Independent Hospital Pricing Authority

Australian Refined Diagnosis Related Groups Version 11.0 Technical Specifications

February 2022

IHPA

Australian Refined Diagnosis Related Groups Version 11.0 Technical Specifications – February 2022

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Acronyms and Abbreviations

ACHI	Australian Classification of Health Interventions
ADRG	Adjacent Diagnosis Related Groups
APC NMDS	Admitted Patient Care National Minimum Dataset
CCAG	Classifications Clinical Advisory Group
CDC	Coherent Diagnosis Classes
DCL	Diagnosis Complexity Level
DRG	Diagnosis Related Groups
DTG	DRG Technical Group
ECC	Episode Clinical Complexity
ECCS	Episode Clinical Complexity Score
GIs	General Interventions
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification
IHPA	Independent Hospital Pricing Authority
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 AR-DRG classification

The Independent Hospital Pricing Authority (IHPA) 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 is underpinned by data coded using ICD-10-AM/ACHI/ACS 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, sex, separation mode, length of stay, newborn admission weight, hours of 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 to provide those services. This mechanism enables activity based funding (ABF) of admitted acute hospital services.

While the AR-DRG classification is instrumental to ABF, it is also used for many other purposes, including benchmarking, epidemiology, facilitation of payment of services in the private health sector, health service planning and performance management.

1.2 Purpose

This document details the methodology and technical specifications used in the development of AR-DRG V11.0, including:

- data preparation and modification
- adjacent DRG (ADRG) intervention hierarchy review
- derivation of the Episode Clinical Complexity Score (ECCS)
- ADRG splitting review.

1.3 Additional resources for AR-DRG V11.0

In addition to the *AR-DRG V11.0 Technical Specifications*, other resources have been developed to support the use and implementation of AR-DRG V11.0.

1.3.1 AR-DRG V11.0 Final Report

The *AR-DRG V11.0 Final Report* outlines the refinement process, analysis undertaken and the rationale for changes for V11.0. Several enhancements were also investigated for V11.0 but, after analysis and consultation with stakeholders, were not progressed.

1.3.2 AR-DRG V11.0 Definitions Manual

The *AR-DRG Definitions Manual* is a set of reference documents that details the definition logic for the DRG process performed by the grouper. The manual provides documentation of how particular episodes of care group to DRGs.

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

1.3.3 AR-DRG Descriptions File

The *AR-DRG V11.0 Descriptions* can be found on the IHPA website. This includes a full listing of long and short descriptions for Major Diagnostic Categories (MDCs), ADRGs and DRGs.

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

AR-DRG V11.0 was designed based on the ICD-10-AM/ACHI/ACS Twelfth Edition classification system to classify diseases and interventions for admitted patient care.

2 Data Preparation

2.1 Overview

The complexity model for AR-DRG V11.0 was developed using the public hospital Admitted Patient Care National Minimum Dataset (APC NMDS) and the National Hospital Cost Data Collection (NHCDC) from 2015–16 to 2018–19.

Diagnosis and intervention codes were mapped to the same edition to allow data to be compared across multiple years. Data was compared using the Eleventh Edition of ICD-10-AM and ACHI.

Cost data from 2015–16 to 2017–18 was inflated to be comparable to 2018–19 utilising the National Efficient Price (NEP) inflation rate from NEP 2018–19 of 1.6% to NEP 2020–21 of 2.1%[1].

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 a certain quality were included in the modelling dataset.

Various episode trimming measures were undertaken to assess the activity and cost information. **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 1,588,859 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[2] 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 V10.0
- episodes with invalid costs.

(c) A total of 127,567 'work in progress' episodes were trimmed and represent episodes with admission dates earlier than the start of the corresponding financial year.

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[1] The inflation rates of NEP 2018–19 (1.6%), NEP 2019–20 (1.8%) and NEP 2020–21(2.1%) were applied to cost data for 2015–16, 2016–17 and 2017–18 respectively to inflate all cost data to 2018–19 level. For example, the 2015–16 cost data was inflated to 2018–19 level using the following formula: $Inflated\ cost = Original\ cost \times (1 + 1.6\%) \times (1 + 1.8\%) \times (1 + 2.1\%)$.

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

(d) The sample was further reduced by 4,052 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. A total of 25,389 episodes were removed at this stage.

(f) The sample was further reduced by 27,859 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 V10.0, 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 per cent (or a decrease in cost over 75 per cent) from the previous observation. In total, 265 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 V10.0 and analysing the resulting cost ratios. Following this, another 1,269 individual episodes with extremely high or low cost ratios were removed.

(i) The resulting sample of 23,319,686 episodes was identified for use in AR-DRG V11.0 development.

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

Episode trimming stage	2015–16	2016–17	2017–18	2018–19	Total
(a) Initial episode-level cost sample of admitted acute records	5,882,349	6,202,798	6,409,880	6,599,919	**25,094,946**
LESS Total trimmed episodes	-476,257	-421,242	-440,401	-437,360	**-1,775,260**
(b) Records with invalid or contradictory information	-428,762	-374,566	-394,592	-390,939	**-1,588,859**
(c) Records that are 'Work in Progress'	-32,843	-34,290	-30,105	-30,329	**-127,567**
(d) Records from hospitals with fewer than 100 costed episodes	-973	-1,220	-884	-975	**-4,052**
(e) Records with hospital-DRG extreme costs	-3,772	-4,150	-8,699	-8,768	**-25,389**
(f) Records with costs lower than $23	-9,536	-6,742	-5,668	-5,913	**-27,859**
(g) Records with extreme outlier costs	-65	-73	-61	-66	**-265**
(h) Extremely high or low cost ratios removed after deriving the preliminary regression model	-306	-201	-392	-370	**-1,269**
(i) Resulting sample size of episodes	5,406,092	5,781,556	5,969,479	6,162,559	**23,319,686**

3 ADRG Intervention Hierarchy Review

3.1 Overview

ADRGs are listed in a specific hierarchical order within an MDC; generally, each MDC consists of an intervention partition and a medical partition. The hierarchy of the intervention partition is important as episodes have the potential to meet multiple intervention ADRG principles. The intervention hierarchy ensures that episodes are assigned in an order based on the intervention hierarchy principles.

The intervention hierarchy principles used to assess and inform changes to the intervention hierarchy for AR-DRG V11.0 are outlined in **Table 2**.

Table 2: Intervention hierarchy principles

Principle	Description
1 Cost	Intervention ADRGs must be sorted from high to low cost with decisions 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 Interventions (GIs) Unrelated to Principal Diagnosis*. This principle may override the cost principle.
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 principle may override the cost principle.
4 Treatment type	Intervention ADRGs must be sorted from treatment to diagnostic interventions. This principle may override the cost principle.

The intervention hierarchy principles apply only to the intervention partition of MDCs. The majority of the medical partition criteria are based on principal diagnosis, so the medical ADRGs are mutually exclusive and will only meet the criteria for one medical ADRG. Therefore, review of the medical partition hierarchy is not required.

3.2 Methodology

The process undertaken to perform the ADRG intervention hierarchy review is outlined in **Table 3**.

Table 3: ADRG intervention hierarchy methodology

Stages	Description
1 Initial intervention ADRG groupings	This stage involves grouping the intervention partition ADRGs in small coherent groups and ordering them according to principles of specificity, intervention and treatment type. For example, grouping more specific ADRGs ahead of less specific ADRGs.
2 Cost simulation	Episodes have the potential to meet multiple intervention ADRG criteria. To ensure optimal ordering of ADRGs by their cost profile, all possible ADRG outcomes and ordering are simulated within the initial groupings created in stage one.
3 ADRG ordering within initial groups	The ADRG with the highest mean cost within an initial group is selected as the first ADRG in the hierarchy within that initial group. 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 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 version of AR-DRGs to determine if the change is justified. For AR-DRG V11.0, the changes were assessed against V10.0. For example, if the proposed changes suggested that two ADRGs should change sequence due to the differential in mean cost, the following stability measures must both be met to ensure the change is significant: • both the mean and median cost suggest that the change in position is warranted and • the cost differential for both mean and median cost is significant (larger than $1,000). Otherwise, the same ordering should be maintained in accordance with the previous version.

The above methodology was an iterative process and was repeated until all proposed changes relative to AR-DRG V10.0 were understood and justified.

3.3 Results

The ADRG intervention hierarchy review for AR-DRG V11.0 resulted in no change to the current intervention hierarchy. For the three new ADRGs in AD-DRG V11.0, the positions in the intervention hierarchy are outlined in **Table 4**.

Table 4: Positions of new ADRGs in intervention hierarchy of AR-DRG V11.0

MDC	ADRG	Position in intervention hierarchy
01 *Diseases and Disorders of the Nervous System*	B08 *Endovascular Clot Retrieval*	2
05 *Diseases and Disorders of the Circulatory System*	F25 *Percutaneous Heart Valve Replacement with Bioprosthesis*	13
06 *Diseases and Disorders of the Digestive System*	G13 *Peritonectomy for Gastrointestinal Disorders*	1

4 Episode Clinical Complexity

4.1 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 DRGs based on 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.

It should be noted that DCLs measure relative resource utilisation within an ADRG. Therefore, a DCL of zero indicates that the diagnosis is not associated with higher resource utilisation relative to the average level of the ADRG and does not mean that the diagnosis is associated with nil resource use. Approximately 11,000 diagnosis codes have a DCL with a non-zero value in AR-DRG V11.0, i.e., they contribute to the complexity of an episode of care.

The components used in the ECCS are detailed in **Table 5**.

Table 5: 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 6.8 million different combinations (400 ADRGs by 17,015 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 in relation to their individual contribution.

4.2 Diagnosis exclusions

A number of diagnosis codes are excluded from consideration in the AR-DRG V11.0 ECC Model based on guiding principles for diagnosis exclusions from the complexity model as specified in the *Governance Framework for the Development of the Admitted Care Classifications*[3].

These guiding principles characterise the scope of the ECC Model in terms of diagnoses considered relevant for classification purposes. Diagnosis codes identified as not being in-scope are called exclusions. Exclusions may be considered unconditional (i.e., diagnosis codes are always excluded) and others are excluded conditionally (i.e., some diagnosis codes are excluded in circumstances where another diagnosis code is present in the same episode of care).

Excluded diagnosis codes are removed from the data prior to the development of the ECC Model. More information with regards to the guiding principles and diagnosis exclusions in AR-DRG V11.0 are 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 count and assumes diminishing returns for multiple diagnoses through a decay factor. Each ADRG geometric mean cost model is defined as:

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

Where:

$$\begin{aligned} a &= base\ Cost \\ b &= change\ parameter \\ r &= decay\ factor \\ i &= number\ of\ diagnosis\ codes \\ A &= ADRG \end{aligned}$$

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 diagnosis codes.

Table 6 provides a breakdown of the calculations for ADRG B78 *Intracranial Injuries*, which has assumed the base cost (a) of $984, a change parameter (b) of 1.49 and a decay factor (r) of 90 per cent.

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[3] *Governance framework for the development of the admitted care classifications*
https://www.ihpa.gov.au/publications/governance-framework-development-admitted-care-classifications

Table 6: Illustrative example for the geometric mean cost model

Number of diagnosis codes	Equation	Interpretation
1	$C_1 = a \times b = \$984 \times 1.49 = \$1,466$	ADRG B78 episodes with one diagnosis code (principal diagnosis) will have an estimated cost of $1,466
2	$C_2 = a \times b \times b^r$ $= \$984 \times 1.49 \times 1.49^{0.9}$ $= \$1,466 \times 1.43 = \$2,096$	ADRG B78 episodes with two diagnosis codes are estimated to be 43 per cent more expensive than episodes with only a principal diagnosis.
3	$C_3 = a \times b \times b^r \times b^{r^2}$ $= \$984 \times 1.49 \times 1.49^{0.9} \times 1.49^{0.9^2}$ $= \$1,466 \times 1.43 \times 1.38 = \$2,892$	ADRG B78 episodes with three diagnosis codes are estimated to be 38 per cent more expensive relative to episodes with two diagnosis codes.

The above table illustrates the diminishing returns for each additional diagnosis code assigned to an episode. Episodes with only one diagnosis code (i.e., a principal diagnosis code only) are estimated to be $1,466, whilst increasing the diagnosis code count to two will increase the cost by 43 per cent, increasing to three by 38 per cent and so on. **Figure 1** provides the actual versus expected cost by number of diagnosis codes for ADRG B78 episodes over the period 2015-16 to 2018-19.

Figure 1 ADRG B78 *Intracranial Injuries* actual versus predicted

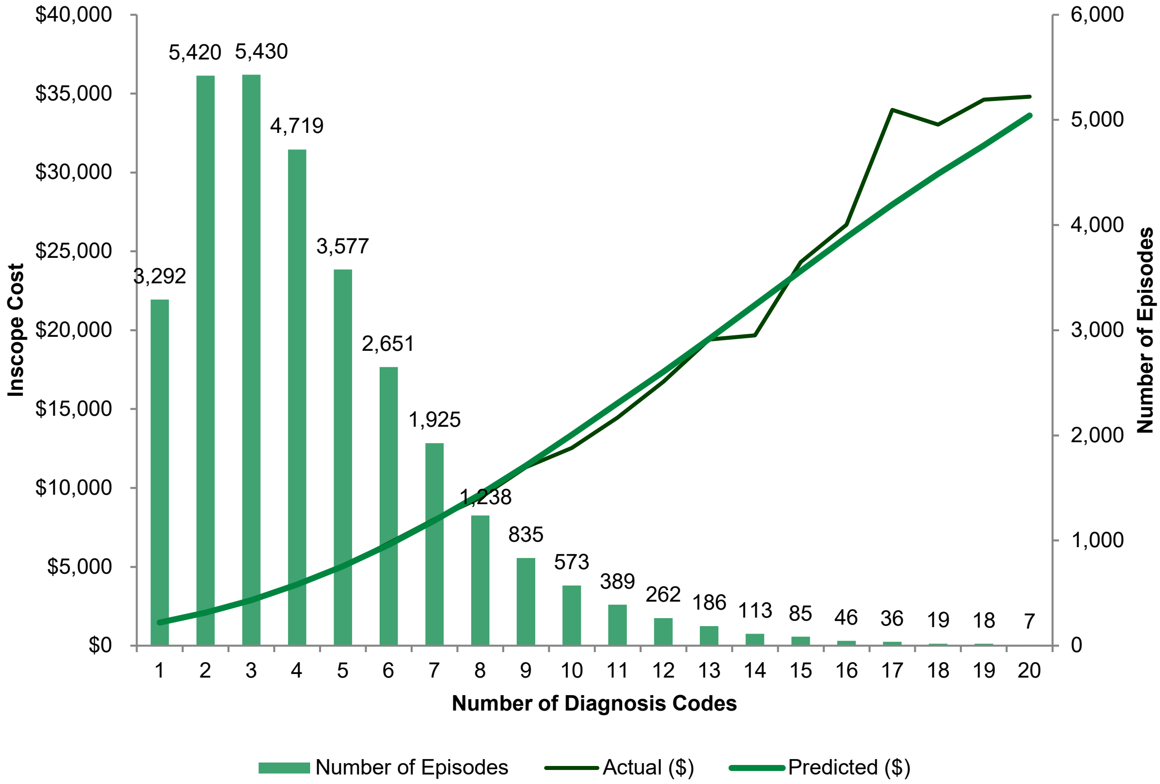
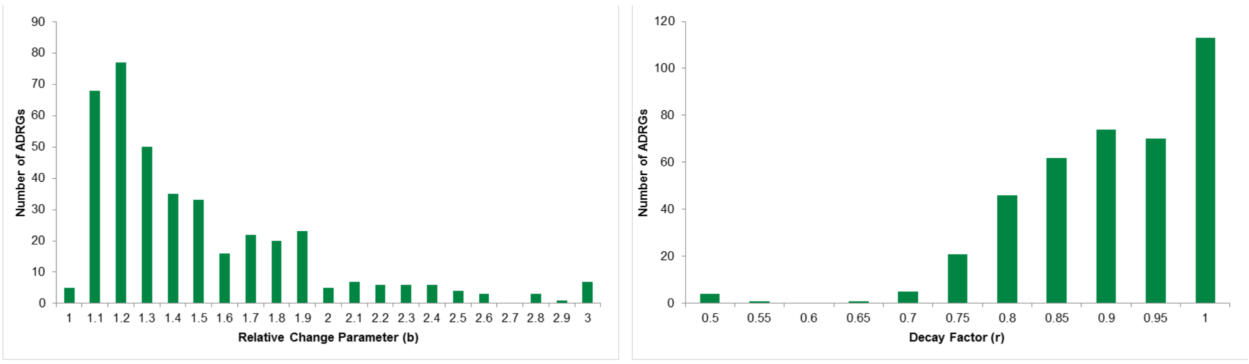


Figure 2 provides the distribution of the change parameters and decay factors adopted from the geometric mean cost model.

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:

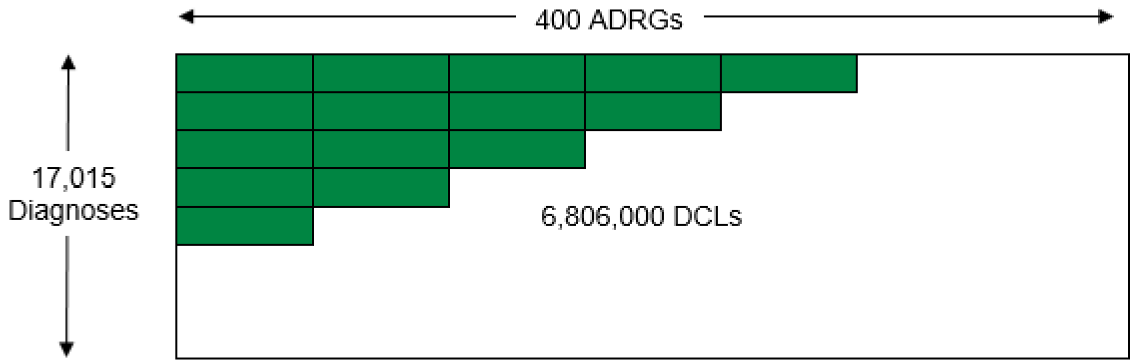
- approximately 49 per cent of the ADRGs have adopted a change parameter between 1.1 and 1.3; that is, the cost increases from approximately 10 to 30 per cent with each additional diagnosis code
- approximately 28 per cent of the ADRGs have adopted a decay factor of one. That is, there was no evidence of diminishing return for each additional diagnosis code.

This model provides a prediction of the episode cost based on the ADRG, number of diagnosis codes and the diminishing return for each additional diagnosis code. The predicted cost for each episode based on the geometric model is then compared to the actual cost to derive the relative DCL weights.

4.4 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 6.8 million different combinations (400 ADRGs multiplied by 17,015 valid diagnosis codes) 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. To achieve this, the in-scope diagnosis codes are combined into coherent diagnosis classes (CDCs) that are based on the medical ADRGs. In-scope diagnosis codes that are unacceptable principal diagnosis codes, that do not have a medical ADRG, are assigned to a clinically appropriate CDC.

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 until the sample size threshold is reached. **Table 7** illustrates the further aggregation principles applied.

Table 7: Aggregation hierarchy for DCL calculations

Precision Level	ADRG	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 8 shows the DCL aggregation profile for AR-DRG V11.0.

Table 8: DCL aggregation profile for AR-DRG V11.0

Precision Level	ADRG	MDC by Partition	MDC	All ADRGs	Total
Three Character category within CDC	4.17%	12.07%			**16.24%**
Code Block within CDC	8.32%	13.40%			**21.72%**
Code Section within CDC	4.49%	4.11%			**8.60%**
Code Chapter within CDC	8.72%	7.60%	6.34%	8.60%	**31.26%**
CDC	12.83%	8.29%	1.01%	0.06%	**22.18%**
Total	**38.53%**	**45.47%**	**7.35%**	**8.65%**	**100.00%**

Table 8 illustrates that:

- 4.17 per cent of derived DCLs are based on the three-character code in the CDC within the corresponding ADRG
- 38.53 per cent of derived DCLs are contained within the ADRG
- 45.47 per cent of DCLs required aggregation up to the MDC by partition precision level
- 16 per cent 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 9 outlines the steps to derive the DCL for diagnosis 'x' in ADRG 'A' (i.e.,(x, A)).

Table 9: 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 4.3) 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	$\bar{C}(x, A) = \frac{\sum_{j=1}^{n(x,A)} (\ln(cost_j) - \ln(p_j(x, A)))}{n(x, A)}$

Step	Notation and Description
	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	$D\dot{C}L(x, A)$ 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	$D\ddot{C}L(x, A)$ The standardised DCLs are stabilised to the previous AR-DRG version to avoid reacting to small shifts in results. That is, $D\dot{C}L(x, A)$ 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.

4.5 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 in relation to their individual contribution. The ECCS of an episode *e* in an ADRG *A* with diagnosis listed in descending order of their DCL values as $x_1, \dots, x_n$ (i.e. $D\ddot{C}L(x_1, A) \geq D\ddot{C}L(x_2, A) \geq \cdots \geq D\ddot{C}L(x_n, A)$) is defined as:

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

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:

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

5 ADRG Splitting Review

5.1 Overview

An episode of care is initially assigned to an ADRG which broadly 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 separation mode, LOS and age. DRG principles specified in the *Governance Framework for the Development of the Admitted Care Classifications* are 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 10 outlines the DRG principles used for splitting the ADRGs for AR-DRG V11.0.

Table 10: AR-DRG V11.0 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 per cent 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 as outlined in **Table 11**.

Table 11: ADRG splitting methodology

Step	Description
1 Threshold simulation	All possible thresholds were simulated for an ADRG assuming no split, one split, two splits or three splits.
2 Selection of optimum simulation	An optimum simulation was selected for each number of splits. The optimum simulation is defined as meeting all DRG principles as outlined in Table 10 (except for criterion four and five where it may meet either) and has the highest reduction in deviance (RID). If there is no simulation meeting all DRG principles for a specific number of splits, there will be no optimum simulation for that number of splits.
3 Selection of modelled split	The preferred simulation was determined by the subsequent increases in RID of the optimum simulations. The minimum increase in RID must be greater than 5 per cent to warrant an additional split. This is referred to as the **modelled split**.
4 Selection of previous split	The optimum simulation which is equivalent to the same number of splits as AR-DRG V10.0 was also assessed and is referred to as the **previous split**.
5 Final selection	The final selection for each ADRG, was then determined on a case by case basis considering statistical performance, clinical coherence and stability principles.

The case by case assessment of the ADRGs is subdivided into the ADRG categories as outlined in **Table 12**.

Table 12: AR-DRG V11.0 ADRG breakdown

Categories	Number of ADRGs
New ADRGs	3
Comparable ADRGs	
ADRGs with same number of splits as V10.0	396
Error ADRGs (960, 961 and 963)	3
ADRGs with GIs unrelated to principal diagnosis (801)	1
ADRGs using administrative variables	6
ADRGs with manual splits to support stability	8
ADRGs with manual splits due to failure to select an optimum threshold	17
Other ADRGs with same number of splits as V10.0	361
ADRG with different number of splits to V10.0	1
Total	400

5.2 New ADRGs

AR-DRG V11.0 has three new ADRGs:

- B08 *Endovascular Clot Retrieval*
- F25 *Percutaneous Hear Valve Replacement with Bioprosthesis*
- G13 *Peritonectomy for Gastrointestinal Disorders*.

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.

5.3 ADRGs using administrative variables

In AR-DRG V11.0, there are six ADRGs that use administrative variables to determine their end classes (DRGs) as listed in **Table 13**. These administrative variables include separation mode, LOS and age. The splitting methodology was modified for these ADRGs, as the incorporation of administrative variables has been maintained.

Table 13: ADRGs using administrative variables

ADRG	Description	Administrative variables
B70	*Stroke and Other Cerebrovascular Disorders*	Maintained two splits and the use of separation mode and LOS to provide an extra split.
B78	*Intracranial Injuries*	Maintained one split and the use of separation mode and LOS to provide an extra split.
F60	*Circulatory Disorders, Admitted for AMI without Invasive Cardiac Investigative Intervention*	Maintained one split solely based on the use of separation mode and LOS.
F62	*Heart Failure and Shock*	Maintained one split and the use of separation mode 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 manual splits to support stability

Stability principles have been adopted to ensure there is strong evidence in the data before the number of splits or splitting points are changed. If a V10.0 split only marginally fails to meet one of the DRG principles in **Table 10** and still has relatively good statistical performance, it is recommended that the V10.0 split be retained for stability.

Table 14 outlines the eight ADRGs with manual splits to support stability.

Table 14: ADRGs with manual splits to support stability

ADRG	Description	Marginally failed principle
A14	*Ventilation >= 96 Hours and < 336 Hours*	Principle 6
B83	*Acute Paraplegia and Quadriplegia and Spinal Cord Conditions*	Principle 6
C15	*Glaucoma and Complex Cataract Interventions*	Principle 3
E63	*Sleep Apnoea*	Principle 3
G47	*Gastroscopy*	Principle 5
I75	*Injuries to Shoulder, Arm, Elbow, Knee, Leg and Ankle*	Principle 6

ADRG	Description	Marginally failed principle
L09	*Other Interventions for Kidney and Urinary Tract Disorders*	Principle 3
Y02	*Skin Grafts for Other Burns*	Principle 3

5.5 ADRGs with manual splits due to failure to select an optimum threshold

There were a small number of ADRGs where the selection principles outlined in **Table 10** were not appropriate, and the splitting methodology was not able to select an optimum threshold. In most cases, these ADRGs satisfy the majority of the DRG principles outlined in **Table 10**, however failed to meet one or two principles. These ADRGs require manual splits for the following reasons:

- the threshold in principle 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*)
- principles four or five were not required to be met for ADRGs with high sample size but low cost variation (e.g., O60 *Vaginal Delivery*);
- principle six was not required to be met for ADRGs with differing complexity profiles (e.g., A15 *Tracheostomy*).

Table 15 provides the list of 17 ADRG with manual splits due to failure to select an optimum threshold and specifies the corresponding selection principles that were relaxed.

Table 15: ADRGs with manual splits due to failure to select an optimum threshold

ADRG	Description	Failed principle(s)
A15	*Tracheostomy*	Principles 1 and 6
F03	*Cardiac Valve Procedures with CPB Pump with Invasive Cardiac Investigation*	Principle 1
F11	*Amputation, Excluding Upper Limb and Toe, for Circulatory Disorders*	Principle 1
J08	*Other Skin Grafts and Debridement Procedures*	Principle 4 or 5
O01	*Caesarean Delivery*	Principles 4 or 5 and Principle 6
O60	*Vaginal Delivery*	Principles 4 or 5 and Principle 6
P04	*Neonate, Admission Weight 1500-1999g with Significant GI or Ventilation >= 96 Hours*	Principle 1

ADRG	Description	Failed principle(s)
P05	*Neonate, Admission Weight 2000-2499g with Significant GI or Ventilation >= 96 Hours*	Principle 1
P60	*Neonate without Significant GI or Ventilation >= 96 Hours, Died or Transferred to Acute Facility <5 Days*	Principle 4 or 5
P62	*Neonate, Admission Weight 750-999g without Significant GI*	Principle 1
P63	*Neonate, Admission Weight 1000-1249g without Significant GI or Ventilation >= 96 Hours*	Principle 1
P65	*Neonate, Admission Weight 1500-1999g without Significant GI or Ventilation >= 96 Hours*	Principle 6
P66	*Neonate, Admission Weight 2000-2499g without Significant GI or Ventilation >= 96 Hours*	Principle 6
P67	*Neonate, Admission Weight >= 2500g without Significant GI or Ventilation >= 96 Hours, < 37 Complete Weeks Gestation*	Principles 4 or 5 and Principle 6
P68	*Neonate, Admission Weight >= 2500g without Significant GI or Ventilation >= 96 Hours, >= 37 Complete Weeks Gestation*	Principle 4 or 5
Q61	*Red Blood Cell Disorders*	Principle 6
R62	*Other Neoplastic Disorders*	Principle 4 or 5

5.6 ADRGs with same number of splits as V10.0

The majority of ADRGs have the same number of splits relative to V10.0 allowing episode complexity shifts within these ADRGs to be assessed. While every ADRG was assessed individually, those ADRGs with a large number of episodes shifting were subject to greater scrutiny to justify various movements in complexity, including:

- improvement in statistical performance, assessed using RID
- modifications to the underlying DCL weights
- enforcement of specific selection principles.

5.7 ADRGs with different number of splits to V10.0

ADRGs with different number of splits to V10.0 are those where the modelled split was a better option based on the most recent data. 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 V10.0, several additional factors were taken into consideration, including:

- the number of splits adopted in V9.0 and V10.0
- the change in RID to warrant removal or addition of a split
- the distribution of ECCS over the 2015–16 to 2018–19 activity data.

As outlined in **Table 12**, one ADRG M04 *Testes Interventions* has changed from having no split in V10.0 to having one split in V11.0.

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 aimed 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, IHPA refined and expanded the guiding principles for diagnosis exclusion. 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 for the Development of the Admitted Care Classifications.* Codes are out-of-scope within the complexity model and excluded if they:

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

To maintain clinical currency and robustness of the AR-DRG classification system, a review of diagnosis codes in-scope for contributing to episode complexity is conducted for each version of the AR-DRG classification. With a move to embedding a standard review process in AR-DRG V11.0, IHPA has developed a method to analyse the assignment of diagnosis codes over time to identify codes with unexpected increase in recent years for assessment against the guiding principles for diagnosis exclusion.

All valid diagnosis codes in ICD-10-AM Eleventh Edition were reviewed. This method identified 50 diagnosis codes warranting further assessment. Each of these diagnosis codes was assessed independently against the guiding principles for diagnosis exclusions in the AR-DRG complexity model. These principles are specified in the *Governance framework for the development of the admitted care classifications*.

The codes being proposed for exclusion following the assessment were supported by CCAG. Following feedback from DTG and public consultation, further analysis was conducted to assess the clinical and cost profile of the proposed diagnosis exclusions, as well as the potential impact of excluding those codes from complexity calculation.

Further consultation was conducted with CCAG and the Australian and New Zealand Neonatal Network specifically in relation to two proposed diagnosis exclusions. To ensure that the proposed diagnosis exclusions do not have a detrimental impact on the complexity model, analysis was also performed to compare the statistical performance of ADRGs containing episodes with the proposed diagnosis exclusions in AR-DRG V10.0 and V11.0.

Based on the combination of impact analysis and clinical advice, 47 ICD-10-AM codes were further excluded from the complexity model in AR-DRG V11.0. The majority of the new ICD-10-AM code exclusions were the expanded Twelfth Edition code set for antimicrobial resistance (42 of the 47).

Further, the following ICD-10-AM Twelfth Edition emergency use codes for coronavirus disease 2019 (COVID-19) were included in the complexity model in AR-DRG V11.0:

- U07.11 *Coronavirus disease 2019 [COVID-19], virus identified, asymptomatic*
- U07.12 *Coronavirus disease 2019 [COVID-19], virus identified, symptomatic*
- U07.2 *Coronavirus disease 2019 [COVID-19], virus not identified*
- U07.5 *Multisystem inflammatory syndrome associated with COVID-19.*

In total, 11,065 codes are in-scope for receiving a DCL in AR-DRG V11.0, as compared to 11,038 codes in AR-DRG V10.0.

The full list of Diagnosis Complexity Level unconditional and conditional exclusion codes can be found in the *AR-DRG V11.0 Definitions Manual* Appendix C.

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 $\bar{C}(x, A) = 0$.

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