

How RUG-III (44 Group) Case Mix Index Values Are Calculated, 2011—CCRS Technical Document



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To help improve Canada's health system and the well-being of Canadians by being a leading source of unbiased, credible and comparable information that will enable health leaders to make better-informed decisions.

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Background

Each year, the Canadian Institute for Health Information (CIHI) updates and publishes Resource Utilization Group III (RUG-III) (44-group) case mix index (CMI) values. The methodology used for the yearly derivation was published in 1999,¹ and a more detailed description of the calculations was included in a 2004 CIHI Case Mix bulletin.²

This document includes a description of the derivation methodology and the detailed calculations from the production of 2011–2012 RUG-III (44-group) CMI values.

RUG-III (44-Group) Grouping Methodology, CMI Values and RWPD Reports

Across Canada, facilities that provide continuing care services collect administrative and clinical data during a resident's period of care and report that information to the Continuing Care Reporting System (CCRS) at CIHI. Each CCRS assessment is assigned to one of the 44 RUG groups using the RUG-III version 5.11b methodology. The RUG-III grouping methodology categorizes assessments into groups that have similar clinical characteristics and levels of resource use.

A fiscal year–specific CMI value is produced for each of the 44 RUG groups. The CMI is a cost weight that reflects the relative resource use of an individual within a specific RUG group compared with a base resource level (the overall average resource use within a given population). The CMI is not a direct measure of the cost of care. More accurately, the CMI provides a means of accounting for differences in the ways that resources are used by groups of residents with distinct therapeutic needs.

Currently, an index-maximizing approach based on resource ranking is used to assign a RUG-III group to assessment data submitted to the CCRS. To apply this approach, each of the 44 groups is reviewed to determine which groups qualify for an assessment. Based on the assessment reference date, the appropriate set of fiscal year— and group-specific CMI values is selected. Then, from the groups that qualify for an assessment, the one having the highest CMI value is assigned as the RUG-III index-maximizing group.

Clinical and administrative data from CCRS assessments is also used to produce RUG weighted patient day (RWPD) reports. For each resident, periods of care (or patient days) are created from the CCRS data each reporting period. RWPDs for those patient days associated with an assessment that has had a RUG-III group assigned can be calculated by multiplying the number of days for the assessed period of care by the fiscal year– and group-specific CMI value.

Ontario CMI Derivation Methodology

The Ontario Joint Policy and Planning Committee (JPPC) described the methodology for calculating RUG-III (44-group) CMI values in 1999.¹

In March 2003, the JPPC recommended that the CMI values be updated annually using the most recent wage and patient-day information available. A phased-in approach for updating CMI values was adopted. For CMI 2002, the relative wage rates were updated. For CMI 2003, the wage rates **and** patient day counts were updated.

Detailed documentation on the calculation of Ontario CMI values was published by CIHI in May 2004.²

Summary

This document is divided into two sections: Section 1 describes the algorithm used for deriving the RUG-III (44-group) CMI values for each fiscal year; Section 2 shows an application of the algorithm and provides details for calculating the RUG-III (44-group) CMI values produced for 2011–2012.

Section 1—Algorithm for Deriving RUG-III (44-Group) CMI Values

The **CMI** value for a group in the RUG classification system is a cost weight reflecting the relative intensity of resource use in that group compared with some base level of resource use (the overall average resource use for all 44 RUG groups combined). The CMI for a RUG group represents the relative cost of caring for the average resident within that group compared with the average resident in a given population.

The **CMI** for each group is obtained by dividing the **resource use per day** for that group by the **average resource use per day** across the population. The **CMI** is defined this way so that, if the CMI values are applied to the source data, the average resource use per day for the specified population will equal 1.0000.

The **resource use per day** for each RUG group is calculated using health care provider wage rate information and staff time measurement data for that RUG group.

- The wage rate information used for the RUG-III (44-group) CMI values is obtained from the annual Ontario Hospital Association wage rate survey.
- The staff time measurement data comes from a study completed in the United States by the U.S. Centers for Medicare & Medicaid Services.³

The **resource use** for each group is the **resource use per day** multiplied by the **patient days** for that RUG group.

The average resource use per day is calculated as the total resource use divided by the total patient days.

1.1 Resource Use per Day

The **resource use per day** for each RUG-III group (labelled "Z") is calculated by multiplying the **minutes per day** spent by health care providers from various occupations by the relative wage rate for that occupation:

Resource Use per Day_Z

$$= \sum_{Z} \left[\textit{Minutes per Day}_{\textit{Occupation Within Z}} \, \textit{x Relative Wage Rate}_{\textit{Occupation}} \, \right]$$

1.2 Average Resource Use per Day (Base Value for CMI Calculations)

To derive CMI values for a given fiscal year, a base value called the average resource use per day must first be calculated. The average resource use per day is the total resource use divided by the total patient days.

The resource use for each RUG group is the resource use per day multiplied by the **patient days** for that RUG group:

Patient Days 7

= The Number of Patient Days for Each RUG Group From the Previous Fiscal Year of Ontario CCC RWPD Reports

Resource Use 7

= Resource Use per Day z x Patient Days z

The total resource use and total patient days are calculated by summing patient days and resource use for all 44 RUG groups:

Total Resource Use

$$=\sum_{Z}$$
Resource Use_Z

Total Patient Days

$$= \sum_{Z} Patient \ Days_{Z}$$

The average resource use per day is the total resource use divided by the total patient days:

The average resource use per day is the base value for CMI calculations.

Deriving the CMI for Each RUG Group 1.3

The CMI for each RUG-III group (labelled "Z") is calculated by normalizing, or scaling, to the population's average:

$$CMI_z$$

$$= \frac{Resource\ Use\ per\ Day_z}{Average\ Resource\ Use\ per\ Day}$$

Section 2—Details for Deriving RUG-III (44-Group) CMI 2011 Values

This section shows the methodology described in Section 1 applied to the data used to derive CMI values for use in 2011–2012.

Special Note: Precision of Calculations

For the tables presented in this document, the **resource use per day**, **resource use** and **average resource use per day** are rounded to the second decimal. For the actual CMI calculations, rounding is not applied until the final CMI values are derived.

2.1 Resource Use per Day

The **resource use per day** for each RUG-III group (labelled "Z") is the **minutes per day** spent by health care providers from various occupations multiplied by the **relative wage rate** for that occupation:

$$= \sum_{Z} \left[Relative \ Wage \ Rate_{Occupation} \ x \ Minutes \ per \ Day_{Occupation \ Within \ Z} \right]$$

2.1.1 Relative Wage Rate

The **relative wage rate** for each occupation is the ratio of the wage rate for that occupation to the lowest wage rate over all occupation groups.

Table 1 (below) shows the wage rates and relative wage rates used for the RUG-III (44-group) CMI 2011 calculations.

Table 1: Relative Wage Rates for RUG-III (44-Group) CMI 2011 Calculations					
Occupation Group	OHA Wage Rate, 2009–2010	Relative Wage Rate			
Registered Nurse	\$42.44	2.0582			
Nursing Assistant	\$26.08	1.2648			
Aide	\$20.62	1.0000			
Physiotherapist (PT)	\$40.48	1.9631			
PT Aide/Assistant	\$22.21	1.0771			
Occupational Therapist (OT)	\$40.54	1.9661			
OT Aide/Assistant	\$22.21	1.0771			
Speech-Language Pathologist (SLP)	\$42.84	2.0776			
SLP Aide/Assistant	\$22.21	1.0771			

2.1.2 Minutes per Day

The **minutes per day** for each RUG-III group are taken from the United States Staff Time Measurement (STM) study.³

That study measured the number of minutes of care per day for each of following occupation groups: registered nurse, registered practical nurse, health support aide, physiotherapist (PT), PT aide or assistant, occupational therapist (OT), OT aide or assistant, speech-language pathologist (SLP) and SLP aide or assistant.

Therapy minutes are shown in Table 2 for the Special Rehabilitation RUG-III groups. For these, the STM data is categorized into five subcategories. The average minutes per day within each subcategory is used for each of the RUG groups within that category.

Table 2: Minutes per Day (Therapy) by RUG-III (44-Group)									
RUG Order	Special Rehabilitation Subcategory	RUG Group	Sample Size	PT	PT Aide	ОТ	OT Aide	SLP	SLP Aide
1		RUC		37.11	22.61	36.98	18.58	26.94	12.82
2	Ultra High	RUB	195	37.11	22.61	36.98	18.58	26.94	12.82
3		RUA		37.11	22.61	36.98	18.58	26.94	12.82
4	Very High	RVC		25.76	18.11	22.53	9.11	11.75	12.11
5		RVB	179	25.76	18.11	22.53	9.11	11.75	12.11
6		RVA		25.76	18.11	22.53	9.11	11.75	12.11
7		RHC		19.90	14.56	13.05	5.84	4.21	10.18
8	High	RHB	264	19.90	14.56	13.05	5.84	4.21	10.18
9		RHA		19.90	14.56	13.05	5.84	4.21	10.18
10		RMC		16.07	9.36	10.95	4.81	4.47	9.77
11	Medium	RMB	431	16.07	9.36	10.95	4.81	4.47	9.77
12		RMA		16.07	9.36	10.95	4.81	4.47	9.77
13	Low	RLB	64	8.53	3.83	4.17	2.73	1.61	13.38
14	LOW	RLA	04	8.53	3.83	4.17	2.73	1.61	13.38

Nursing minutes are shown in Table 3 for all 44 RUG-III groups. For the nursing minutes, a small sample size indicates that fewer than 10 observations were available within the sample for that RUG group.

Table 3: Minutes per Day (Nursing) by RUG-III (44-Group) Group								
RUG Order	RUG Group	Sample Size	Registered Nurse	Registered Practical Nurse	Health Care Aide			
1	RUC	45	112.70	53.80	180.10			
2	RUB	216	87.70	37.40	123.80			
3	RUA	82	64.50	40.40	98.40			
4	RVC	37	90.90	50.70	164.90			
5	RVB	127	94.70	41.60	136.30			
6	RVA	89	75.60	30.00	106.80			
7	RHC	82	110.60	53.50	167.00			
8	RHB	112	102.30	39.90	129.90			
9	RHA	41	89.70	27.60	102.60			
10	RMC	123	111.20	66.80	180.00			
11	RMB	217	101.20	42.40	141.80			
12	RMA	76	95.00	33.90	117.30			
13	RLB	26	79.00	48.90	191.30			
14	RLA	59	64.50	32.00	122.80			
15	SE3	73	140.70	101.50	191.30			
16	SE2	246	110.40	85.40	163.20			
17	SE1	20	77.90	60.10	195.30			
18	SSC	116	72.90	64.30	184.10			
19	SSB	126	70.90	55.00	172.40			
20	SSA	161	91.70	41.70	130.40			
21	CC2	11	85.20	42.50	191.10			
22	CC1	75	55.70	57.70	176.90			
23	CB2	47	61.50	41.80	159.00			
24	CB1	249	59.00	36.20	147.30			
25	CA2	41	58.80	43.30	130.30			
26	CA1	192	59.70	37.60	103.30			
27	IB2	31	40.00	32.00	137.20			
28	IB1	127	39.00	32.00	130.00			
29	IA2	Small	38.00	27.00	100.00			
30	IA1	101	33.00	26.00	96.00			
31	BB2	Small	40.00	30.00	136.00			
32	BB1	Small	38.00	28.00	130.00			
33	BA2	Small	38.00	30.00	90.00			

Table 3: Minutes per Day (Nursing) by RUG-III (44-Group) Group (cont'd)							
RUG Order	RUG Group	Sample Size	Registered Nurse	Registered Practical Nurse	Health Care Aide		
34	BA1	13	34.00	25.00	73.50		
35	PE2	41	37.00	32.00	184.80		
36	PE1	160	37.00	29.40	181.60		
37	PD2	76	36.00	25.00	170.00		
38	PD1	358	36.00	27.60	160.00		
39	PC2	Small	25.60	32.80	154.40		
40	PC1	41	45.10	20.60	124.20		
41	PB2	Small	28.00	36.80	80.60		
42	PB1	86	27.50	27.70	93.90		
43	PA2	10	31.90	30.60	72.90		
44	PA1	175	28.20	29.80	72.80		

2.1.3 Resource Use per Day

The **resource use per day** for each RUG-III group (labelled "Z") is the **minutes per day** spent by health care providers from various occupations multiplied by the **relative wage rate** for that occupation:

$$\begin{aligned} \textit{Resource Use per Day}_{\textit{Z}} \\ &= \sum_{\textit{Z}} \left[\textit{Minutes per Day}_{\textit{Occupation Within Z}} \, \textit{x Relative Wage Rate}_{\textit{Occupation}} \right] \end{aligned}$$

Table 4 shows the RUG-III (44-group) CMI 2011 detailed calculation of resource use per day when Z = RUC.

Table 4: Resource Use per Day-	-Calculation for RUG-III	(44-Group) CMI 2011
for RUC Group		

Occupation Group	Relative Wage Rate	Minutes per Day	Resource Use per Day (RUC)
Registered Nurse	2.0582	112.70	231.96
Registered Practical Nurse	1.2648	53.80	68.05
Health Care Aide	1.0000	180.10	180.10
Physiotherapist (PT)	1.9631	37.11	72.85
PT Aide/Assistant	1.0771	22.61	24.35
Occupational Therapist (OT)	1.9661	36.98	72.71
OT Aide/Assistant	1.0771	18.58	20.01
Speech-Language Pathologist (SLP)	2.0776	26.94	55.97
SLP Aide/Assistant	1.0771	12.82	13.81
		Total	739.81

2.2 Average Resource Use per Day (Base Value for CMI Values)

To derive CMI values for a given fiscal year, a base value—the average resource use per day—must first be calculated. The average resource use per day is the total resource use divided by the total patient days.

2.2.1 Patient Days

At the time that the CMI values are derived, patient day counts for each RUG group are obtained from RWPD reports that are produced using data from the most recent fiscal year.

For the RUG-III (44-group) CMI 2011 calculations, the patient day values are taken from 2009–2010 RWPD data for Ontario complex continuing care (CCC) facilities and are shown in Table 6.

2.2.2 Resource Use

For each RUG group, the **resource use** is the product of **resource use per day** and **patient days**:

Resource Use z

= Resource Use per Day 7 x Patient Days 7

The **resource use** value for each of the 44 RUG groups can be found in Table 6.

2.2.3 Special Note About Patient Day Counts for RUG Groups RVC and RHA

The RUG groups used for Ontario RWPD reports are assigned using the index-maximizing approach. With that approach, each assessment is reviewed to determine which RUG groups might apply; of these groups, the one having the highest CMI value is used as the index-maximized value.

Within the Special Rehabilitation category there are five independent subcategories. Using the index-maximizing RUG code assignment and existing CMI values, the RUG groups RHA and RVC are never assigned to any assessments.

2.2.4 Special Note About a CMI Inversion for RUG Groups PB2 and PB1

A **CMI inversion** identifies a set of RUG-III groups where the CMI value for a clinically more serious group is lower than the CMI value for a less serious group. Assessments within the PB groups (PB2 and PB1) that have fewer nursing therapies will receive a higher CMI than those receiving more nursing therapies. The resource use per day for RUG groups PB1 and PB2 can be found in Table 5.

Table 5: Resource Use per Day—Calculations for RUG-III (44-Group)
CMI 2011 for PB2 and PB1

		PB2		PI	B1
CMI 2011	Relative Wage Rate	Minutes per Day	Resource Use per Day	Minutes per Day	Resource Use per Day
Registered Nurse	2.0582	28.00	57.63	27.50	56.60
Registered Practical Nurse	1.2648	36.80	46.54	27.70	35.03
Health Care Aide	1.0000	80.60	80.60	93.90	93.90
Physiotherapist (PT)	1.9631	0.00	0.00	0.00	0.00
PT Aide/Assistant	1.0771	0.00	0.00	0.00	0.00
Occupational Therapist (OT)	1.9661	0.00	0.00	0.00	0.00
OT Aide/Assistant	1.0771	0.00	0.00	0.00	0.00
Speech-Language Pathologist (SLP)	2.0776	0.00	0.00	0.00	0.00
SLP Aide/Assistant	1.0771	0.00	0.00	0.00	0.00
Resource	Jse per Day		184.77		185.54

The inversion is likely the result of the small sample size of the PB2 group in the American STM study, as well as differences in the wage index values between the U.S. and Ontario.

Table 6: Resource Use—Calculation for CMI 2011							
RUG Order	RUG Group	Resource Use per Day—Weighted Minutes per Day	Patient Days, 2009–2010	Resource Use			
1	RUC	739.81	1,841	1,361,984.90			
2	RUB	611.31	3,475	2,124,300.14			
3	RUA	541.95	847	459,034.66			
4	RVC	577.76	0	0.00			
5	RVB	545.47	6,409	3,495,898.34			
6	RVA	461.98	2,681	1,238,578.44			
7	RHC	568.71	12,557	7,141,309.41			
8	RHB	497.33	22,996	11,436,533.74			
9	RHA	428.54	0	0.00			
10	RMC	581.51	204,015	118,636,545.99			
11	RMB	491.87	180,501	88,782,272.01			
12	RMA	443.85	73,416	32,585,998.33			
13	RLB	465.51	204,255	95,083,298.58			
14	RLA	345.79	93,306	32,264,626.04			
15	SE3	609.27	92,109	56,118,876.47			
16	SE2	498.44	209,045	104,196,222.56			
17	SE1	431.65	7,563	3,264,555.79			
18	SSC	415.47	45,435	18,876,853.10			
19	SSB	387.89	54,277	21,053,526.16			
20	SSA	371.88	98,453	36,612,613.03			
21	CC2	420.21	91,066	38,267,084.27			
22	CC1	364.52	25,266	9,209,980.01			
23	CB2	338.45	50,910	17,230,384.63			
24	CB1	314.52	49,118	15,448,571.75			
25	CA2	306.09	47,934	14,672,022.19			
26	CA1	273.73	72,419	19,823,326.74			
27	IB2	260.00	9,031	2,348,074.45			
28	IB1	250.74	7,358	1,844,969.94			
29	IA2	212.36	6,191	1,314,728.19			
30	IA1	196.81	7,446	1,465,413.01			
31	BB2	256.27	283	72,524.98			
32	BB1	243.63	283	68,946.16			
33	BA2	206.16	563	116,065.60			

Table 6: Resource Use—Calculation for CMI 2011 (cont'd)							
RUG RUG Order Group		Resource Use per Day—Weighted Minutes per day	Patient Days, 2009–2010	Resource Use			
34	BA1	175.10	2,043	357,726.85			
35	PE2	301.43	32,269	9,726,747.86			
36	PE1	294.94	22,428	6,614,881.13			
37	PD2	275.72	31,283	8,625,198.60			
38	PD1	269.00	20,663	5,558,423.04			
39	PC2	248.58	2,209	549,102.97			
40	PC1	243.08	2,559	622,040.95			
41	PB2	184.77	3,159	583,701.82			
42	PB1	185.54	5,533	1,026,567.70			
43	PA2	177.26	4,028	714,001.10			
44	PA1	168.53	14,029	2,364,339.36			
	Totals	16,183.40	1,821,252.00	793,357,850.98			

2.2.5 Average Resource Use per Day

To derive CMI values for a given fiscal year, a base value—the **average resource use per day**—must first be calculated.

The **total resource use** and **total patient days** are summed over all 44 RUG groups:

$$=\sum_{Z}$$
 Resource Use_Z = 793,357,850.98

Total Patient Days

$$= \sum_{Z} Patient Days_{Z} = 1,821,252$$

The average resource use per day is the total resource use divided by the total patient days:

Average Resource Use per Day

$$= \frac{\sum_{Z} Resource \ Use_{Z}}{\sum_{Z} Patient \ Days_{Z}}$$
$$= \frac{793,357,850.98}{1,821,252} = 435.61$$

The **total resource use** and **total patient days** values for RUG-III (44-group) CMI 2011 calculations are taken from Table 6.

2.3 Deriving the CMI for Each RUG Group

The CMI for RUG-III group "Z" is calculated by normalizing, or scaling, to the population's average:

$$CMI_z$$

$$= \frac{Resource\ Use\ per\ Day_z}{Average\ Resource\ Use\ per\ Day}$$

For the RUG-III (44-group) CMI 2011 calculations, the CMI value for group RUC is

$$\begin{array}{l}
\mathbf{CMI}_{\text{RUC}} \\
= \frac{739.81}{435.61} = 1.6983
\end{array}$$

See Table 7 for the RUG-III (44-group) CMI 2011 values for each of the 44 RUG groups.

Table 7: Calculations for RUG-III (44-Group) CMI 2011 Values					
RUG Order	RUG-III Group	Resource Use per Day	Average Resource Use per Day	RUG-III (44-Group) CMI 2011 Values	
1	RUC	739.81	435.61	1.6983	
2	RUB	611.31	435.61	1.4033	
3	RUA	541.95	435.61	1.2441	
4	RVC	577.76	435.61	1.3263	
5	RVB	545.47	435.61	1.2522	
6	RVA	461.98	435.61	1.0605	
7	RHC	568.71	435.61	1.3055	
8	RHB	497.33	435.61	1.1417	
9	RHA	428.54	435.61	0.9838	
10	RMC	581.51	435.61	1.3349	
11	RMB	491.87	435.61	1.1291	
12	RMA	443.85	435.61	1.0189	
13	RLB	465.51	435.61	1.0686	
14	RLA	345.79	435.61	0.7938	
15	SE3	609.27	435.61	1.3986	
16	SE2	498.44	435.61	1.1442	
17	SE1	431.65	435.61	0.9909	
18	SSC	415.47	435.61	0.9538	
19	SSB	387.89	435.61	0.8905	
20	SSA	371.88	435.61	0.8537	
21	CC2	420.21	435.61	0.9647	
22	CC1	364.52	435.61	0.8368	
23	CB2	338.45	435.61	0.7769	
24	CB1	314.52	435.61	0.7220	
25	CA2	306.09	435.61	0.7027	
26	CA1	273.73	435.61	0.6284	
27	IB2	260.00	435.61	0.5969	
28	IB1	250.74	435.61	0.5756	
29	IA2	212.36	435.61	0.4875	
30	IA1	196.81	435.61	0.4518	
31	BB2	256.27	435.61	0.5883	
32	BB1	243.63	435.61	0.5593	
33	BA2	206.16	435.61	0.4733	
34	BA1	175.10	435.61	0.4020	
35	PE2	301.43	435.61	0.6920	

Table 7: Calculations for RUG-III (44-Group) CMI 2011 Values (cont'd)							
RUG Order	RUG-III Group	Resource Use per Day	Average Resource Use per Day	RUG-III (44-Group) CMI 2011 Values			
36	PE1	294.94	435.61	0.6771			
37	PD2	275.72	435.61	0.6329			
38	PD1	269.00	435.61	0.6175			
39	PC2	248.58	435.61	0.5706			
40	PC1	243.08	435.61	0.5580			
41	PB2	184.77	435.61	0.4242			
42	PB1	185.54	435.61	0.4259			
43	PA2	177.26	435.61	0.4069			
44	PA1	168.53	435.61	0.3869			

References

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