotic behavior	140	1.07
Bipolar I disorder, most recent episode (or current) mixed, unspecified	219	1.68
Major depressive disorder, recurrent episode, moderate	107	0.82
Major depressive disorder, recurrent episode, severe, specified as with psychotic behavior	460	3.53
Major depressive disorder, recurrent episode, severe, without mention of psychotic behavior	788	6.05
Major depressive disorder, recurrent episode, unspecified	406	3.12
Major depressive disorder, single episode, severe, specified as with psychotic behavior	167	1.28
Major depressive disorder, single episode, severe, without mention of psychotic behavior	112	0.86
Major depressive disorder, single episode, unspecified	352	2.7
Other and unspecified bipolar disorders/Other	203	1.56
Paranoid schizophrenia, chronic condition	460	3.53
Paranoid schizophrenia, chronic condition with acute exacerbation	1330	10.21
Paranoid schizophrenia, unspecified condition	635	4.87
Schizoaffective disorder, chronic	101	0.78
Schizoaffective disorder, chronic with acute exacerbation	841	6.45
Schizoaffective disorder, unspecified	2024	15.53
Unspecified episodic mood disorder	425	3.26
Unspecified psychosis	826	6.34
Unspecified schizophrenia, unspecified condition	199	1.53

Table 4 – Heterogeneity of Patient Episodes With Inpatient Stays Assigned To DRGs 510, 511, or 512

Sum of Count	Column Labels			Grand Total
	SHOULDER,ELBOW OR FOREARM PROC,EXC MAJOR JOINT PROC W CC	SHOULDER,ELBOW OR FOREARM PROC,EXC MAJOR JOINT PROC W MCC	SHOULDER,ELBOW OR FOREARM PROC,EXC MAJOR JOINT PROC W/O CC/MCC	
Row Labels				
MS - bone - nos - fx - malunion / nonunion			2	2
MS - femoral shaft fx - femoral shaft fx - closed	1			1
MS - forearm - acqrd defrmtly - other			1	1
MS - Fracture - forearm - fx	67	32	90	189
MS - joint - replace compl	1	1	1	3
MS - shldr - arthropathy - adhesive capsulitis			1	1
MS - shldr - disloc	1	1	2	4
MS - shldr - disloc - ac joint			1	1
MS - shldr - disloc - humerus	1		1	2
MS - shldr - fx - scapula			1	1
MS - shldr - injury - sprn/strn	3	2	11	16
MS - shldr - tendon ds - enthesopathy	3		22	25
MS - shldr - tendon ds - rotator cuff			7	7
MS - spine - lmbr - fx - w/o cord injury	1			1
MS - synvm / tndn / brsa - nos - synvtis/tensyn			1	1
MS - uppr arm - fx - shaft humerus	1			1
MS - wrist - jnt derangmnt - other			1	1
MS - wrst/hnd - synvtis/tensyn			1	1
Grand Total	79	36	144	259