

RISK-ADJUSTMENT METHODOLOGY

1. Enables fairer and more appropriate comparisons of quality of care delivered by continuing care facilities serving diverse populations
2. Adjusts for specific resident characteristics beyond the control of the facility, which can impact measures of quality
3. Helps to level the playing field by modifying the quality indicator results relative to a standard reference population

THREE-STEP RISK-ADJUSTMENT PROCESS

Subdivide facility population into risk groups and calculate unadjusted QI scores

- a. The facility population is subdivided into three risk groups (high, medium and low) based on either a RAI-MDS 2.0 outcome scale or the Case Mix Index (CMI).
- b. The unadjusted QI scores are calculated (numerator/denominator \times 100) for each risk group for both the facility and the standard reference population.

Calculate expected QI scores for each risk group

- a. Regression models (based on the standard reference population) are then used to predict the expected QI score for each risk group in the facility, based on a set of resident characteristics (called *individual covariates*) specific to each QI.
- b. For example, the individual covariates included in the regression model for the Percentage of residents whose ability to communicate worsened QI are
 1. Long-term memory problem;
 2. Short-term memory problem; and
 3. Age younger than 65.

THREE-STEP RISK-ADJUSTMENT PROCESS

Create a single risk-adjusted QI score

a. For each risk group in the facility, the observed (unadjusted) QI score is divided by the expected QI from the regression model to create a ratio. This ratio is multiplied by the unadjusted QI score from the corresponding risk group in the standard reference population (calculated in Step 1b) to create a risk-adjusted QI score.

b. The risk-adjusted QI scores from each risk group are combined and re-weighted so that all facilities are treated as if they have the same distribution of residents among the three risk groups (and the same distribution as the standard reference population).

NOTE:

- i. The standard reference population and associated statistical parameters used for risk adjustment have been created through interRAI research and are based on assessment data collected from more than 3,000 facilities in six U.S. states, and 92 residential care facilities and continuing care hospitals in Ontario and Nova Scotia.
- ii. Risk adjustment does not control for all factors that affect resident outcomes.

QI	Province
2: Improved or remained independent in mid-loss ADL (ADL05)	23.80
3: Improved or remained independent in early-loss ADL (ADL06)	13.20
4: Improved late-loss ADL (ADL1A)	8.80
9: Improved locomotion (MOB1A)	11.60
11: Improved behavioural symptoms (BEHI4)	13.50
13: Improved cognitive ability (COG1A)	4.10
15: Improved communication ability (COM1A)	5.30
30: Improved bowel continence (CNT2A)	15.10
31: Improved bladder continence (CNT3A)	8.30
1: Worsened late-loss ADL (ADL01)	15.50
5: Worsened or remained dependent in mid-loss ADL (ADL5A)	36.70
6: Worsened or remained dependent in early-loss ADL (ADL6A)	26.80
7: Worsened ADL (ADLD7)	33.10
8: Worsened locomotion (MOB01)	18.10
10: Worsened behavioural symptoms (BEHD4)	13.20
12: Worsened cognitive ability (COG01)	9.50
14: Worsened communication ability (COM01)	8.50
17: Worsened mood from symptoms of depression (MOD4A)	23.60
22: Worsened stage 2 to 4 pressure ulcer (PRU06)	3.20
25: Worsened/unchanged respiratory condition (RSPX2)	7.60
27: Worsened bowel continence (CNT02)	21.20
28: Worsened bladder continence (CNT03)	17.40
34: Worsened pain (PAN01)	10.30
16: Has symptoms of delirium (DEL0X)	14.70
18: Has taken antipsychotics without a diagnosis of psychosis (DRG01)	20.80
19: Has fallen (FAL02)	15.20
20: Has one or more infections (INF0X)	9.90
21: Has a stage 2 to 4 pressure ulcer (PRU05)	5.40
23: Has a new stage 2 to 4 pressure ulcer (PRU09)	3.00
24: Has daily physical restraints (RES01)	5.40
26: Has an indwelling catheter (CAT02)	3.40
29: Has urinary tract infection (CNT04)	4.90
32: Has a feeding tube (NUT01)	1.00
33: Has pain (PAI0X)	5.60
35: Has had weight loss (WGT01)	6.40

Stratification

Scale	Low	Medium	High
ADL Long	0 – 9	10 – 23	24 - 28
CPS	0 – 1	2 – 4	5 – 6
Pain	0	1	2 – 3
DRS	0	1 – 2	3 – 14
CMI	≤ 0.73	$0.73 < \text{CMI} \leq 1.05$	> 1.05
CMI Code	SE3, SE2, RMC, RUC, RHC, SE1, RVC, SSC, CC2, RLB, RMB, RHB, SSB, RVB, SSA, CC1, RMA	RUB, CB2, RHA, CB1, CA2, RVA, RLA, PE2, RUA, PE1, CA1, PD2, IB2, BB2	IB1, PD1, PC2, BB1, PC1, IA2, BA2, IA1, PB2, PB1, PA2, BA1, PA1

EXAMPLE WORSENERD BLADDER CONTINENCE

NUMERATOR - Residents where the Rule has been triggered

Residents with a greater value for bowel incontinence on their target assessment compared with prior assessment

DENOMINATOR - Residents who could have triggered the Rule (At Risk)

Residents with valid assessments whose bowel continence could worsen (did not have Maximum score on prior assessment), excluding comatose and end-of-life residents and those with ostomy present

$$\text{PERCENT} = \left(\frac{\text{NUMERATOR}}{\text{DENOMINATOR}} \right) * 100$$

STRATIFICATION BY ADL LONG FORM

RISK LEVEL / ADL	LOW	MEDIUM	HIGH
ADL LONG SCORE	0 – 9	10 – 23	24 - 28

ITEM	DESCRIPTION	VALUE (8 IS SET TO 4)
G1aA	Bed Mobility Self-Performance	0, 1, 2, 3, 4, 8
G1bA	Transfer Self-Performance	0, 1, 2, 3, 4, 8
G1eA	Locomotion on Unit Self-Performance	0, 1, 2, 3, 4, 8
G1gA	Dressing Self-Performance	0, 1, 2, 3, 4, 8
G1hA	Eating Self-Performance	0, 1, 2, 3, 4, 8
G1iA	Toilet Self-Performance	0, 1, 2, 3, 4, 8
G1jA	Personal Hygiene Self-Performance	0, 1, 2, 3, 4, 8

ADL Long Form

This scale provides a measure of the resident's ability to perform ADLs. The ADL Long Form is more sensitive to clinical changes than the other ADL scales.

Seven ADL Long Form Items

- Mobility in Bed (G1aA)
- Transfers (G1bA)
- Locomotion (G1eA)
- Dressing (G1gA)
- Eating (G1hA)
- Toilet Use (G1iA)
- Personal Hygiene (G1jA)

0-28

Higher scores indicate more impairment of self-sufficiency in ADL performance.

FIVE COVARIATES
USED TO ESTIMATE
WORSENER BLADDER CONTINENCE

PSI: Subset 1 Diagnoses

PSI: Subset 2 Non-Diagnoses

CPS

RUG Nursing CMI

Age younger than 65

PSI S1

ASSESSMENT ITEM	RULE	CALCULATION
AGE AT ASSESSMENT	> 90	C_P SIS1_COUNT + 1
H1a_BOWEL_CONTINENCE_SELF	IN (2,3,4)	C_P SIS1_COUNT + 1
J5a_CONDITION_LEAD_TO_INSTABLE	1	C_P SIS1_COUNT + 1
J5b_EXPERIENCING_ACUTE_EPISODE	1	C_P SIS1_COUNT + 1
J5c_END_STAGE_DISEASE	1	C_P SIS1_COUNT + 1
K3a_WEIGHT_LOSS	1	C_P SIS1_COUNT + 1
M2a_STAGE_OF_PRESSURE_ULCER	IN (1,2,3,4)	C_P SIS1_COUNT + 1
M2b_STAGE_OF_STASIS_ULCER	IN (1,2,3,4)	C_P SIS1_COUNT + 1
Q2_CHANGE_IN_CARE_NEEDS	2	C_P SIS1_COUNT + 1
PSIS1	= C_P SIS1_COUNT	

PSIS2

ASSESSMENT ITEM	RULE	CALCULATION
AGE AT ASSESSMENT	>= 90	C_P SIS2_COUNT + 1
B4_COGNITIVE_SKILLS	3	C_P SIS2_COUNT + 1
B5e_PERIODS_OF_LETHARGY	2	C_P SIS2_COUNT + 1
C6_UNDERSTANDS_OTHERS	IN (2,3)	C_P SIS2_COUNT + 1
G1bA_TRANSFER_SELF	IN (3,4,8)	C_P SIS2_COUNT + 1
G1eA_LOCOMOT_ON_UNIT_SELF	IN (3,4,8)	C_P SIS2_COUNT + 1
G1hA_EATING_SELF	IN (3,4,8)	C_P SIS2_COUNT + 1
G1jA_PERSONAL_HYGIENE_SELF	IN (4,8)	C_P SIS2_COUNT + 1
E1c_REPETITIVE_VERBALIZATIONS	2	C_P SIS2_COUNT + 1
E1g_RECURRENT_STATEMENTS	2	C_P SIS2_COUNT + 1
PSIS2	C_P SIS2_COUNT	

OTHER COVARIATES

CPS	0 TO 6	COGNITIVE PERFORMANCE SCALE
RUG HIERARCHY CMI	0.63 TO 1.94	HIERARCHICAL RUG MODEL
AGE AT ASSESSMENT	0 OR 1	0 > 65, 1 <= 65

REGRESSION COEFFICIENTS OR WEIGHTS FOR COVARIATES

EXAMPLE OF USING STATISTICS TO GUESS SOMETHING WHEN THE DIRECT INFORMATION IS NOT AVAILABLE

GUESS SOMEONE'S INCOME

WHAT WE KNOW

1. If over 50 is 2 times more likely to earn higher income
2. If male 1.5 times as likely to earn higher income
3. If you have a graduate education you are 10 times as likely to earn a higher income

From a study we find that that for

1. Every year of life we earn 1000 dollars more
2. If you're a male then you earn 20000 dollars more than a female
3. Every year of education you earn 10000 dollars more

One day you meet a 50 year old male with 15 years of education challenges you to guess his income

$$\begin{aligned}\text{INCOME} &= 1,000(\text{AGE}) + 20,000(\text{MALE}) + 10,000(\text{EDUCATION}) \\ &= 1,000(50) + 20,000(1) + 10,000(15) \\ &= 50,000 + 20,000 + 150,000 = 220,000\end{aligned}$$

REGRESSION COEFFICIENTS FOR ESTIMATING PERCENT WORSENER BLADDED CONTINENCE BY STRATIFICATION GROUP

RISK LEVEL / ADL	LOW	MEDIUM	HIGH
ADL LONG SCORE	0 – 9	10 – 23	24 - 28

Logistic Regression Parameter		Risk Group (Stratum)		
		LOW	MEDIUM	HIGH
Intercept	b0	-3.13538	-1.83147	-1.64911
PSI: Subset 1 Diagnoses	b1	0.03901	-0.06807	0.18776
PSI: Subset 2 Non-Diagnoses	b2	0.11296	0.07532	-0.0778
CPS	b3	0.20813	0.09379	0.06105
RUG Nursing CMI	b4	0.85531	0.16075	-0.06845
Age younger than 65	b5	-0.9695	-0.3769	-0.38272

Facility Average Scores by ADL Long Form Risk Levels

RISK LEVEL / ADL	LOW	MEDIUM	HIGH
ADL LONG SCORE	0 – 9	10 – 23	24 - 28
	ADL Long Form		
Facility Average Score	Low	Medium	High
PSI: Subset 1 Diagnoses	0	7	3.2
PSI: Subset 2 Non-Diagnoses	1	4	10
CPS	1	2	0
RUG Nursing CMI	0.6	0.8	1.6
Age younger than 65	0.7	0.8	1.0

Quality Indicator Worsened Continence

Calculate Percentage of residents experiencing Worsened Continence 3 ways

1. Directly from the homes CCRS assessment information
2. Estimated from other CCRS assessment data in the nursing home
3. Directly from the provinces CCRS assessment information

Worsened Bladder Continence Percent by Home, and Province

Percent within	Number with Worsened Bladder Continence	Number at Risk for Worsened Bladder Continence	Percentage
Facility	83	486	17.08
Province (Reference Group)	18,806	122,886	15.30

Risk Levels Based on ADL Long Score

RISK LEVEL / ADL	LOW	MEDIUM	HIGH
ADL LONG SCORE	0 – 9	10 – 23	24 - 28

Percent Worsened Blabber Continenence by Home and Province within ADL Long Risk Levels

Home

Risk Group (ADL Long)	Numerator	Denominator	Observed QI Score
Low score 0 to 9	22	214	0.1028
Medium score 10 to 23	36	206	0.1748
High score 24 to 28	25	66	0.3788
Total score 0 to 28	83	486	0.1708

Province

Risk Group (ADL Long)	Numerator	Denominator	Observed QI	Proportion in strata (weight)
Low score 0 to 9	5,255	52,607	0.0999	0.43
Medium score 10 to 23	11,855	62,562	0.1895	0.51
High score 24 to 28	1,696	7,717	0.2198	0.06
Total score 0 to 28	18,806	122,886	0.1530	1.00

Estimated Percent Based on Population Parameters

$$\text{Percent} = \frac{e^{\text{Estimate}}}{1 + e^{\text{Estimate}}}$$

RISK	$=(b0+(b1*PSI1)+(b2*PSI2)+(b3*CPS)+(b4*CMI)+(b5*AGE))$
LOW 0 - 9	$=(-3.1354 + (0.0390*PSI1) + (0.1130*PSI2) + (0.2081*CPS) + (0.8553*CMI) + (-0.9695*AGE))$
MEDIUM 10 - 23	$=(-1.8315 + (-0.0681*PSI1) + (0.0753*PSI2) + (0.0938*CPS) + (0.1608*CMI) + (-0.3769*AGE))$
HIGH 24 - 28	$=(-1.6491 + (0.1878*PSI1) + (-0.0778 * PSI2) + (0.0611*CPS) + (-0.0685* CMI) + (-0.3827*AGE))$

PERCENT	$= \frac{e^{(b0+(b1*PSI1)+(b2*PSI2)+(b3*CPS)+(b4*CMI)+(b5*AGE))}}{1+e^{(b0+(b1*PSI1)+(b2*PSI2)+(b3*CPS)+(b4*CMI)+(b5*AGE))}}$
LOW 0 - 9	$= \frac{e^{(-2.9798)}}{1+e^{(-2.9798)}} = 0.10$
MEDIUM 10 - 23	$= \frac{e^{(-1.9920)}}{1+e^{(-1.9920)}} = 0.27$
HIGH 24 - 28	$= \frac{e^{(-2.3185)}}{1+e^{(-2.3185)}} = 0.20$

Home QI Adjusted by Estimated and Provincial Calculations

Risk Group (ADL Long)	Observed QI Home	Expected QI (logistic regression model)	Performance Ratio	QI for reference group Province	Adjusted QI
			(Observed QI/ Expected QI)		(Performance Ratio * QI for province)
Low 0 to 9	0.1028	0.1000	1.0276	0.0999	0.1027
Medium 10 to 23	0.1748	0.2710	0.6448	0.1895	0.1222
High 24 to 28	0.3788	0.2012	1.8830	0.2198	0.4138
Total 0 to 28					

Population Size Weighted Quality Indicator

Risk Group (ADL Long)	A Risk Group Adjusted QI	B Proportion Weight from reference population	C = A*B Weighted score
Low score 0 to 9	0.1027	0.4281	0.0439
Medium score 10 to 23	0.1222	0.5091	0.0622
High score 24 to 28	0.4138	0.0628	0.0260
Total score 0 to 28			0.1322