IHACPA

Australian Refined Diagnosis Related Groups Version 12.0

Technical Specifications

March 2025

Australian Refined Diagnosis Related Groups Version 12.0 — Technical Specifications March 2025

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Acronyms and Abbreviations

ABF	Activity Based Funding
ACS	Australian Coding Standards
ACHI	Australian Classification of Health Interventions
ADRG	Adjacent Diagnosis Related Group
AICD	Automated implantable cardioverter defibrillator
AMI	Acute myocardial infarction
APC NMDS	Admitted Patient Care National Minimum Dataset
AR-DRG	Australian Refined Diagnosis Related Groups
CCAG	Classifications Clinical Advisory Group
CDC	Coherent Diagnosis Classes
CPB	Cardiopulmonary bypass
DCL	Diagnosis Complexity Level
DRG	Diagnosis Related Group
DTG	DRG Technical Group
ECC	Episode Clinical Complexity
ECCS	Episode Clinical Complexity Score
GI	General Intervention
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification

IHACPA	Independent Health and Aged Care Pricing Authority
LOS	Length of Stay
MDC	Major Diagnostic Category
NEP	National Efficient Price
NHCDC	National Hospital Cost Data Collection
RID	Reduction in Deviance

1 Introduction

1.1 AR-DRG classification

The Independent Health and Aged Care Pricing Authority (IHACPA) is responsible for the development of the Australian Refined Diagnosis Related Groups (AR-DRG) classification. The classification categorises similar episodes of admitted acute care based on clinical and administrative information.

The AR-DRG classification is underpinned by the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM), the Australian Classification of Health Interventions (ACHI) and the Australian Coding Standards (ACS); collectively known as ICD-10-AM/ACHI/ACS.

The AR-DRG classification uses ICD-10-AM/ACHI/ACS coded data along with other routinely collected information to classify admitted acute episodes of care in public and private hospitals across Australia. Other routinely collected information used by the AR-DRG classification includes age, mode of separation, length of stay, newborn admission weight, hours of continuous ventilatory support (mechanical ventilation) and same-day status.

The AR-DRG classification provides a clinically meaningful way of relating the number and types of admitted patients to the resources required by the health service in the provision of those services. This facilitates activity based funding (ABF) of admitted acute episodes of care.

While the AR-DRG classification is instrumental to ABF, it is also used for many other purposes, including benchmarking, service planning, monitoring quality and safety and epidemiological studies.

1.2 Purpose

This document details the methodology and technical specifications used in the development of AR-DRG V12.0, including:

- data preparation and modification
- Adjacent Diagnosis Related Group (ADRG) intervention hierarchy review
- derivation of the Episode Clinical Complexity Score (ECCS)
- ADRG splitting review.

Each of these processes was undertaken in accordance with the Governance Framework for the Development of the Admitted Care Classifications for ICD-10-AM/ACHI/ACS Thirteen Edition and AR-DRG Version 12.0.

1.3 Additional resources for AR-DRG V12.0

In addition to the AR-DRG Version 12.0 Technical Specifications, other resources have been developed to support the use and implementation of AR-DRG V12.0.

1.3.1 AR-DRG Version 12.0 Final Report

The AR-DRG Version 12.0 Final Report outlines the changes made for AR-DRG V12.0 and details the refinement process, associated analysis and the rationale for changes. Several potential refinement areas were also assessed for V12.0 but, after analysis and consultation with stakeholders, were not progressed.

1.3.2 AR-DRG Version 12.0 Definitions Manual

The AR-DRG Version 12.0 Definitions Manual is a set of reference documents detailing the definition logic for the Diagnosis Related Group (DRG) grouping process performed by the grouper. The manual provides documentation of how particular episodes of care group to DRGs and is available for purchase.

While the manual assists with the identification of likely DRG assignments for individual episodes, it is not a substitute for the grouping software that is provided by vendors under licence from IHACPA.

1.3.3 AR-DRG V12.0 Descriptions

The AR-DRG V12.0 Descriptions includes a full list of long and short descriptions for Major Diagnostic Categories (MDCs), ADRGs and DRGs.

1.3.4 ICD-10-AM/ACHI/ACS Thirteenth Edition

AR-DRG V12.0 is underpinned by the ICD-10-AM/ACHI/ACS Thirteenth Edition.

2 Data Preparation

2.1 Overview

AR-DRG V12.0 was released in July 2025. The complexity model for AR-DRG V12.0 was developed using the public hospital Admitted Patient Care National Minimum Data Set (APC NMDS) and the National Hospital Cost Data Collection (NHCDC) from 2018–19 to 2021–22.

Data from 2018–19 to 2021–22 was initially coded in ICD-10-AM/ACHI/ACS Tenth and Eleventh Editions. For development purposes, this data was mapped forward to ICD-10-AM/ACHI/ACS Twelfth Edition. Once AR-DRG V12.0 was developed, its supporting ICD-10-AM (diagnosis) and ACHI (intervention) codes were mapped from Twelfth Edition to Thirteenth Edition. Consequently, AR-DRG V12.0 is designed to be used in conjunction with ICD-10-AM/ACHI/ACS Thirteenth Edition.

2.2 Record trimming

To develop a robust complexity model within the AR-DRG classification, data preparation steps were required to ensure only episodes of sufficient quality were included in the modelling dataset. Episode trimming was undertaken to enforce these data quality standards. **Table 1** summarises the trimming stages and the number of episodes trimmed. The following notes correspond to the Episode trimming stage column in **Table 1**:

(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 81,124 episodes were trimmed due to invalid or contradictory information recorded in the APC NMDS, including:

- episodes with invalid ICD-10-AM or ACHI codes
- episodes with care type[1] other than Acute care (1), Newborn care (7), Posthumous organ procurement (9) 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 or age at admission strictly greater than 9 days
- episodes with error DRGs in AR-DRG V11.0.

[1] Australian Institute of Health and Welfare (2019) METEOR, Care Type https://meteor.aihw.gov.au/content/index.phtml/itemId/711010

(c) A total of 2,600,505 episodes were removed due to NHCDC data that was not considered suitable for analysis. This represents instances in which cost data could not be identified with activity data or in which the episode cost was too small to be representative of admitted acute care. Episodes were removed on this basis if in-scope cost (total cost excluding depreciation and capital expenditure) was less than either:

- $23 in total
- -$100 in any cost bucket[2].

(d) A total of 143,031 'work in progress' episodes were trimmed. These are episodes with admission and separation dates in different financial years.

(e) The sample was further reduced by 6,172 by removing episodes from hospitals with fewer than 100 costed episodes.

(f) Based on advice from Queensland Health, IHACPA removed 7,768 episodes from Queensland standalone mental health facilities which were considered unrepresentative of mental health activity classified using AR-DRGs.

(g) Hospital and DRG combinations with extremely high or low cost per day were also trimmed. A total of 48,294 episodes were removed at this stage.

(h) The remaining sample was then analysed using AR-DRG V11.0, and observations with extreme outlier costs were removed. This was done by ranking observations by cost and identifying those episodes that recorded an extreme increase in cost over 200% (or a decrease in cost over 75%) from the previous observation. In total, 398 episodes were removed at this stage.

(i) The final stage of extreme outlier identification was undertaken by first deriving a regression model using length of stay (LOS) and AR-DRG V11.0. The ratio between an episode's modelled cost and its in-scope cost was analysed. Following this, another 1,412 episodes with extremely high or low ratios were removed.

(j) The resulting sample of 25,133,827 episodes was identified for use in AR-DRG V12.0 development.

[2] A cost bucket is a combination of line item and cost centre defined as part of the NHCDC collection for each year.

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

Episode trimming stage	2018–19	2019–20	2020–21	2021–22	Total
(a) **Initial episode-level cost sample of admitted acute records**	6,913,385	6,878,888	7,200,047	7,030,211	**28,022,531**
(b) Records with invalid or contradictory information in APC NMDS	-3,420	-12,461	-32,230	-33,013	-81,124
(c) Records with unsuitable NHCDC data	-572,649	-625,774	-715,618	-686,464	-2,600,505
(d) Records that are 'work in progress'	-34,978	-36,824	-34,177	-37,052	-143,031
(e) Records from hospitals with fewer than 100 costed episodes	-1,283	-1,477	-1,821	-1,591	-6,172
(f) Records removed based on jurisdictional advice	-2,320	-2,153	-1,893	-1,402	-7,768
(g) Records with hospital-DRG extreme costs	-9,169	-9,799	-16,808	-12,518	-48,294
(h) Records with extreme outlier costs	-81	-97	-140	-80	-398
(i) Extreme removed following regression analysis due to extreme cost ratios	-279	-333	-390	-410	-1,412
Total trimmed episodes	-624,179	-688,918	-803,077	-772,530	**-2,888,704**
(j) **Resulting sample size**	**6,289,206**	**6,189,970**	**6,396,970**	**6,257,681**	**25,133,827**

Throughout the development process, including data trimming, all costs submitted to the NHCDC were used apart from those having a line item for depreciation, leasing, capital works or excluded costs. The remaining costs are referred to as in-scope costs.

2.3 Cost indexation

Cost data from 2018–19 to 2020–21 was indexed to 2021–22 levels using a regression model constructed at the DRG level.

The indexation model was developed using 2021–22 cost data to create a linear regression model. This model estimates in-scope costs based on the LOS for each DRG in AR-DRG V11.0. Initially, a regression model with an intercept was tested for episodes in each DRG. If this resulted in a negative intercept or negative coefficient for LOS, a model without intercept was used instead.

Using this regression model a predicted cost was calculated for each episode. The indexation factor between one year (the base year) and the following year (the target year) was calculated as follows:

1) The sample was restricted to episodes from establishments which reported data in both the base year and target year. Denote the sample of episodes from the base year used for indexation calculations by $\{x_1, \dots, x_{N_B}\}$ and those from the target year used for indexation calculations by $\{y_1, \dots, y_{N_T}\}$.

2) A total predicted cost and in-scope cost was calculated for the base year and target year by summing the predicted cost and in-scope cost of each episode, as follows:

$$PredictedCost_B = \sum_{i=1}^{N_B} PredictedCost(x_i)$$

$$InScopeCost_B = \sum_{i=1}^{N_B} InScopeCost(x_i)$$

$$PredictedCost_T = \sum_{i=1}^{N_T} PredictedCost(y_i)$$

$$InScopeCost_T = \sum_{i=1}^{N_T} InScopeCost(y_i)$$

where:

$PredictedCost(x_i)$ is the predicted cost of the episode x_i

$PredictedCost(y_i)$ is the predicted cost of the episode y_i

$InScopeCost(x_i)$ is the in-scope cost of the episode x_i

$InScopeCost(y_i)$ is the in-scope cost of the episode y_i

3) The indexation factor between the base year and the target year is the growth in the ratio of predicted cost to in-scope cost, denoted $IndexationFactor_{B,T}$. It is calculated as follows:

$$IndexationFactor_{B,T} = \frac{PredictedCost_T}{InScopeCost_T} \times \frac{InScopeCost_B}{PredictedCost_B}$$

The resulting indexation factors are listed in **Table 2**.

Table 2: List of indexation rates used for AR-DRG V12.0 development

Base year	Target year	Indexation factor
2018–19	2019–20	1.0781
2019–20	2020–21	1.0010
2020–21	2021–22	1.0856

Table 2 lists the indexation factors used to adjust costs from the base year to the target year. Costs can be inflated to 2021-22 levels by applying a product of the relevant indexation factor for each year. For example, if an episode with separation in 2019–20 has in-scope cost of $1,500 then this cost is inflated to 2021–22 levels by applying the following factor.

$$1.0010 \times 1.0856 = 1.0867$$

The cost of this episode for development purposes is

$$\$1{,}500.00 \times 1.0867 = \$1{,}630.05$$

3 ADRG Intervention Hierarchy Review

3.1 Overview

Episodes are generally assigned to an MDC based on their principal diagnosis. In most MDCs, ADRGs belong to one of two partitions – the intervention partition and the medical partition. ADRGs in the intervention partition are generally defined by the presence of a particular ACHI code whereas those in the medical partition are generally defined by an episode's principal diagnosis.

An episode may have more than one ACHI code and may therefore satisfy the definition of more than one intervention ADRG. Therefore, ADRGs in the intervention partition are placed in a hierarchy. If an episode satisfies the definition of more than one intervention ADRG then it is assigned to the ADRG which appears earliest in the intervention hierarchy.

The intervention hierarchy is reviewed in each development cycle to maintain clinical currency and statistical integrity. The review is undertaken in accordance with the ADRG intervention hierarchy principles specified in the governance framework. The ADRG intervention hierarchy principles used to assess and inform changes to the intervention hierarchy for AR-DRG V12.0 are provided in **Table 3**.

Table 3: ADRG intervention hierarchy principles

Principle	Description
1 Cost	Intervention ADRGs must be sorted from high to low cost based on both mean and median cost.
2 Specificity	Intervention ADRGs must be sorted from specific to non-specific ADRGs and before ADRG 801 *General Intervention unrelated to principal diagnosis*. This criterion may override the cost criterion[3].
3 Intervention type	Intervention ADRGs must be sorted from the initial, definitive intervention, to follow-up and supportive interventions and from major to minor or other interventions. This criterion may override the cost criterion.
4 Treatment type	Intervention ADRGs must be sorted from treatment to diagnostic interventions. This criterion may override the cost criterion.

[3] Specific ADRGs are those designed for one or more specific interventions. Non-specific ADRGs are residual ADRGs designed to catch episodes not grouped to specific ADRGs but have interventions related to an episode's principal diagnosis. Non-specific ADRGs normally start with the word 'other'. For example ADRG C01 *Interventions for penetrating eye injury* is a specific ADRG whereas ADRG C14 *Other eye interventions* is a non-specific ADRG. Non-specific ADRGs are normally last in the intervention hierarchy but before ADRG 801 *General Intervention unrelated to principal diagnosis*.

The ADRG intervention hierarchy principles apply only to the intervention partition of MDCs. The majority of the medical partition criteria are based on principal diagnosis. Therefore, medical ADRGs are almost always mutually exclusive, with a small number of exceptions for ADRGs defined using principal diagnosis in combination with administrative variables, such as I80 *Femoral fractures, transferred to acute facility in less than 2 days*. Therefore, review of the medical partition hierarchy is not required.

In AR-DRG V12.0 development, the ADRG intervention hierarchy was impacted by the General Intervention (GI) review. This review formalised which interventions are included in the definitions of intervention ADRGs. The details of this development task can be found in the AR-DRG Version 12.0 Final Report.

3.2 Methodology

The ADRG intervention hierarchy review process is outlined in **Table 4**.

Table 4: ADRG intervention hierarchy methodology

Stage		Description
1	Initial intervention ADRG groupings	This stage involves the grouping of the intervention partition ADRGs in small coherent groups, referred to as initial groupings. They are ordered according to hierarchy principles of specificity, intervention and treatment type. For example, initial groups containing more specific ADRGs are placed ahead of those containing less specific ADRGs. Thereafter, no ADRG from the less specific initial group is placed above any ADRG in the more specific initial group.
2	Cost simulation	Episodes may satisfy the definition of multiple intervention ADRGs. To ensure optimal ordering of ADRGs by their cost profile, all possible ADRG orderings are simulated within the initial groupings created in stage one.
3	ADRG ordering within initial groups	The ADRG with the highest mean cost within each initial group is selected as the first ADRG in the hierarchy within that initial group. Episodes satisfying the definition of multiple intervention ADRGs are used in the mean cost calculation of all relevant ADRGs. Once the ADRG has been placed in the hierarchy, episodes meeting the criteria of that ADRG are removed from the sample and stage two is repeated without these episodes. This is an iterative process and is repeated until the hierarchical ordering of all ADRGs are determined.
4	Stability evaluation	The final stage is to assess the changes using median cost and the reasonableness of the ordering relative to the previous AR-DRG version to consider if the change is justified.

Stage	Description
	Two ADRGs interchange positions only if the following stability measures are both satisfied: • Both the mean and median cost changes suggest that the change in position is warranted. • The cost difference for both mean and median cost is larger than $1,000. Otherwise, the ordering used in the previous version is retained.

The above methodology was repeated until all proposed changes relative to AR-DRG V11.0 were understood and justified.

3.3 Results

The ADRG intervention hierarchy review for AR-DRG V12.0 resulted in one change relative to the AR-DRG V11.0 intervention hierarchy. This took place in MDC 02 *Diseases and disorders of the eye* in which ADRG C01 *Interventions for penetrating eye injury* rose from third to first position. ADRGs C02 *Enucleations and orbital interventions* and C04 *Major corneal, scleral and conjunctival interventions* moved back one place each in the hierarchy. This change was due to an increase in average episode cost for ADRG C01 *Interventions for penetrating eye injury* and the specificity principle. ADRG C01 was deemed to be more specific than the other ADRGs in **Table 5** because it is defined both in terms of interventions and diagnoses.

Table 5: Intervention hierarchy change in MDC 02 *Diseases and disorders of the eye*

Position	AR-DRG V11.0	AR-DRG V12.0
1	C02 *Enucleations and orbital interventions*	C01 *Interventions for penetrating eye injury*
2	C04 *Major corneal, scleral and conjunctival interventions*	C02 *Enucleations and orbital interventions*
3	C01 *Interventions for penetrating eye injury*	C04 *Major corneal, scleral and conjunctival interventions*

3.4 A16 Posthumous organ procurement

One new intervention ADRG, A16 *Posthumous organ procurement*, was introduced in AR-DRG V12.0. This ADRG is designed to contain instances in which posthumous organ procurement is undertaken as well as instances in which posthumous organ procurement is attempted but not completed.

When AR-DRG V12.0 is in use, instances of attempted but incomplete posthumous organ procurement will be identifiable using the ICD-10-AM Thirteenth Edition code Z53.32 *Posthumous organ procurement attempted but not completed*. This diagnosis code is not available in ICD-10-AM Twelfth Edition, so, for development purposes, episodes were grouped

to ADRG A16 on the bases of having a care type or an ACHI code indicating posthumous organ procurement. This will no longer be necessary when ICD-10-AM/ACHI/ACS Thirteenth Edition is in use so care type is not used in the final AR-DRG V12.0 grouper.

ADRG A16 was placed in MDC 00 *Pre Major Diagnostic Category* as it meets the Pre Major Diagnostic Category criteria listed in the governance framework. When the process described in **Table 4** was applied to ADRG A16 *Posthumous organ procurement*, it was placed last in the intervention hierarchy as it recorded lower mean and median cost than the other ADRGs in MDC 00 *Pre Major Diagnostic Category.*

4 Episode Clinical Complexity

4.1 Overview

AR-DRG V8.0 introduced a methodology for measuring clinical complexity known as the Episode Clinical Complexity (ECC) Model. The ECC Model assigns an Episode Clinical Complexity Score (ECCS) to each episode which quantifies the expected resources expended in providing care during that episode, relative to other episodes in the same ADRG. Episodes within an ADRG are ranked by their ECCS. Most DRGs are defined by the set of episodes within a particular ADRG and with ECCS falling into a specific range.

The process of deriving an ECCS for each episode begins by assigning a Diagnosis Complexity Level (DCL) to each in-scope diagnosis code reported for the episode. A DCL is an integer that quantifies the expected level of resource utilisation associated with each diagnosis code among episodes that belong to the same ADRG. DCL values are assigned to principal diagnosis and additional diagnosis codes and range between zero and five.

DCLs measure *relative resource utilisation* within an ADRG. A DCL of zero indicates that the diagnosis is not associated with higher resource utilisation than the minimum level of resource use among episodes in the same ADRG. In some ADRGs, for example H09 *Liver transplantation*, this minimum value represents a large volume of resource utilisation.

Moreover, DCL values are calculated only among episodes that belong to a particular ADRG. If an ICD-10-AM code is uncommon within a particular ADRG then the DCL value for that code is calculated using additional information from episodes with clinically similar codes and ADRGs. This process is described in Section 4.4.

Consequently, the assignment of a DCL to any diagnosis code should be understood in the context of the specific ADRG to which that DCL applies. A DCL of zero does not mean that the diagnosis is associated with nil resource use.

In AR-DRG V12.0, 11,057 ICD-10-AM Thirteenth Edition codes are used for ECCS calculations. The components used in the ECCS calculation are detailed in **Table 6**.

Table 6: ECCS calculation components

Component	Description
Diagnosis exclusions	This stage defines which diagnoses are considered relevant for the AR-DRG classification. Those diagnoses not identified as in-scope are called exclusions, some of which are excluded unconditionally, and others are excluded conditionally. The latter are excluded only based on the presence of another diagnosis code.

Component	Description
Geometric mean cost model	A geometric mean cost model estimates ADRG cost per episode according to the number of diagnoses in each episode, with diminishing returns for multiple diagnoses.
DCL	DCL weights represent the relative resource utilisation accompanying each diagnosis code within the context of a specific ADRG. They are calculated for every combination of diagnosis code and ADRG, which results in approximately 7 million different combinations, arising from 405 ADRGs and 17,271 valid Thirteenth Edition diagnosis codes. This includes combinations containing diagnosis codes which are not used in ECC Model development. These codes are assigned a DCL of zero in each ADRG.
ECCS decay factor	The ECCS decay factor adjusts for the diminished contribution of multiple diagnosis codes. For each additional diagnosis code, the ECCS contribution of that code decreases according to the decay factor.

4.2 Diagnosis exclusions

Some diagnosis codes are excluded from consideration in the AR-DRG V12.0 ECC Model based on guiding principles for exclusion from the complexity model as specified in the governance framework.

These guiding principles characterise the scope of the ECC Model in terms of diagnosis codes considered relevant for classification purposes. Diagnosis codes identified as not being in-scope are called diagnosis exclusions. These codes may be deemed out of the scope of the ECC Model in all circumstances, in which they are referred to as unconditional exclusions. Alternatively, they may be excluded only when they appear in the same episode as another specified code, in which case they are referred to as conditional exclusions.

Diagnosis exclusions are removed from the data prior to the development of the ECC Model. More information regarding the guiding principles and diagnosis exclusions in AR-DRG V12.0 is provided in **Appendix A: Diagnosis Exclusions**.

4.3 Geometric mean cost model

A geometric mean cost model is used to estimate the ADRG costs by diagnosis code count and assumes diminishing returns for each additional diagnosis code through a decay factor. For each ADRG, the 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 = one greater than the number of in-scope additional diagnosis codes
A = ADRG

A least squares best fit determines the optimum parameters for each ADRG geometric mean cost model. To minimise the influence of outliers, the calculation of a, b and r uses only episodes containing 20 or fewer diagnosis codes.

Following the first attempt at fitting the geometric mean cost model, additional conditions are imposed to prevent the use of extreme values:

1) If $b < 1.01$ then assign $\begin{cases} a = \text{average cost for this ADRG} \\ b = 1 \\ r = 1 \end{cases}$
2) Otherwise, if $r \geq 0.9949$ then another geometric mean cost model is fit using $r = 1$ and this model is used for DCL calculations.

Table 7 provides a breakdown of the calculations for ADRG B78 *Intracranial injuries*, which has a base cost (a) of $1,302, a change parameter (b) of 1.45 and a decay factor (r) of 91%. **Table 7** illustrates the diminishing returns for each additional diagnosis code assigned to an episode.

Table 7: Illustrative example for the geometric mean cost model

Number of diagnosis codes	Equation	Interpretation
1	$C_1 = a \times b$ $= \$1{,}302 \times 1.45$ $= \$1{,}888$	Episodes in ADRG B78 *Intracranial injuries* with one diagnosis code (principal diagnosis only) have an estimated cost of $1,888.
2	$C_2 = a \times b \times b^r$ $= \$1{,}302 \times 1.45 \times 1.45^{0.91}$ $= \$1{,}302 \times 1.45 \times 1.40$ $= \$2{,}647$	Episodes in ADRG B78 *Intracranial injuries* with 2 diagnosis codes are estimated to be 40% more expensive than episodes with only a principal diagnosis.
3	$C_3 = a \times b \times b^r \times b^{r^2}$ $= \$1{,}302 \times 1.45 \times 1.45^{0.91}$ $\times 1.45^{0.91^2}$ $= \$1{,}302 \times 1.45 \times 1.40 \times 1.36$ $= \$3{,}601$	Episodes in ADRG B78 *Intracranial injuries* with 3 diagnosis codes are estimated to be 36% more expensive than episodes with 2 diagnosis codes.

Episodes in ADRG B78 *Intracranial injuries* with only one diagnosis code (a principal diagnosis code only) are estimated to be $1,888. The presence of 2 diagnosis codes (one principal diagnosis code and one additional diagnosis code) increases this estimate by a factor of $1.45^{0.91}$ or 1.40, resulting in a predicted cost of $2,647 as shown in the third row of **Table 7**. An episode with 3 diagnosis codes is estimated to have a cost $1.45^{0.91^2}$ or 1.36 times greater than an episode with 2 diagnosis codes or a predicted cost of $3,601 as shown in the final row of **Table 7**.

Figure 1 compares the predicted cost with the actual cost by the number of diagnosis codes for ADRG B78 *Intracranial injuries* episodes over the period 2018–19 to 2021–22. The line graphs depict the actual and predicted costs and are measured against the vertical axis on the left. The line graphs show that for episodes with one diagnosis code (a principal diagnosis only), at the far left of the horizontal axis, the predicted cost of $1,888, shown in **Table 7** is very close to the actual cost of these episodes. This is in part because most episodes have a small number of diagnosis codes, as shown by the bar graph which is measured against the vertical axis on the right of **Figure 1,** which shows that 3,761 episodes in ADRG B78 have only one diagnosis code. Conversely, the number of episodes with 15 or more diagnosis codes is less than 300 and the difference between the actual and predicted cost, depicted in the line graphs grows larger for these episodes.

Figure 1: ADRG B78 *Intracranial injuries* actual and predicted cost

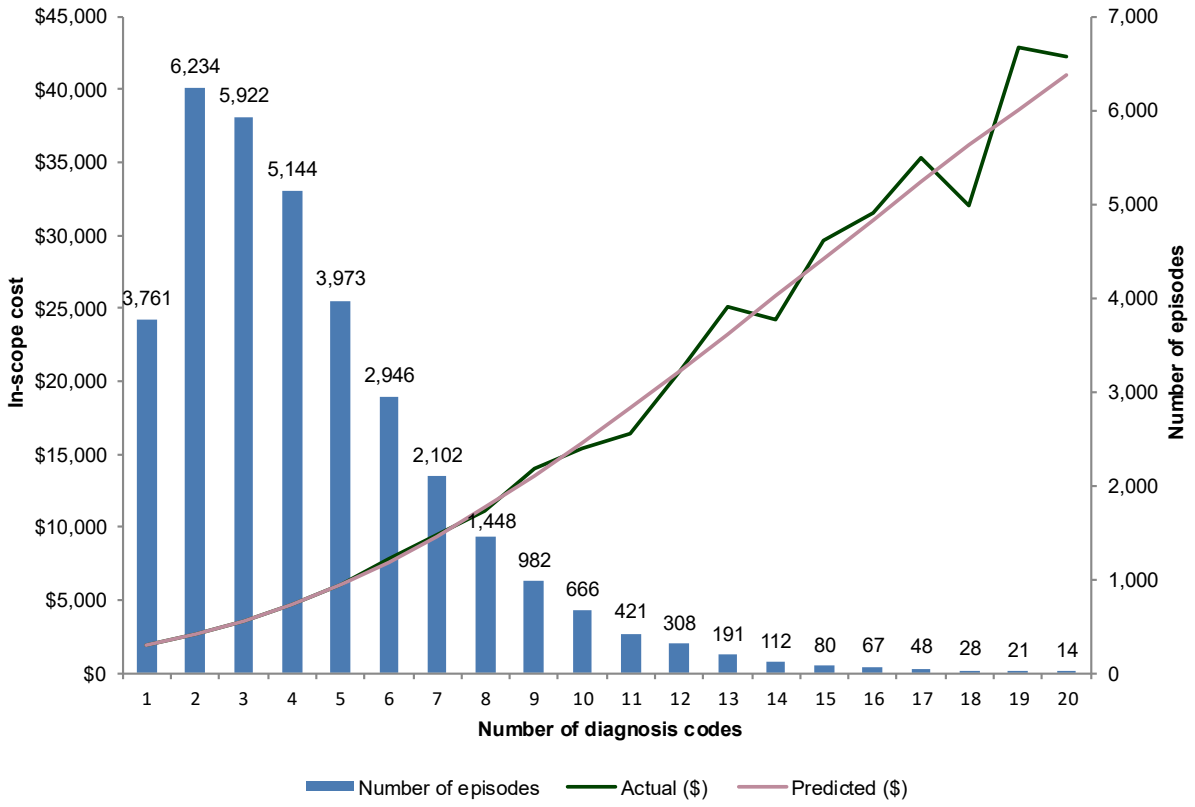
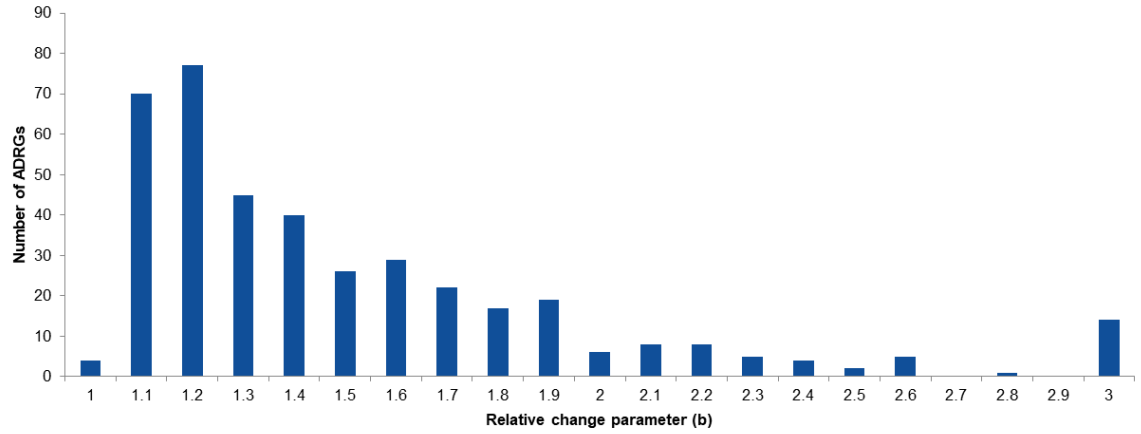
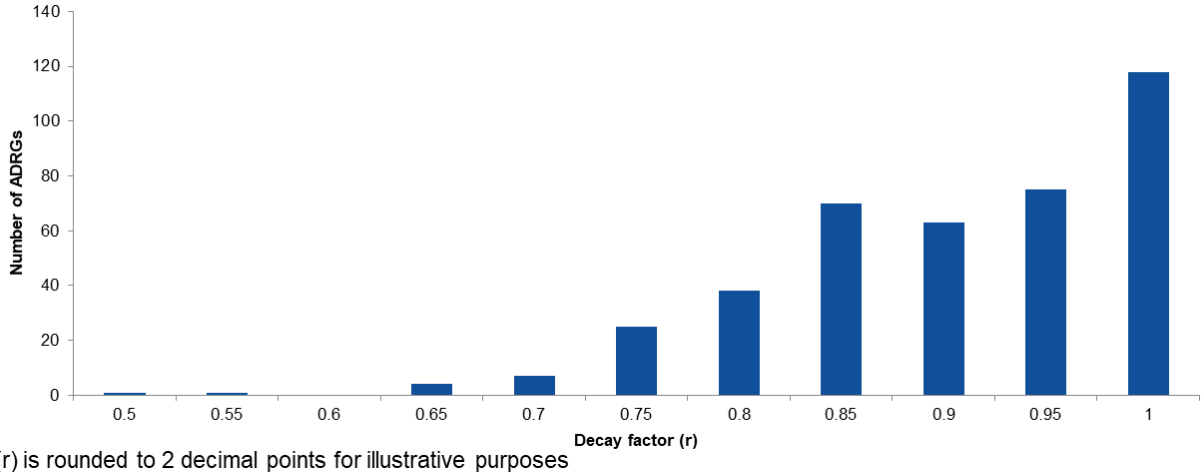


Figure 2 shows the distributions of the change parameter and decay factor values in the geometric mean cost model.

Figure 2: Distribution of change parameters (b) and decay factors (r) among different ADRGs



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



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

Figure 2 illustrates that:

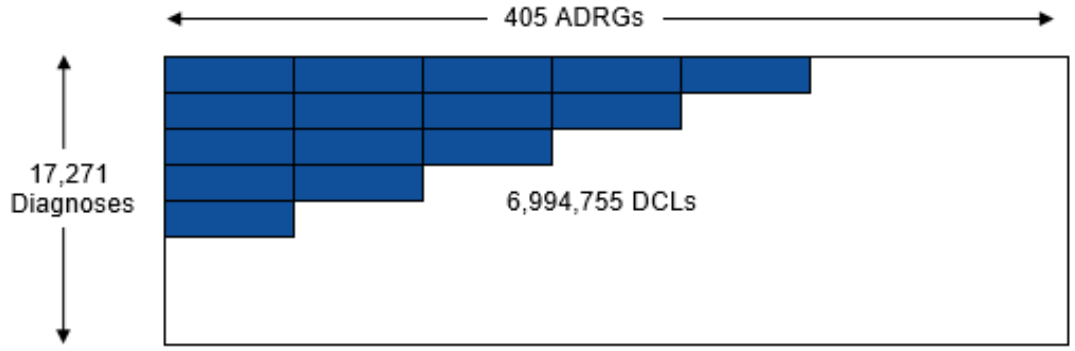
- Approximately 48% of ADRGs have adopted a change parameter between 1.1 and 1.3. That is, the estimated cost increase accompanying a single additional diagnosis is between 10% and 30%.
- Approximately 29% of ADRGs have adopted a decay factor of 1. That is, there was no evidence of diminishing return for each additional diagnosis code.

The predicted cost for each episode based on the geometric mean cost model is compared to the actual cost to derive DCLs.

4.4 DCL

The next stage within the complexity model is the estimation of DCLs. These represent the relative costs associated with each diagnosis code in the context of a specific ADRG. DCLs are calculated for every combination of diagnosis and ADRG, giving approximately 7 million different combinations (405 ADRGs multiplied by 17,271 valid ICD-10-AM/ACHI Thirteenth Edition diagnosis codes) with values between zero and five. **Figure 3** illustrates the DCL matrix formed by these combinations.

Figure 3: A depiction of the DCL matrix



4.4.1 Aggregation principles

The level of precision of the DCLs needs to be balanced against the requirement that they demonstrate stability over time. To achieve this, code assignment data is aggregated based on common clinical characteristics. One tool used for this purpose is the grouping of ICD-10-AM codes into Coherent Diagnosis Classes (CDCs).

There is a unique CDC for each medical ADRG, apart from medical ADRGs defined using administrative variables. The principal diagnosis codes that inform the grouping of episodes to a particular medical ADRG are contained in the CDC identified with that medical ADRG. In-scope diagnosis codes that are unacceptable principal diagnosis codes do not have a medical ADRG and are assigned to a clinically appropriate CDC.

Each DCL is based on a sample of at least 100 code assignments. At first, the DCL calculation is restricted to diagnosis code assignments sharing the following properties.

- Codes appear on episodes in the same ADRG.
- Codes belong to the same CDC.
- Codes share the same initial characters. For most diagnosis codes, this means the same initial 3 characters. For codes listed in **Appendix C: DCLs with 4 character Precision**, the initial 4 characters are used.

Using this logic, two diagnosis codes appearing on the same episode are counted once each if they share the same initial characters and CDC.

If there are fewer than 100 code assignments based on this initial restriction an iterative aggregation process is applied as depicted in **Table 8**.

For example, if a sample of 100 code assignments is not attained by considering codes sharing the same initial 3 characters category and CDC, among episodes in the same ADRG, then the next level of aggregation is stage 3 in **Table 8**. At stage 3, the DCL calculation still only considers codes in the same CDC and episodes in the same ADRG. However, instead of using only codes with the same initial 3 characters, the calculation is made based on any codes in the same code sub-block.

Table 8: The DCL aggregation hierarchy

Precision level	ADRG	MDC by partition	MDC	All ADRGs
4 character category within CDC*	1			
3 character category within CDC	2	7		
Code sub-block within CDC	3	8		
Code block within CDC	4	9		
Code chapter within CDC	5	10	12	14
CDC	6	11	13	15

* This category only applies to the ICD-10-AM codes listed in **Appendix C: DCLs with 4 character Precision**.

The process continues until a sample of 100 code assignments has been reached. At the 15th level of precision a DCL is calculated by considering codes in the same CDC appearing on an episode in any ADRG. There is no need to proceed any further as all CDCs contain codes that appear at least 100 times.

When calculating from the seventh level to the thirteenth level of precision in **Table 8**, ADRG 801 *General Intervention unrelated to principal diagnosis* is treated as belonging to a unique MDC, rather than the episode's assigned MDC. This special treatment is required because, unlike other ADRGs, this ADRG is not contained in a unique MDC.

4.4.2 DCL derivation process

Table 9 outlines the steps to derive the DCL for diagnosis x in ADRG A, denoted (x, A). The aggregation process described in **Table 8** is contained in step 4 and described explicitly in **Appendix B: Aggregation Calculations**.

Table 9: DCL derivation steps

Step	Notation and description
Step 1	$E(n, A)$ Identify the cohort of episode, diagnosis code combinations at the n^{th} precision level based on the aggregation principles shown in **Table 8**. Denote these episodes $\{e_1, \ldots, e_{E(n,A)}\}$. Let the episode e_k have d_k in-scope additional diagnosis codes and denote its cost by cost_k.

Step	Notation and description
Step 2	$p(d_k - 1, A) = a \times b^{\frac{1-r^{d_k}}{1-r}}$ Let a, b and r be the base cost, change parameter and decay factor for ADRG *A*, as calculated using the geometric mean cost model in Section 4.3. Create a cost prediction for each episode based on the geometric mean cost model (Section 4.3) for the cohort of episodes identified in step 1. This is determined by the ADRG A and the number of in-scope additional diagnosis codes d_k on the episode e_k. The cost prediction $p(d_k - 1, A)$ used in DCL calculation is for an episode in ADRG A and having a number of in-scope additional diagnosis codes one fewer than d_k.
Step 3	$\ln(\text{cost}_k) - \ln(p(d_k - 1, A))$ Calculate the difference between the log-transformed cost of each episode and the log-transformed cost prediction of an episode in the same ADRG but having one fewer in-scope additional diagnosis codes. This is an estimate of the cost impact of the diagnosis code x.
Step 4	$DCL_{\text{raw}}(x, A)$ The raw DCL value is denoted $DCL_{\text{raw}}(x, A)$. It is an estimate of the impact of the log-transformed cost of the diagnosis code x on an episode in ADRG A, using the weighted average of the values calculated in Step 3. The process for deriving $DCL_{\text{raw}}(x, A)$ follows the aggregation principles described in **Table 8** to ensure that the DCL is based on a robust sample. The process is described explicitly in **Appendix B: Aggregation Calculations**.
Step 5	$DCL_{\text{st}}(x, A)$ The value $DCL_{\text{raw}}(x, A)$ calculated in Step 4 is multiplied by a standardisation factor, unique to each ADRG. The standardisation factor is calculated explicitly in **Appendix B: Aggregation Calculations**.
Step 6	$DCL(x, A)$ Denote $DCL_{\text{st,prev}}(x, A)$ as the pre-stabilisation DCL for the pair (x, A) obtained in AR-DRG V11.0 development.[4] If $\left\lvert DCL_{\text{st}}(x, A) - DCL_{\text{st,prev}}(x, A) \right\rvert \geq 0.2$ then $DCL_{\text{st}}(x, A)$ is used in AR-DRG V12.0. Otherwise, $DCL_{\text{st,prev}}(x, A)$ is used in AR-DRG V12.0. The outcome of this process is rounded to the nearest integer and denoted $DCL(x, A)$.

Table 10 presents the DCL profile at each level of the aggregation process in AR-DRG V12.0 development.

[4] The final DCLs used in AR-DRG V11.0 were also subject to stabilisation. Therefore, to ensure the ECC Model is sensitive to genuine change in cost profiles, the AR-DRG V11.0 DCLs used in step 6 are equivalent to the values $DCL_{st}(x, A)$ obtained before the AR-DRG V11.0 stabilisation process.

Table 10: DCL aggregation profile for AR-DRG V12.0

Precision Level	ADRG	MDC by Partition	MDC	All ADRGs	Total
4 character category within CDC	0.03%				**0.03%**
3 character category within CDC	4.32%	12.43%			**16.75%**
Code sub-block within CDC	2.58%	4.63%			**7.21%**
Code block within CDC	8.78%	10.93%			**19.71%**
Code chapter within CDC	10.97%	8.72%	6.32%	8.82%	**34.84%**
CDC	12.68%	7.65%	1.09%	0.04%	**21.46%**
Total	**39.36%**	**44.37%**	**7.41%**	**8.86%**	**100.00%**

Table 10 illustrates that:

- 4.35% of DCLs are based on the 3 character **or** 4 character code in the CDC within their corresponding ADRGs
- 39.36% of DCLs are calculated based on episodes in the same ADRG
- 44.37% of DCLs required aggregation up to their MDC, by partition precision level
- 16.27% of DCLs required aggregation **beyond** their MDC, by partition precision level.

4.5 ECCS decay factor

The ECCS decay factor is the final component required to calculate an episode's ECCS. It represents the decay component that adjusts for the diminished resource consumption expected of each diagnosis as the number of diagnoses in a given episode increases. However, it is a single value applied to all episodes, rather than the unique value for each ADRG which was used to calculate the geometric mean cost model in Section 4.3.

Let the episode e in ADRG A have in-scope diagnoses denoted $x_1, \ldots, x_n$ and numbered in descending order of their DCLs. That is, the order of diagnoses is chosen so that

$$DCL(x_1, A) \geq DCL(x_2, A) \geq \cdots \geq DCL(x_n, A)$$

The ECCS of episode e is defined as:

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

where $\tilde{r}$ is the ECCS decay factor

The performance of the ECCS formula was tested using decay factors ($\tilde{r}$) between 0.83 and 0.88. A decay factor of $\tilde{r} = 0.86$ was identified as the best fit using a nonlinear regression analysis. The model was fitted separately for each ADRG, ensuring that the parameters were within a reasonable range to maintain accuracy and reliability. After fitting the model, the resulting statistics were ranked and ties resolved by assigning the mean rank. The decay factor with the lowest mean rank across all ADRGs was selected as the best fit, ensuring an optimal model fit across different ADRGs. Replacing $\tilde{r}$ with 0.86 in the above formula, the ECCS of episode e becomes:

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

5 ADRG Splitting Review

5.1 Overview

An episode of care is initially assigned to an ADRG which broadly groups episodes with the same diagnosis and intervention profile. In this final stage, each ADRG is split into individual DRGs based on the ECCS. Occasionally, splitting is based on factors such as mode of separation, LOS and age. DRG principles specified in the governance framework were used to determine when a complexity split is warranted within an ADRG. These principles are expected to be met for the majority of the ADRGs. While it is optimal that all DRG principles are met, there are some exceptions where ADRGs have been split without satisfying all principles.

Table 11 outlines the DRG principles used for splitting the ADRGs for AR-DRG V12.0.

Table 11: AR-DRG V12.0 DRG principles

Principle	Description
1	A DRG must have at least 200 episodes per year, except for those within an ADRG with a limited number of episodes.
2	A DRG must have a minimum total cost of $1 million per year.
3	A DRG must have at least 10% of episodes within the ADRG.
4	The absolute change in mean cost between consecutive DRGs must be at least $3,700.
5	The relative change in mean cost between consecutive DRGs should be at least 2 times.
6	There should be an inverse trend between the number of episodes in a DRG and the complexity level of the DRG.

All ADRGs are then assessed using the ADRG splitting methodology steps as outlined in **Table 12.**

Table 12: ADRG splitting methodology steps

Step	Description
1 Threshold simulation	All possible thresholds were simulated for an ADRG assuming one split, 2 splits or 3 splits.
2 Selection of candidate simulations	A candidate simulation was selected for one, 2 and 3 splits. This is done by first considering all simulations which satisfy DRG principles 1, 2, 3, 6 and either 4 or 5 in **Table 11**. Among these, the simulations with the same number of splits and thresholds as used in AR-DRG V11.0 were considered. Denote this number of splits x. If the thresholds used in AR-DRG V11.0 were among the remaining simulations and the resulting Reduction in Deviance (RID) was within 2% of the highest RID possible among the remaining simulations, then the V11.0 thresholds were the candidate simulation for x splits. Otherwise, the candidate simulation for a given number of splits was that with the highest RID among those with that number of splits. If there was no simulation meeting all DRG principles for a specific number of splits, there was deemed to be no candidate simulation for that number of splits
3 Selection of modelled split	The **modelled split** is determined by comparing the RID of the candidate simulations identified in Step 2. If multiple simulation candidates are identified, the simulation chosen to be the modelled split must increase RID by at least 5% compared to the simulation candidate that has 1 less split. Otherwise, the simulation candidate that has 1 less split is selected. If one simulation candidate is identified in step 2, that stimulation candidate will be selected. If no simulation candidates are identified in Step 2 then the modelled split recommends no complexity splits in the relevant ADRG.
4 Selection of previous split	The candidate simulation having the same number of splits as was selected in AR-DRG V11.0 is identified. This simulation is referred to as the **previous split**. If no simulation candidate is identified then the previous split recommends no complexity splits in the relevant ADRG.
5 Final selection	The final selection for each ADRG was determined by reviewing the modelled split, previous split, and historical selections from the past 2 versions on a case-by-case basis, with the number of splits from the previous version being generally preferred. This process is manually reviewed, and the final selection is based on judgement that considers statistical performance, clinical

	coherence and satisfaction of stability principles in consultation with IHACPA's clinical and technical working groups.

The splitting of all ADRGs in AR-ADRG V12.0 is summarised in **Table 13.**

Table 13: AR-DRG V12.0 ADRG breakdown

Category	Number of ADRGs
ADRGs not comparable to those in AR-DRG V11.0	
New ADRGs	**6**
ADRGs comparable to those in AR-DRG V11.0	
ADRGs with same number of splits as AR-DRG V11.0	
Error ADRGs (960, 961 and 963)	3
ADRG 801 *General Intervention unrelated to principal diagnosis*	1
ADRGs split using administrative variables	6
ADRGs with splits retained due to marginal failure	11
ADRGs with manual splits due to failure to select a candidate threshold	18
Other ADRGs with same number of splits as AR-DRG V11.0	358
Total with same number of splits as AR-DRG V11.0	**397**
ADRGs with different number of splits to AR-DRG V11.0	
Total with different number of splits to AR-DRG V11.0	2
Total ADRGs comparable to those in AR-DRG V11.0	**399**
Total	**405**

5.2 New ADRGs

AR-DRG V12.0 has 6 new ADRGs, one intervention ADRG and 5 medical ADRGs:

Intervention ADRG

- A16 *Posthumous organ procurement*

Medical ADRG

- O67 *Diabetes mellitus and intermediate hyperglycaemia in pregnancy and the puerperium*
- O68 *Maternal medical conditions complicating pregnancy and the puerperium*
- O69 *Gestational disorders complicating pregnancy and the puerperium*

- O70 *Care and screening for other antenatal presentations*
- U69 *Mental and behavioural disorders in the postnatal period*

There are no splits from previous versions with which the splits of these ADRGs can be compared so the stability principles could not be applied. The splitting of these ADRGs was primarily based on statistical performance and clinical coherence.

5.3 ADRGs split using administrative variables

In AR-DRG V12.0, there are 6 ADRGs that use administrative variables to determine the DRGs within them. These are listed in **Table 14**, along with the splitting methodology used in each case. These administrative variables include mode of separation, LOS and age. The splitting methodology for these ADRGs was retained from AR-DRG V11.0, generally incorporating both administrative information and ECCS.

Table 14: ADRGs that are split using administrative variables

ADRG	Description	Administrative variables
B70	*Stroke and other cerebrovascular disorders*	Maintained 2 splits and the use of mode of separation and LOS to provide a third split.
B78	*Intracranial injuries*	Maintained one split and the use of mode of separation and LOS to provide an extra split.
F60	*Circulatory disorders, admitted for AMI without invasive cardiac investigative interventions*	Maintained one split solely based on the use of mode of separation and LOS.
F62	*Heart failure and shock*	Maintained one split and the use of mode of separation and LOS to provide an extra split.
L10	*Kidney transplantation*	Maintained one split based on ECCS and age.
R05	*Other haematopoietic stem cell transplantation*	Maintained one split based on ECCS and age.

5.4 ADRGs with splits retained due to marginal failure

Stability principles have been adopted to ensure there is strong evidence in the data before the number of splits are changed. If the same number of splits and thresholds used for a particular ADRG in AR-DRG V11.0 fail only one of the principles in **Table 11** by no more than 2%, then these splits are subject to a case-by-case review. In this situation, the violated principle is said to have been 'marginally failed'. The review determines whether it is appropriate to retain the AR-DRG V11.0 splits to support the stability of the classification.

Table 15 lists the 11 ADRGs in which a review was undertaken and AR-DRG V11.0 splits were retained due to marginal failure.

Table 15: ADRGs with splits retained due to marginal failure

ADRG	Description	Marginally failed principle
E76	*Respiratory tuberculosis*	Principle 6
F07	*Other cardiothoracic/vascular interventions with CPB pump*	Principle 6
F61	*Infective endocarditis*	Principle 6
G01	*Rectal resection*	Principle 6
K40	*Endoscopic and investigative interventions for metabolic disorders*	Principle 3
L04	*Kidney, ureter and major bladder interventions for non-neoplastic disorders*	Principle 3
L67	*Other kidney and urinary tract disorders*	Principle 3
P60	*Neonate without significant General Intervention or ventilatory support 96 hours or more, died or transferred to acute facility in less than 5 days*	Principle 4
P65	*Neonate, admission weight 1500-1999g without significant General Intervention or ventilatory support 96 hours or more*	Principle 6
R02	*Other neoplastic disorders with major General Intervention*	Principle 1
X04	*Other interventions for injuries to lower limb*	Principle 3

5.5 ADRGs with manual splits due to failure to select a candidate threshold

Under certain circumstances, the ADRG splitting methodology is not able to select a threshold that satisfies the principles in **Table 11** and therefore the previous split in **Table 12** has no splits and manual selection is required. In most cases, the manually selected splits for these ADRGs satisfy the majority of the DRG principles in **Table 11,** however failed to meet 1 or 2 principles. For example, principle 1 may not be met due to the presence of a low-volume, high-complexity diagnosis code within an otherwise homogeneous ADRG.

Table 16: ADRGs with manually selected splits due to the absence of a candidate threshold

ADRG	Description	Failed principles
A15	*Tracheostomy*	Principles 1 and 6
B68	*Multiple sclerosis and cerebellar ataxia*	Principle 3
C02	*Enucleations and orbital interventions*	Principle 6
F03	*Cardiac valve procedures with CPB pump with invasive cardiac investigation*	Principle 1
H07	*Open cholecystectomy*	Principle 1
I24	*Arthroscopy*	Principle 1
J08	*Other skin grafts and debridement interventions*	Principle 5
O01	*Caesarean delivery*	Principles 5 and 6
O60	*Vaginal delivery*	Principles 5 and 6
P05	*Neonate, admission weight 2000-2499g with significant General Intervention or ventilatory support 96 hours or more*	Principle 1
P62	*Neonate, admission weight 750-999g without significant General Intervention*	Principles 1 and 3
P63	*Neonate, admission weight 1000-1249g without significant General Intervention or ventilatory support 96 hours or more*	Principle 1
P66	*Neonate, admission weight 2000-2499g without significant General Intervention or ventilatory support 96 hours or more*	Principle 6
P67	*Neonate, admission weight 2500g or more without significant General Intervention or ventilatory support 96 hours or more, less than 37 completed weeks gestation*	Principle 6
P68	*Neonate, admission weight 2500g or more without significant General Intervention or ventilatory support 96 hours or more, 37 or more completed weeks gestation*	Principles 3 and 5
Q61	*Red blood cell disorders*	Principle 6
R01	*Lymphoma and leukaemia with major General Intervention*	Principle 1
R06	*Autologous haematopoietic stem cell transplantation*	Principle 1

provides the list of ADRGs with manual splits due to the absence of a candidate threshold and specifies the corresponding selection principles that were relaxed.

Table 16: ADRGs with manually selected splits due to the absence of a candidate threshold

ADRG	Description	Failed principles
A15	*Tracheostomy*	Principles 1 and 6
B68	*Multiple sclerosis and cerebellar ataxia*	Principle 3
C02	*Enucleations and orbital interventions*	Principle 6
F03	*Cardiac valve procedures with CPB pump with invasive cardiac investigation*	Principle 1
H07	*Open cholecystectomy*	Principle 1
I24	*Arthroscopy*	Principle 1
J08	*Other skin grafts and debridement interventions*	Principle 5
O01	*Caesarean delivery*	Principles 5 and 6
O60	*Vaginal delivery*	Principles 5 and 6
P05	*Neonate, admission weight 2000-2499g with significant General Intervention or ventilatory support 96 hours or more*	Principle 1
P62	*Neonate, admission weight 750-999g without significant General Intervention*	Principles 1 and 3
P63	*Neonate, admission weight 1000-1249g without significant General Intervention or ventilatory support 96 hours or more*	Principle 1
P66	*Neonate, admission weight 2000-2499g without significant General Intervention or ventilatory support 96 hours or more*	Principle 6
P67	*Neonate, admission weight 2500g or more without significant General Intervention or ventilatory support 96 hours or more, less than 37 completed weeks gestation*	Principle 6
P68	*Neonate, admission weight 2500g or more without significant General Intervention or ventilatory support 96 hours or more, 37 or more completed weeks gestation*	Principles 3 and 5
Q61	*Red blood cell disorders*	Principle 6
R01	*Lymphoma and leukaemia with major General Intervention*	Principle 1
R06	*Autologous haematopoietic stem cell transplantation*	Principle 1

5.6 ADRGs with a different number of splits to V11.0

There are 2 ADRGs in **Table 17** that have more splits in AR-DRG V12.0 than in AR-DRG V11.0. This is because AR-DRG V12.0 development increased the volume and changed the casemix of both classes which enabled the modelled split to identify an extra split in comparison to AR-DRG V11.0.

ADRG C01 *Interventions for penetrating eye injury*, was moved to the highest position in the intervention hierarchy in MDC 02 *Diseases and disorders of the eye*. Consequently, it captures a large number of high-complexity episodes involving enucleations due to penetrating eye injury in AR-DRG V12.0 which were not in this ADRG in AR-DRG V11.0.

Similarly, ADRG C61 *Neurological and vascular disorders of the eye* increased in volume due to changes to the GI list in AR-DRG V12.0. In previous versions, episodes with ACHI code 42740-03 *Administration of therapeutic agent into posterior chamber* or 42740-02 *Administration of therapeutic agent into anterior chamber* would group to an ADRG in the intervention partition. The removal of these codes from the GI list resulted in a large volume of episodes moving into ADRG C61 *Neurological and vascular disorders of the eye*. This resulted in an additional split for this ADRG in AR-DRG V12.0 as the additional volume satisfied the DRG splitting principles in **Table 11**.

Table 17: ADRGs with different number of complexity splits in AR-DRG V12.0 and AR-DRG V11.0

ADRG	Description	Number of complexity splits	
		AR-DRG V11.0	AR-DRG V12.0
C01	*Interventions for penetrating eye injury*	0	1
C61	*Neurological and vascular disorders of the eye*	1	2

Appendix A: Diagnosis Exclusions

A number of diagnosis codes were excluded from receiving a DCL in the ECC Model based on the guiding principles formalised during its initial development in AR-DRG V8.0. These guiding principles aim to characterise the scope of the ECC Model in terms of diagnoses considered relevant for DRG classification purposes. However clinical determination of exclusions for all diagnosis codes was not possible during the development of AR-DRG V8.0.

In AR-DRG V10.0, the guiding principles for diagnosis exclusion were refined and expanded. A comprehensive review of all in-scope codes informed by the new guiding principles was undertaken in consultation with the Classifications Clinical Advisory Group (CCAG) and the DRG Technical Group (DTG) in the ECC Model for V10.0, with 1,511 additional codes excluded from receiving a DCL.

In AR-DRG V11.0, the guiding principles for diagnosis exclusion were formalised in the governance framework. These principles were retained for AR-DRG V12.0 development. Codes are out-of-scope from the complexity model if they:

- represent undefined or ill-specified conditions
- represent symptoms and findings or transient conditions
- provide additional or contextual information only
- are unacceptable principal diagnosis codes
- represent asymptomatic or sub-clinical conditions (for example, latent conditions)
- represent markers of other diseases (for example, hypercholesterolaemia)
- represent minor conditions that do not generally result in admitted acute episodes of care
- represent an underlying cause of disease (for example, tobacco dependence/use).

To maintain clinical currency and robustness of the AR-DRG classification, a review of diagnosis codes that are in-scope for episode complexity is conducted for every new version of the AR-DRG classification.

For AR-DRG V12.0, IHACPA reviewed the diagnosis codes assigned in admitted acute episodes in public hospitals over the 6 year period from 2016–17 to 2021–22. This is consistent with the diagnosis exclusion review performed for AR-DRG V11.0 that was informed by data from 2013–14 to 2018–19 with the inclusion of 2019–20 only when this data became available.

All valid diagnosis codes in ICD-10-AM Twelfth Edition were eligible for review. Following statistical analysis, diagnosis codes warranting individual assessment were identified. An analysis of the changing prevalence of each diagnosis code over time resulted in a review of 17 codes to ensure they were still fit-for-purpose for inclusion in the complexity model. Each of these diagnosis codes was assessed independently against the guiding principles for diagnosis exclusion. Following this assessment and in consultation with CCAG and DTG, all 17 of these codes were retained as in-scope within the complexity model.

In AR-DRG V11.0 development, code U07.11 *Coronavirus disease 2019 [COVID-19], virus identified, asymptomatic*, was identified as a candidate for exclusion on the basis that it represents an asymptomatic condition. In October 2021, CCAG recommended that this code be retained in the complexity model for AR-DRG V11.0 but that the decision be revisited once COVID-19 treatment had normalised. Consequently, in consultation with CCAG and DTG, U07.11 *Coronavirus disease 2019 [COVID-19], virus identified, asymptomatic* is not in scope within the complexity model in AR-DRG V12.0 based on the guiding principles for exclusion.

The 122 codes created in ICD-10-AM Thirteenth Edition were assessed against the guiding principles for exclusion from the complexity model. In consultation with CCAG and DTG, 107 of the new ICD-10-AM Thirteenth Edition codes were consequently excluded from the complexity model. A list of the codes assessed and their status for receiving a DCL in AR-DRG V12.0 is presented in **Appendix A7** of the AR-DRG V12.0 Final Report.

In total, 11,057 ICD-10-AM Thirteenth Edition codes are in-scope for receiving a DCL in AR-DRG V12.0, as compared to 11,065 ICD-10-AM Twelfth Edition codes in AR-DRG V11.0.

The full list of DCL unconditional and conditional exclusion codes[5] can be found in Appendix C of the AR-DRG Version 12.0 Definitions Manual and on the IHACPA website.

[5] Unconditional exclusion codes are diagnosis codes that have been excluded from consideration in the ECC Model. Conditional exclusion codes are diagnosis codes that are excluded conditionally, depending on other diagnoses assigned in the episode.

Appendix B: Aggregation Calculations

DCL Calculation

This section demonstrates the calculation of the raw DCL value, $DCL_{\text{raw}}(x, A)$ for a diagnosis code x within ADRG A introduced in **Table 9** to demonstrate the DCL derivation process. This section is also an explicit demonstration of the aggregation principles depicted in **Table 8**. An episode is used more than once in this calculation at any precision level if it contains at least 2 distinct diagnosis codes sharing the same initial 4 characters as x and which belong to the same CDC as x.

First precision level*:*

This precision level is only used if x is listed in **Appendix C: DCLs with 4 character Precision**.

$E_1(x, A)$ is the number of code assignments containing a code with the same initial 4 characters and CDC as x appearing in an episode in ADRG A. Order these code assignments from 1 to $E_1(x, A)$. Denote the episode containing the j^{th} code assignment by $e_{1,j}$. Let the cost of $e_{1,j}$ be denoted $cost_{1,j}$ and the number of in-scope additional diagnosis codes on $e_{1,j}$ be denoted $d_{1,j}$. Define

$$DCL_1(x, A) = \frac{\sum_{j=1}^{E_1(x,A)} \left(\ln(\text{cost}_{1,j}) - \ln\left(p(d_{1,j} - 1, A)\right)\right)}{E_1(x, A)}$$

To determine whether $DCL_1(x, A)$ is used in AR-DRG V12.0, proceed to the second precision level.

Second precision level*:*

$E_2(x,A)$ is the number of code assignments containing a code with the same initial 3 characters and CDC as x appearing on an episode in ADRG A. Order these code assignments from 1 to $E_2(x,A)$. Denote the episode containing the j^{th} code assignment by $e_{2,j}$. Let the cost of $e_{2,j}$ be denoted $cost_{2,j}$ and the number of in-scope additional diagnosis codes on $e_{2,j}$ be denoted $d_{2,j}$.

a. If x is listed in **Appendix C: DCLs with 4 character Precision** then define

$$E_2'(x,A) = \min\left(100, E_2(x,A)\right)$$

$$DCL'_2(x,A) = \frac{\sum_{j=1}^{E_2(x,A)} \left(\ln\left(\text{cost}_{2,j}\right) - \ln\left(p\left(d_{2,j}-1, A\right)\right)\right)}{E_2(x,A)}$$

$$DCL_2(x,A) = \frac{E_1(x,A) \times DCL_1(x,A) + \left(E_2'(x,A) - E_1(x,A)\right) \times DCL'_2(x,A)}{E_2'(x,A)}$$

If $DCL_1(x,A) \geq DCL_2(x,A)$ then define $DCL_{\text{raw}}(x,A) = DCL_1(x,A)$. Otherwise proceed to step b.

b. Define

$$DCL_2(x,A) = \frac{\sum_{j=1}^{E_2(x,A)} \left(\ln\left(\text{cost}_{2,j}\right) - \ln\left(p\left(d_{2,j}-1, A\right)\right)\right)}{E_2(x,A)}$$

If $E_2(x,A) \geq 100$, define $DCL_{\text{raw}}(x,A) = DCL_2(x,A)$. Otherwise proceed to the third precision level.

Third precision level:

$E_3(x,A)$ is the number of code assignments of a code in the same code block and CDC as x on an episode in ADRG A. Order these code assignments from 1 to $E_3(x,A)$. Denote the episode containing the j^{th} code assignment by $e_{3,j}$. Let the cost of $e_{3,j}$ be denoted $cost_{3,j}$ and the number of in-scope additional diagnosis codes on $e_{3,j}$ be denoted $d_{3,j}$.

Define the following terms.

$$E_3'(x,A) = \min(100, E_3(x,A))$$

$$DCL'_3(x,A) = \frac{\sum_{j=1}^{E_3(x,A)} \left(\ln\left(\text{cost}_{3,j}\right) - \ln\left(p\left(d_{3,j}-1, A\right)\right)\right)}{E_3(x,A)}$$

$$DCL_3(x,A) = \frac{E_2(x,A) \times DCL_2(x,A) + \left(E_3'(x,A) - E_2(x,A)\right) \times DCL'_3(x,A)}{E_3'(x,A)}$$

a. If $E_3(x,A) \geq 100$, define $DCL_{raw}(x,A) = DCL_3(x,A)$.

b. Otherwise proceed to next precision level.

This process continues until $DCL_{raw}(x,A)$ is defined, with the n^{th} precision defined in the following manner.

n^{th} precision level:

$E_n(x, A)$ is the number of code assignments at the n^{th} precision level for the diagnosis code x and ADRG A. Order these code assignments from 1 to $E_n(x, A)$. Denote the episode containing the j^{th} code assignment by $e_{n,j}$. Let the cost of $e_{n,j}$ be denoted $cost_{n,j}$ and the number of in-scope additional diagnosis codes on $e_{n,j}$ be denoted $d_{n,j}$.

Define the following terms.

$$E'_n(x, A) = \min(100, E_n(x, A))$$

$$DCL'_n(x, A) = \frac{\sum_{j=1}^{E_n(x,A)} \left(\ln(\text{cost}_{n,j}) - \ln\left(p(d_{n,j} - 1, A)\right)\right)}{E_n(x, A)}$$

$$DCL_n(x, A) = \frac{E_{n-1}(x, A) \times DCL_{n-1}(x, A) + \left(E'_n(x, A) - E_{n-1}(x, A)\right) \times DCL'_n(x, A)}{E'_n(x, A)}$$

a. If $E_n \geq 100$, define $DCL_{\text{raw}}(x, A) = DCL_n(x, A)$.

b. Otherwise proceed to next precision level.

At the fifteenth step, all code assignments of diagnosis codes in the same CDC as x are considered, across all ADRGs. As each CDC appears in more than 100 episodes, the required sample size must be achieved at or before this step.

Standardisation factor

This section demonstrates the calculation of the standardisation factor Std_A for an ADRG A introduced in **Table 9** to demonstrate the DCL derivation process. Having obtained $DCL_{\text{raw}}(x, A)$ for a diagnosis code x in ADRG A, we can estimate the value that each diagnosis code contributes to the ECCS of an episode e in ADRG A. This is done by first ranking the diagnosis codes on the episode e in descending order of $DCL_{\text{raw}}(x, A)$. Subject to this ranking, we denote by d_j the j^{th} diagnosis code on the episode e, starting with $j = 1$. If 2 diagnosis codes have the same raw DCL, then their rank is assigned according to the order in which they appear in the APC submission as this does not impact the final calculation:

$$ECCS_{\text{Cont}}(d_j, e) = 0.86^{j-1} DCL_{\text{raw}}(d_j, A)$$

The value 0.86 is chosen because it is the ECCS decay factor used in AR-DRG V11.0. This value is recalculated for AR-DRG V12.0 in Section 4.5.

Define the multiset

$$A_{dist} = \{ECCS_{cont}(d, e) | d \text{ is an in-scope diagnosis code on an episode } e \text{ in ADRG } A\}$$

Let A_{95} denote the 95th percentile of A_{dist}. The standardisation factor for A is defined as follows.

$$Std_A = \begin{cases} 1/\ln 1.5 & \text{if } A_{95} > 5 \ln 1.5 \\ 1/\ln 1.05 & \text{if } A_{95} < 5 \ln 1.05 \\ 5/A_{95} & \text{otherwise} \end{cases}$$

Define the standardised DCL as follows.

$$DCL_{\mathrm{st}}(x, A) = Std_A \times DCL_{\mathrm{raw}}(x, A)$$

Appendix C: DCLs with 4 character Precision

This appendix lists the ICD-10-AM (diagnosis) codes used to calculate DCLs by considering groups of diagnosis codes sharing the same initial 4 characters and belonging to the same CDC. For other diagnosis codes, the most granular level at which DCLs were calculated was for diagnosis codes sharing the same initial 3 characters and belonging to the same CDC.

ICD-10-AM Thirteenth Edition code
E10.11 *Type 1 diabetes mellitus with ketoacidosis, without coma*
E10.12 *Type 1 diabetes mellitus with ketoacidosis, with coma*
E10.13 *Type 1 diabetes mellitus with lactic acidosis, without coma*
E10.14 *Type 1 diabetes mellitus with lactic acidosis, with coma*
E10.15 *Type 1 diabetes mellitus with ketoacidosis, with lactic acidosis, without coma*
E10.16 *Type 1 diabetes mellitus with ketoacidosis, with lactic acidosis, with coma*
E10.64 *Type 1 diabetes mellitus with hypoglycaemia*
E10.65 *Type 1 diabetes mellitus with poor control*
E10.69 *Type 1 diabetes mellitus with other specified complication*
E11.01 *Type 2 diabetes mellitus with hyperosmolarity without nonketotic hyperglycaemic-hyperosmolar coma [NKHHC]*
E11.02 *Type 2 diabetes mellitus with hyperosmolarity with coma*
E11.11 *Type 2 diabetes mellitus with ketoacidosis, without coma*
E11.12 *Type 2 diabetes mellitus with ketoacidosis, with coma*
E11.13 *Type 2 diabetes mellitus with lactic acidosis, without coma*
E11.14 *Type 2 diabetes mellitus with lactic acidosis, with coma*
E11.15 *Type 2 diabetes mellitus with ketoacidosis, with lactic acidosis, without coma*
E11.16 *Type 2 diabetes mellitus with ketoacidosis, with lactic acidosis, with coma*
E11.64 *Type 2 diabetes mellitus with hypoglycaemia*
E11.65 *Type 2 diabetes mellitus with poor control*
E11.69 *Type 2 diabetes mellitus with other specified complication*
E11.72 *Type 2 diabetes mellitus with features of insulin resistance*
E11.73 *Type 2 diabetes mellitus with foot ulcer due to multiple causes*
E13.64 *Other specified diabetes mellitus with hypoglycaemia*
E13.65 *Other specified diabetes mellitus with poor control*
E13.69 *Other specified diabetes mellitus with other specified complication*

Independent Health and Aged Care Pricing Authority

Eora Nation, Level 12, 1 Oxford Street
Sydney NSW 2000

Phone 02 8215 1100
Email enquiries.ihacpa@ihacpa.gov.au

www.ihacpa.gov.au