Independent Hospital Pricing Authority

Australian Refined Diagnosis Related Groups Version 10.0 Technical Specifications

February 2019

IHPA

Australian Refined Diagnosis Related Groups Version 10.0 Technical Specifications – February 2019

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Acronyms and Abbreviations

ADRG	Adjacent Diagnosis Related Groups
APC NMDS	Admitted Patient Care National Minimum Dataset
ACHI	Australian Classification of Health Interventions
CDC	Coherent Diagnosis Classes
DRG	Diagnosis Related Groups
DCL	Diagnosis Complexity Level
ECC	Episode Clinical Complexity
ECCS	Episode Clinical Complexity Score
GIs	General Interventions
IHPA	Independent Hospital Pricing Authority
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification
LOS	Length of Stay
MDC	Major Diagnostic Category
NEP	National Efficient Price
NHCDC	National Hospital Cost Data Collection
RID	Reduction in Deviance
V	Version

1 Introduction

1.1 Purpose

Version (V) 10.0 of the Australian Refined Diagnosis Related Groups (AR-DRG) classification has been finalised following clinical and statistical analysis and in consultation with clinicians, jurisdictions and other health sector stakeholders.

This document accompanies the AR-DRG V10.0 Final Report. The final report outlines the changes made for AR-DRG V10.0, including the refinement process undertaken and the rationale for changes, while this document details the methodology and technical specifications used in the development of AR-DRG V10.0, including:

- Data preparation and modification;
- Derivation of the Episode Clinical Complexity Score (ECCS);
- Adjacent DRG (ADRG) splitting review;
- ADRG hierarchy review.

2 Data Preparation

2.1 Overview

To ensure data consistency across the years, the complexity model for AR-DRG V10.0 was developed using the public hospital Admitted Patient Care National Minimum Dataset (APC NMDS) and the National Hospital Cost Data Collection (NHCDC) from 2013-14 to 2015-16.

All episode diagnosis and intervention codes were mapped to the Tenth Edition of the International Statistical Classification of Diseases and Related Health Interventions, Tenth Revision, Australian Modification (ICD-10-AM) and the Australian Classification of Health Interventions (ACHI).

All episode cost information was inflated to 2015-16 utilising the National Efficient Price (NEP) 2018-19 inflation rate of 1.6%.

In order to develop a robust complexity model within the AR-DRG classification, data preparation steps were required to ensure only episodes of a certain quality were included in the modelling dataset, as described below.

2.2 Record trimming

Various episode trimming measures were undertaken to assess the activity and cost information. Table 1 below summarises the trimming stages and the number of episodes trimmed at each stage.

Table 1: Number of episodes trimmed at each data preparation stage.

Episode trimming stage	2013-14	2014-15	2015-16	Total
a. Initial number of admitted acute episodes	5,429,586	5,600,233	5,882,349	16,912,168
LESS total trimmed episodes	-460,726	-380,064	-477,153	-1,317,943
b. Episodes with invalid or contradictory information	-412,342	-329,823	-428,719	-1,170,884
c. Episodes that span reporting periods (work in progress)	-29,974	-33,332	-32,844	-96,150
d. Episodes from hospitals with fewer than 100 costed episodes	-935	-772	-973	-2,680
e. Episodes with hospital-diagnosis related groups (DRG) extreme costs	-7,579	-8,353	-4,452	-20,384
f. Episodes with costs lower than $23	-9,454	-7,270	-9,512	-26,236
g. Episodes with extreme outlier costs	-80	-133	-66	-279
h. Extremely high or low cost ratios removed after deriving the preliminary regression model	-362	-381	-587	-1,330
i. Resulting sample size of episodes	4,968,860	5,220,169	5,405,196	15,594,225

Further explanation relating to Table 1 is provided below:

a. The initial episode activity information has been sourced from a combination of the APC NMDS and NHCDC data for each corresponding financial year.

b. A total of 1,170,884 episodes were trimmed due to invalid or contradictory information, including:

   - Episodes with invalid ICD-10-AM or ACHI (diagnosis or intervention) codes;
   - Episodes with care type other than Acute care (01), Newborn care (07) or Mental health care (11);
   - Episodes with invalid or contradictory birth date, admission date and separation date;
   - Newborn episodes with missing or contradictory qualified days;
   - Episodes with error DRGs in AR-DRG V9.0;
   - Episodes with invalid costs.

c. A total of 96,150 ‘work in progress’ episodes were trimmed and represent episodes with admission dates earlier than the start of the corresponding financial year.

d. The sample was further reduced by 2,680 by removing episodes from hospitals with fewer than 100 costed episodes.

e. Hospital and DRG combinations with extremely high or low cost to funding ratios were also trimmed from the patient level modelling.

f. The sample was further reduced by 26,236 by removing episodes with total in-scope cost (excluding depreciations and Emergency Department costs) of $23 or less.

g. The remaining sample was then analysed using AR-DRG V9.0, and observations with extreme outlier costs were identified and removed. This was done by ranking observations by cost and identifying those values that recorded an extreme increase in cost over 200 percent (or a decrease in cost over 75 percent) from the previous observation. In total, 279 episodes were removed at this stage.

h. The final stage of extreme outlier identification was undertaken by first deriving a preliminary regression model using length of stay (LOS) and AR-DRG V9.0, and analysing the resulting cost ratios. Following this, another 1,330 individual episodes with extremely high or low cost ratios were removed.

i. The resulting sample of 15,594,225 episodes was identified for use in AR-DRG V10.0 development.

3 Episode Clinical Complexity

3.1 Overview

AR-DRG V8.0 introduced a new methodology for determining clinical complexity known as the Episode Clinical Complexity (ECC) Model. The ECC Model assigns an ECCS, to each episode and quantifies relative levels of resource utilisation within each ADRG and is used to split ADRGs into different DRG levels on the basis of resource homogeneity. The process of deriving an ECCS for each episode begins by assigning a Diagnosis Complexity Level (DCL) value to each diagnosis reported for the episode. DCLs are integers that quantify levels of resource utilisation associated with each diagnosis, relative to levels within the ADRG to which the episode belongs. DCL values are assigned to principal diagnosis and additional diagnosis codes and range between zero and five. A DCL value of zero indicates the diagnosis has no effect on complexity within that specific ADRG. Approximately 11,000 diagnosis codes have a DCL with a non-zero value in AR-DRG V10.0, i.e. they contribute to the complexity of an episode of care.

The components used in the ECCS are detailed in Table 2.

Table 2: ECCS components

Component	Description
Diagnosis exclusions	This stage defines the scope of the complexity model in terms of diagnoses considered relevant for DRG classification purposes. Those diagnoses not identified as in-scope are called exclusions, some of which are excluded unconditionally and others are excluded conditionally (i.e. some diagnoses are excluded in circumstances where another diagnosis is present in the same episode).
Geometric mean cost model	A geometric mean cost model is used to estimate the ADRG costs by diagnosis count which assumes the diminishing returns for multiple diagnoses. This is the foundation model from which the diagnosis complexity level weights are derived.
DCL	DCL weights represent the relative costs associated with each diagnosis within the context of a specific ADRG. The weights are calculated for every combination of diagnosis and ADRG, which results in approximately 6.7 million different combinations (397 ADRGs by 16,953 diagnoses).
ECCS decay factor	The ECCS decay factor is the final component required to calculate an episode ECCS. It represents the decay component that adjusts for the diminished contribution of multiple diagnoses vis-à-vis their individual contribution.

3.2 Diagnosis exclusions

A number of diagnosis codes are excluded from consideration in the AR-DRG ECC Model based on guiding principles formalised during its initial development (V8.0). These guiding principles characterise the scope of the model in terms of diagnoses considered relevant for DRG classification purposes. Diagnosis codes identified as not being in-scope are called exclusions, some of which are excluded unconditionally and others are excluded conditionally (i.e. some diagnoses are excluded in circumstances where another diagnosis is present in the same episode). Out of scope (excluded) diagnoses are removed from the data prior to the development of the ECC Model. More information with regards to diagnosis exclusions and the underlying principles are provided in Appendix A: Diagnosis Exclusions.

3.3 Geometric mean cost model

A geometric mean cost model is used to estimate the ADRG costs by diagnosis count and assumes diminishing returns for multiple diagnoses through a decay factor. Each ADRG geometric mean cost model is defined as:

$$C_i(A) = a \times b \times b^r \times b^{r^2} \times \ldots\ldots \times b^{r^{i-1}} = a \times b^{\frac{1-r^i}{1-r}}$$

Where:

$$a = base\ Cost$$
$$b = change\ parameter$$
$$r = decay\ factor$$
$$i = \#\ diagnosis$$
$$A = ADRG$$

A least squares best fit is utilised to determine the optimum parameters for each ADRG geometric mean model. To minimise the influence of high leverage observations the estimation of $C_i(A)$ model parameters are restricted to episodes containing less than or equal to 20 diagnoses. Table 3 provides a breakdown of the calculations for ADRG B78 *Intracranial Injuries*, which has assumed the base cost (a) of $856, a change parameter (b) of 1.55 and a decay factor (r) of 88 percent.

Table 3: Illustrative example for the geometric mean cost model

Number of diagnoses	Equation	Interpretation
1	$C_1 = a \times b = \$856 \times 1.55 = \$1{,}327$	ADRG B78 episodes with only a principal diagnosis will have an estimated cost of $1,327
2	$C_2 = a \times b \times b^r$ $= \$856 \times 1.55 \times 1.55^{0.88}$ $= \$1{,}327 \times 1.47 = \$1{,}951$	ADRG B78 episodes with 2 diagnoses are estimated to be 47% more expensive than episodes with only a principal diagnosis.
3	$C_3 = a \times b \times b^r \times b^{r^2}$ $= \$856 \times 1.55 \times 1.55^{0.88} \times 1.55^{0.88^2}$ $= \$1{,}327 \times 1.47 \times 1.40 = \$2{,}731$	ADRG B78 episodes with 3 diagnoses are estimated to be 40% more expensive relative to episodes with 2 diagnoses.

The above table illustrates the diminishing returns for an additional diagnosis assigned to an episode. Episodes with only one principal diagnosis are estimated to be $1,327, whilst increasing the diagnosis count to two will increase the cost by 47 percent, increasing to three by 40 percent

and so on. Figure 1 provides the actual versus expected cost by number of diagnosis for ADRG B78 episodes over the period 2013-14 to 2015-16.

Figure 1 ADRG B78 *Intracranial Injuries* actual versus predicted

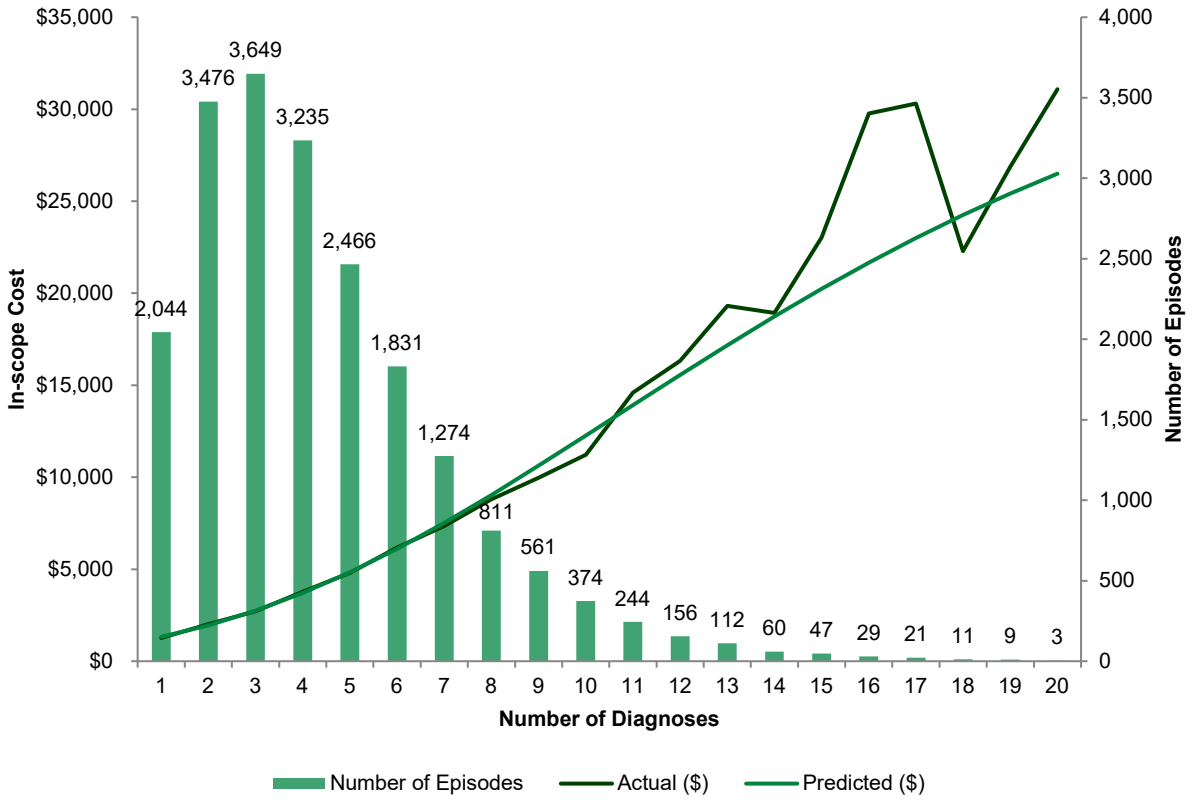
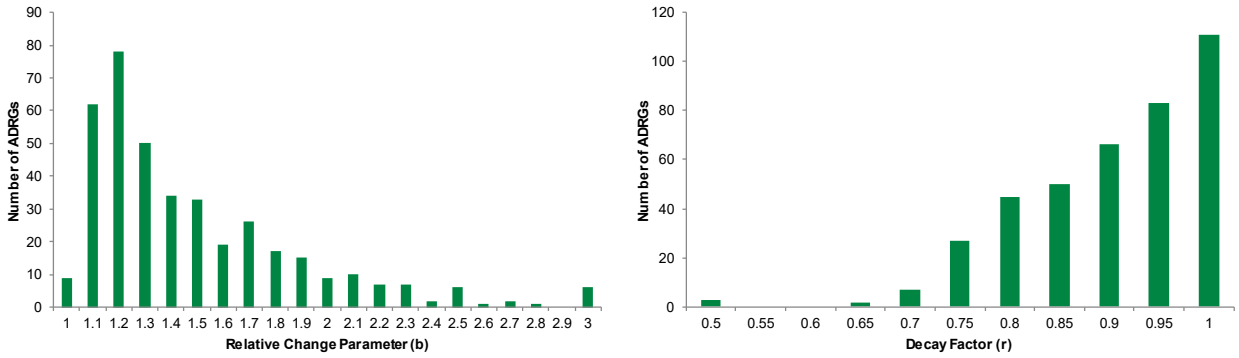


Figure 2 provides the distribution of the change parameters and decay factors adopted from the geometric mean cost model.

Figure 2: ADRG distribution of change parameters (b) and decay factors (r)



(b) is rounded to 1 decimal point for illustrative purposes
(r) is rounded to 2 decimal points for illustrative purposes

The above figure illustrates that:

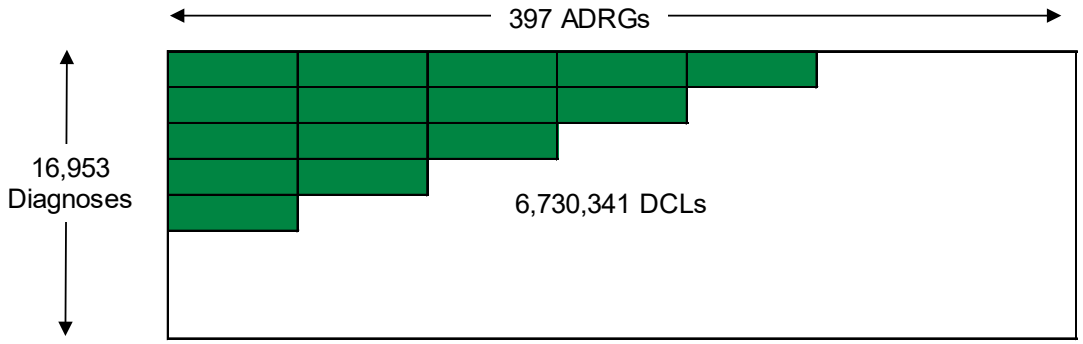
- Approximately 48 percent of the ADRGs have adopted a change parameter between 1.1 and 1.3. That is, the cost increases from approximately 10 to 30 percent with each additional diagnosis.
- Approximately 28 percent of the ADRGs have adopted a decay factor of one. That is, there was no evidence of diminishing return for each additional diagnosis.

This model provides a prediction of the episode cost based on the ADRG, number of diagnoses and the diminishing return for an additional diagnosis. The predicted cost for each episode based on the geometric model is then compared to the actual cost to derive the relative DCL weights and are discussed further in Section 3.4 below.

3.4 DCL

The next stage within the complexity model is the estimation of DCL weights which represent the relative costs associated with each diagnosis within the context of a specific ADRG. DCL weights are calculated for every combination of diagnosis and ADRG, which results in approximately 6.7 million different combinations (397 ADRGs multiplied by 16,953 diagnoses) with values ranging between zero and five. Figure 3 illustrates the DCL array.

Figure 3: Illustration of DCL array



Aggregation principles

The level of precision of the DCLs needs to be balanced against sample variation and stability over time, therefore, the in-scope diagnosis codes are combined into coherent diagnosis classes (CDCs) that are based on the medical ADRGs but also include several in-scope diagnosis codes that do not appear as a principal diagnosis for any medical ADRG. These are assigned to a clinically appropriate CDC. There are also 67 diagnoses that have a sex specific CDC assignment.

The optimum level of precision for the DCL is at the three character code category within the CDC, provided that there is an adequate sample size (i.e. all codes that belong to the same three character code category and CDC are assigned the same DCL). If specific combinations of CDC and three character codes do not meet the sample size threshold of 100 episodes, further aggregation principles are applied to ensure the sample size threshold is reached. Table 4 illustrates the further aggregation principles applied.

Table 4: Aggregation hierarchy for DCL calculations

Precision Level	ADRG	Major Diagnostic Category (MDC) by partition	MDC	All ADRGs
Three character category within CDC	1	6		
Code block within CDC	2	7		
Code section within CDC	3	8		
Code chapter within CDC	4	9	11	13
CDC	5	10	12	14

The above table illustrates that if the first level of precision (three character code within the CDC within the ADRG) does not meet the sample size criteria of 100 episodes, it progresses to the second level (code block within the CDC within the ADRG). The process continues to the fourteenth level of precision within the CDC across all ADRGs.

Table 5 shows the DCL aggregation profile for AR-DRG V10.0.

Table 5: AR-DRG V10.0 DCL aggregation profile

Precision Level	ADRG	MDC by partition	MDC	All ADRGs	Total
Three character category within CDC	3.34%	11.72%			15.07%
Code block within CDC	6.66%	13.85%			20.52%
Code section within CDC	3.75%	4.50%			8.25%
Code chapter within CDC	7.62%	8.43%	8.12%	9.40%	33.57%
CDC	12.18%	8.98%	1.38%	0.06%	22.60%
Total	33.56%	47.48%	9.50%	9.46%	100.00%

The table above illustrates that:

- 3.34 percent of derived DCLs are based on the three character code in the CDC within the corresponding ADRG;
- 33.56 percent of derived DCLs are contained within the ADRG;
- 47.48 percent of DCLs required aggregation up to the MDC by partition precision level;
- 18.96 percent of DCLs required aggregation beyond the MDC by partition precision level.

These aggregation principles provide a framework to determine the optimum precision level to adopt for each diagnosis and ADRG combination.

DCL derivation process

Table 6 outlines the steps to derive the DCL for episodes with diagnosis ‘x’ in ADRG ‘A’ (i.e.(x, A)).

Table 6: DCL derivation steps

Step	Notation and Description
Step 1	$n(x, A)$ Identify the cohort of episodes and the required precision level based on the aggregation principles.
Step 2	$p(x, A)$ Predict the cost for each episode based on the geometric mean model. (Section 3.3) for the cohort of episodes identified in the previous step.
Step 3	$\ln(cost) - \ln(p(x, A))$ Calculate the log transformed cost differential between actual and predicted costs.
Step 4	$\bar{C}(x, A) = \frac{\sum_{j=1}^{n(x,A)} (\ln(cost_j) - \ln(p_j(x, A)))}{n(x, A)}$ Generally $\bar{C}(x, A)$ is the average log cost differential for the cohort. This is modified to a cumulative cost differential if further aggregation principles are applied. This modification is outlined in Appendix B: Aggregation Calculations.
Step 5	$\dot{DCL}(x, A)$ The $\bar{C}(x, A)$ calculated in step four are then standardised and capped to ensure a reasonable overall ECCS distribution for the ADRG.
Step 6	$\ddot{DCL}(x, A)$ The standardised DCLs are stabilised to the previous AR-DRG version to avoid reacting to small shifts in results. That is, $\dot{DCL}(x, A)$ would need to shift by a minimum of ±0.2 to constitute a change in a DCL. Once stabilised the DCLs are then rounded to the nearest integer.

3.5 ECCS decay factor

The ECCS decay factor is the final component required to calculate an episode ECCS. It represents the decay component that adjusts for the diminished contribution of multiple diagnoses vis-à-vis their individual contribution. The ECCS of an episode *e* in an ADRG *A* with diagnosis listed in descending order of their DCL values as $x_1, \ldots, x_n$ (i.e. $\ddot{DCL}(x_1, A) \geq \ddot{DCL}(x_2, A) \geq \cdots \geq \ddot{DCL}(x_n, A)$) is defined as

$$ECCS(e) = \sum_{i=1}^{n} \ddot{DCL}(x_i, A) \times (\tilde{r})^{i-1}$$

Where $\tilde{r} = ECCS\ Decay\ Factor$

Adopting the above definition for all episodes, decay factors ($\tilde{r}$) between 0.83 and 0.88 were assessed. A decay factor of $\tilde{r} = 0.86$ was identified as the best fit with regards to statistical performance. Replacing $\tilde{r}$ by 0.86 in the above formula, the ECCS of episode *e* becomes:

$$ECCS(e) = \sum_{i=1}^{n} \ddot{DCL}(x_i, A) \times (0.86)^{i-1}$$

4 ADRG Splitting Methodology

4.1 Overview

An episode of care is initially assigned to an ADRG which broadly group episodes with the same diagnosis and intervention profile. The final stage is to subdivide (or split) each ADRG into individual DRGs based on the ECCS and occasionally other factors such as LOS and transfer status. Splitting criteria are used to determine when a complexity split is warranted within an ADRG. These criteria are expected to be met for the majority of the ADRGs. While it is optimal that all splitting criteria are met, there are some exceptions (special case ADRGs) where ADRGs have been split without satisfying all criteria.

Table 7 outlines the selection criteria used for splitting the ADRGs for AR-DRG V10.0.

Table 7: AR-DRG V10.0 splitting criteria

Criteria		Optimum threshold
1	Minimum episodes per category 200 per year	✓
2	Minimum cost per category $1million per year	✓
3	Minimum percentage per category 10 percent per year	✓
4	Minimum absolute change in mean cost between consecutive categories $3,700	Either criterion 4 or criterion 5
5	Minimum relative change in mean cost between consecutive categories 2*	
6	Inverse trend between sample size and complexity level	✓

**The increase in the cost of a category needs to be, as a minimum, twice as much e.g. if the cost of a category is $3,000 the increase in cost needs to be at least $6,000.*

As outlined in the above table, the optimum threshold meets all criteria (except for criterion four and five where it may meet either) and has the highest reduction in deviance (RID). All ADRGs are then assessed as follows:

- Simulations of various splitting points were performed to derive the optimum threshold for each ADRG. There may be four optimum thresholds selected based on the ADRG having zero, one, two, or three splits;
- The preferred simulation is then determined by the subsequent increases in RID. The minimum increase in RID must be greater than 5 percent to warrant an additional split. This is referred to as the **modelled split** for AR-DRG V10.0;
- The simulation which is equivalent to the same number of splits as AR-DRG V9.0 was also assessed and is referred to as the **previous split** for AR-DRG V10.0;
- The final selection for each ADRG, was then determined on a case by case basis taking into account statistical performance, clinical coherence and stability principles.

The case by case assessment of the ADRGs is subdivided into six groups as outlined in Table 8 and further described below.

Table 8: ADRG structure breakdown

Categories	Number of ADRGs
New ADRGs	2
ADRGs with administrative variables	4
ADRGs with a different number of splits compared to V9.0	19
ADRGs with the same number of splits as V9.0	353
ADRG exceptions (special case ADRGs)	15
Error ADRGs (960, 961, 963, 801)	4
Total	397

4.2 New ADRGs

AR-DRG V10.0 has two new ADRGs relating to nephrolithiasis interventions. They are:

- L43 *Nephrolithiasis Interventions*;
- L44 *Cystourethroscopy for Urinary Disorder*.

As there are no previous splits to compare for the new ADRGs the stability principles do not apply and assessment was primarily based on statistical performance and clinical coherence principles.

4.3 Administrative ADRGs

In AR-DRG V10.0, there are four ADRGs that require administrative variables to determine their end class. These administrative variables include LOS and transfer status. The splitting methodology was modified to these ADRGs, as the incorporation of administrative variables has been maintained.

Table 9: ADRGs requiring administrative variables

ADRG		Administrative variables
B70	Stroke and Other Cerebrovascular Disorders	Maintained the use of LOS and transfer status for the first subdivision.
B78	Intracranial Injuries	Maintained the use of LOS and transfer status for the first subdivision.
F62	Heart Failure and Shock	Maintained the use of LOS and transfer status.
F60	Circulatory Disorders, Admitted for AMI Without Invasive Cardiac Investigative Intervention	Maintained the use of LOS and transfer status for the first subdivision

4.4 ADRGs with a different number of splits compared to V9.0

There are a number of ADRGs with a different number of splits when compared to V9.0. This is because the modelled split performed better with regards to the principles outlined in Section 4.1. Alterations to the number of splits inevitably creates instability between AR-DRG versions and so

in determining whether to modify the number of splits relative to V9.0, a number of additional factors were taken into consideration, including:

- The number of splits adopted in V8.0 and V9.0;
- The change in RID to warrant removal or addition of a split;
- The distribution of ECCS over the 2013-14 to 2016-17 activity data.

As outlined in Table 8, there were 19 ADRGS that have a different number of splits in comparison to V9.0, including:

- Ten ADRGs that have reverted to the V8.0 selected number of splits;
- Nine ADRGs that have a different number of splits relative to V9.0 and V8.0.

4.5 ADRGs with the same number of splits compared to AR-DRG V9.0

The majority of ADRGs have the same number of splits relative to V9.0 allowing episode complexity shifts within these ADRG to be assessed. While every ADRG was assessed individually those ADRGs which saw a large number of episodes shifting were subject to greater scrutiny to justify various movements in complexity, including:

- Improvement in statistical performance (RID);
- Modifications to the underlying DCL weights;
- Enforcement of specific selection criteria.

4.6 ADRG exceptions

There are a small number of ADRGs exceptions where the selection principles outlined in Section 4.1 were not appropriate. In most cases these exceptions satisfied the majority of the criteria outlined in Table 7 however failed to meet one or two criteria. Some ADRGs are exceptions (or special cases) because of the following reasons:

- The threshold in criterion one (minimum of 200 episodes per category) was relaxed for ADRGs with low sample size but large cost variation (e.g. F03 *Cardiac Valve Interventions With CPB Pump With Invasive Cardiac Investigation*);
- Criterion four or five were not required to be met for ADRGs with high sample size but low cost variation (e.g. O60 *Vaginal Delivery*);
- Criterion six was not required to be met for ADRGs with differing complexity profiles (e.g. A15 *Tracheostomy*).

Appendix C: ADRG Exceptions provides the list of 15 ADRG exceptions and specifies the corresponding selection principles that were relaxed.

5 Intervention Hierarchy Review

5.1 Overview

Within each MDC episodes are allocated to an ADRG in a specific hierarchical order. The hierarchy of the intervention partition is important as episodes have the potential to meet multiple surgical and/or other ADRG criteria. The criteria used to assess and inform changes to the hierarchy for AR-DRG V10.0 are outlined in Table 10.

Table 10: Intervention hierarchy principles

Criteria	Description
1. Cost	Sorting of intervention ADRGs from high to low cost with decisions based on both mean and median cost.
2. Specificity	Sorting of intervention ADRGs from specific to non-specific ADRGs (the most common of these are the other/catch-all ADRGs at the bottom of the intervention hierarchy, just before ADRG 801 *General Interventions (GIs) Unrelated to Principal Diagnosis*. This criterion may override the cost criterion.
3. Procedure type	Sorting of intervention ADRGs from the initial definitive intervention, to follow-up and supportive interventions and from major to minor/other interventions.
4. Treatment type	Sorting of intervention ADRGs from treatment to diagnostic interventions.

These criteria are used to assess the hierarchy of the intervention partition only, as the medical partition is primarily based on principal diagnosis where categories are mutually exclusive (i.e. episodes will only meet the criteria for one medical ADRG).

5.2 Methodology

The process undertaken to perform the hierarchy review is outlined in Table 11.

Table 11: Intervention hierarchy methodology

Stages		Description
1	Initial intervention ADRG groupings	This step involved grouping the intervention partition ADRGs in small coherent groups and ordering them according to criteria two to four outlined in Table 10. For example grouping more specific ADRGs ahead of less specific ADRGs.
2	ADRG 801 positioning	For AR-DRG V9.0 ADRG 801 *GIs Unrelated to Principal Diagnosis* resided within the intervention partition as it formed the differential between the former surgical and other partitions.

Stages		Description
		ADRG 801 has been repositioned to the end of the intervention partition for the majority of MDCs except for MDCs 06, 10 and 11, where there is a clear distinction between the former surgical and other partitions.
3	Cost simulation	Episodes have the potential to meet multiple intervention ADRG criteria. To ensure optimal cost profile of ADRG ordering all possible ADRG outcomes and ordering within the initial groupings were simulated.
4	Reasonableness evaluation	The stages detailed above create the AR-DRG hierarchy based on first principles. The final stage is to assess the reasonableness of the ordering relative to the previous version (AR-DRG V9.0) to determine if the change is justified. For example, if the proposed changes suggested that two ADRGs should 'flip' due to the cost differential, but the cost differential is not significant (e.g. less than $1,000), the same ordering has been maintained as in V9.0.

The above methodology was an iterative process and was repeated until all proposed changes relative to AR-DRG V9.0 were understood and justified.

5.3 Results

A total of 11 out of 25 MDCs in AR-DRG V10.0 have a new ADRG sequence within the intervention partition. Table 12 outlines the main changes for these 11 MDCs.

Table 12: AR-DRG V10.0 hierarchy results

MDC	Main Changes
01 Diseases and Disorders of the Nervous System	Repositioning of ADRG 801 *GIs Unrelated to Principal Diagnosis* to the end of the intervention partition resulting in 84 episodes moving into ADRG B42 *Nervous System With Ventilator Support*. Repositioning of ADRG B42 before ADRG B07 *Cranial or Peripheral Nerve and Other Nervous System Procedures*, due to the higher cost profile, resulting in a further 63 episodes moving into ADRG B42.
02 Diseases and Disorders of the Eye	Repositioning of ADRG C01 *Procedures for Penetrating Eye Injury* from position one to three, providing a better cost profile for the top three ADRGs. This has resulted in 542 episodes moving out of ADRG C01. Repositioning of ADRG C03 *Retinal procedures* after ADRG C10 *Strabismus Procedures* due to the lower cost profile, resulting in 1,680 episodes moving out of ADRG C03.
03 Diseases and Disorders of the Ear, Nose, Mouth and Throat	Repositioning of ADRG 801 to the end of the intervention partition, resulting in 30 episodes moving into ADRG D40 *Dental Extractions and restorations*.
04 Diseases and Disorders of the Respiratory System	Repositioning of ADRG 801 to the end of the intervention partition, resulting in 308 episodes moving out of ADRG 801.

MDC	Main Changes
05 Diseases and Disorders of the Circulatory System	Repositioning of ADRG 801 to the end of the intervention partition, resulting in 177 episodes moving out of ADRG 801. Other positional shifts did occur within this MDC, but did not result in significant changes to the ADRG episode composition (less than 50 episodes).
08 Diseases & Disorders of the Musculoskeletal System and Connective Tissue	ADRG I28 *Other Musculoskeletal Procedures* and ADRG I24 *Arthroscopy* have been switched due to the descending cost profile. This has resulted in 626 episodes moving into I28. Other positional shifts did occur within this MDC, but did not cause significant changes to the ADRG episode composition (less than 50 episodes).
09 Diseases and Disorders of the Skin, Subcutaneous Tissue and Breast	Repositioning of ADRG J06 *Major Procedures for Breast Disorders* before ADRG J13 *Lower Limb Procedures Without Ulcer or Cellulitis* due to cost profiles. This had no impact on the episode composition of these ADRGs.
10 Endocrine, Nutritional and Metabolic Diseases and Disorders	Repositioning of ADRG K05 *Parathyroid Procedures* below ADRG K06 *Thyroid Procedures* resulting in 866 episodes moving into ADRG K06. Other positional shifts did occur within this MDC, but did not result in significant changes to the ADRG episode composition (less than 50 episodes).
12 Diseases and Disorders of the Male Reproductive System	Repositioning of ADRG 801 to the end of the intervention partition, resulting in 20 episodes moving out of ADRG 801.
14 Pregnancy, Childbirth and the Puerperium	Repositioning of ADRG O60 *Vaginal Delivery* into the medical partition but did not result in significant changes to ADRG episode composition.
21B Injuries, Poisonings and Toxic Effects of Drugs B	Repositioning of ADRG 801 to the end of the intervention partition, with no impact on episode composition.

Appendix A: Diagnosis Exclusions

A number of diagnosis codes are excluded from consideration in the ECC Model based on the guiding principles formalised during initial development. The guiding principles aimed to characterise the scope of the ECC Model in terms of diagnoses considered relevant for DRG classification purposes. Some diagnosis codes are excluded conditionally (depending on other diagnoses present) and some unconditionally.

Following these principles, codes were excluded in V8.0 that provided additional or supplementary information to another code already assigned. This included codes that specify outcome of delivery, infectious agents as the cause of diseases classifiable elsewhere, dagger (underlying cause) codes when an asterisk (manifestation) code is present, and so on.

The majority of codes from Chapter 18 *Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified*, Chapter 21 *Factors influencing health status and contact with health services* and the unacceptable principal diagnosis codes were excluded.

Some unacceptable principal diagnosis codes and codes from Chapters 18 and 21, however, were considered exceptions and included if they were deemed capable of providing information critical to the clinical description of an admitted acute episode of care.

Clinical determination of exclusions for all (approximately) 16,000 diagnosis codes was not possible during the development of the complexity model for V8.0, however, it was acknowledged that further refinement of diagnosis codes considered as in-scope and out of scope for the model would be required.

IHPA undertook this refinement for AR-DRG V10.0 and expanded the guiding principles for exclusion as outlined in Table 13:

Table 13: Guiding principles for exclusion in the AR-DRG complexity model

Original (AR-DRG V8.0)	Additional (AR-DRG V10.0)
Codes for undefined or ill-specified conditions	Codes for asymptomatic or sub-clinical conditions e.g. latent conditions
Codes for symptoms and findings or transient conditions	Codes that represent markers of other diseases e.g. hypercholesterolaemia
Codes that provide additional or contextual information	Codes that represent minor conditions that do not generally result in an admitted acute episode of care
Most unacceptable principal diagnosis codes	Codes that represent an underlying cause of disease e.g. tobacco dependence/use

A comprehensive review of the current in-scope code set (12,559 codes) informed by the guiding principles was undertaken in consultation with IHPA's clinical and technical advisory groups to refine the code set. The results of this review also went out to public consultation during May/June 2018.

Impact analysis was then undertaken on the proposed diagnosis exclusions to determine which codes should potentially be reincorporated into the ECC Model. An iterative consultation process was conducted that included further analysis and clinical and technical consultation, which also took into consideration feedback from the public consultation.

A list of codes for exclusion was then finalised based on a combination of the impact analysis and clinical advice.

Of the 12,559 codes initially in-scope within the complexity model 1,576 were proposed for exclusion, decreasing the number of in-scope codes by approximately 12.5%. Following feedback from stakeholders, the impact analysis and further clinical advice the final list excludes 1,511 codes (with 65 having been reincorporated), reducing the in-scope codes by approximately 12.0%.

Appendix B: Aggregation Calculations

This appendix provides an example of diagnosis 'x' within ADRG 'A' to illustrate the calculations regarding the DCL aggregation principles.

$$\bar{C}(x, A) = \text{average log cost differential associated with x in A}$$

$$E_n = number\ of\ episodes\ within\ n^{th}\ precision\ level$$

$$C_n = \text{average log cost differential } within\ step\ n^{th}\ precision\ level$$

First precision level*:* Three character, within CDC and ADRG*.*

a. If $E_1 \geq 100$, define $\bar{C}(x, A) = C_1$, and the calculation is complete
b. If $E_1 < 100$, define $\overline{C_1} = C_1$, proceed to step 2

Second Precision level: Code block, within CDC and ADRG*.*

a. If $E_1 + E_2 \geq 100$, define $\bar{C}(x, A) = \frac{E_1 \times C_1 + (100 - E_1) \times C_2}{100}$, and the calculation is complete
b. If $E_1 + E_2 < 100$, define $\bar{C}_2 = \frac{E_1 \times C_1 + E_2 \times C_2}{E_1 + E_2}$, proceed to next precision level.

This process continues, with the n^{th}precision defined as:

n^{th} precision level:

a. If $\sum_{i=1}^{n} E_i \geq 100$, define $\bar{C}(x, A) = \frac{(\sum_{i=1}^{n-1} E_i) \times \bar{C}_{n-1} + (100 - E_{n-1}) \times C_n}{100}$, and the calculation is complete
b. If $\sum_{i=1}^{n} E_i < 100$, define $\bar{C}_n = \frac{(\sum_{i=1}^{n-1} E_i) \times \bar{C}_{n-1} + E_n \times C_n}{\sum_{i=1}^{n} E_i}$, proceed to next precision level.

If this process continues to the last precision, which is CDC level across all ADRGs (n=14), and the sample size threshold is still not satisfied, then $\bar{C}(x, A) = 0$.

Appendix C: ADRG Exceptions

Table 14: ADRG exceptions where splitting criteria was relaxed

ADRG	Description	Modified Criteria
A15	Tracheostomy	Criterion 6
F03	Cardiac Valve Procedures W CPB Pump W Invasive Cardiac Investigation	Criterion 1
J01	Microvascular Tissue Transfers for Skin, Subcutaneous Tissue & Breast Disorders	Criterion 1
J08	Other Skin Grafts and Debridement Procedures	Criterion 4 or 5
J11	Other Skin, Subcutaneous Tissue and Breast Procedures	Criterion 4 or 5
O01	Caesarean Delivery	Criterion 4 or 5
O60	Vaginal Delivery	Criterion 4 or 5
P04	Neonate, Admission Weight 1500-1999g With Significant General Intervention or Ventilation >=96hours	Criterion 1
P05	Neonate, Admission Weight 2000-2499g With Significant General Intervention or Ventilation >=96hours	Criterion 1
P60	Neonate Without Significant General Intervention or Ventilation >=96hrs, Died or Transferred to Acute Facility <5Days	Criterion 4 or 5
P63	Neonate, Admission Weight 1000-1249g Without Significant General Intervention or Ventilation >=96hours	Criterion 1
P65	Neonate, Admission Weight 1500-1999g Without Significant General Intervention or Ventilation >=96hours	Criterion 6
P66	Neonate, Admission Weight 2000-2499g Without Significant General Intervention or Ventilation >=96hours	Criterion 6
P67	Neonate, Admission Weight >=2500g Without Significant General Intervention/Ventilation >=96hrs, <37 Completed Weeks Gestation	Criterion 4 or 5 Criterion 6
P68	Neonate, Admission Weight >=2500g Without Significant General Intervention/Ventilation >=96hrs, >=37 Completed Weeks Gestation	Criterion 3 Criterion 4 or 5

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