

ASIAN ACTUARIAL CONFERENCE 2026

Beating the Odds: Redefining Risk

Risk Adjustment Without Illusion
Can we truly price for fairness?

Part 2 — International Experiences

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MARINA BAY SANDS, SINGAPORE

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Agenda

PART I

Resources allocation and payments in different types of health systems

PART II

Risk Adjustment in Competitive Health Systems

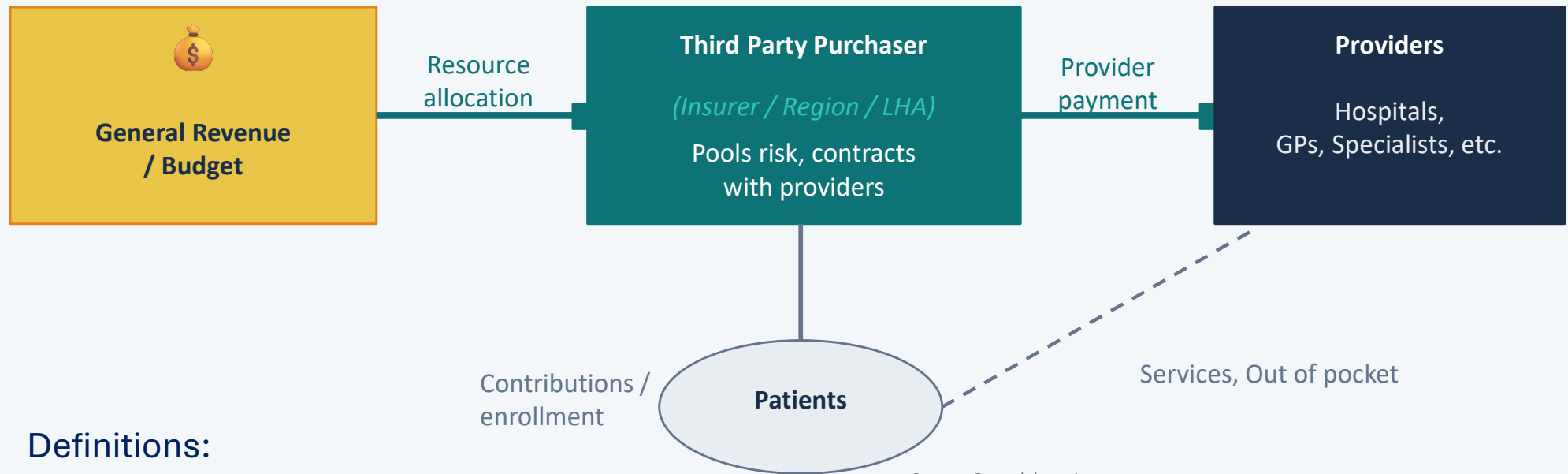
PART III

Risk Adjustment in Non-Competitive Health Systems / Providers Payments

PART I

Resources allocation and payments in different types of health system

How Funds Flow: The Systemic Picture



Source: Own elaboration.

Definitions:

- **Resource allocation:** What and Where to allocate financial resources before a decision of how to use them through various purchasing mechanisms is taken.
- **Payments:** The mechanisms and methods used to transfer allocated resources to healthcare entities in exchange for services.

PART II

Risk Adjustment in Competitive Healthcare systems

Types of Healthcare Systems (Paolucci, 2010)

Competitive systems rely on a series of regulatory tools to achieve equity and efficiency.

A key part of these tools is the regulation of health plan payment. This regulation includes:

- Premium regulation
- Risk equalization
- Risk sharing
- Subsidies

Source: McGuire and van Kleeef (2018)

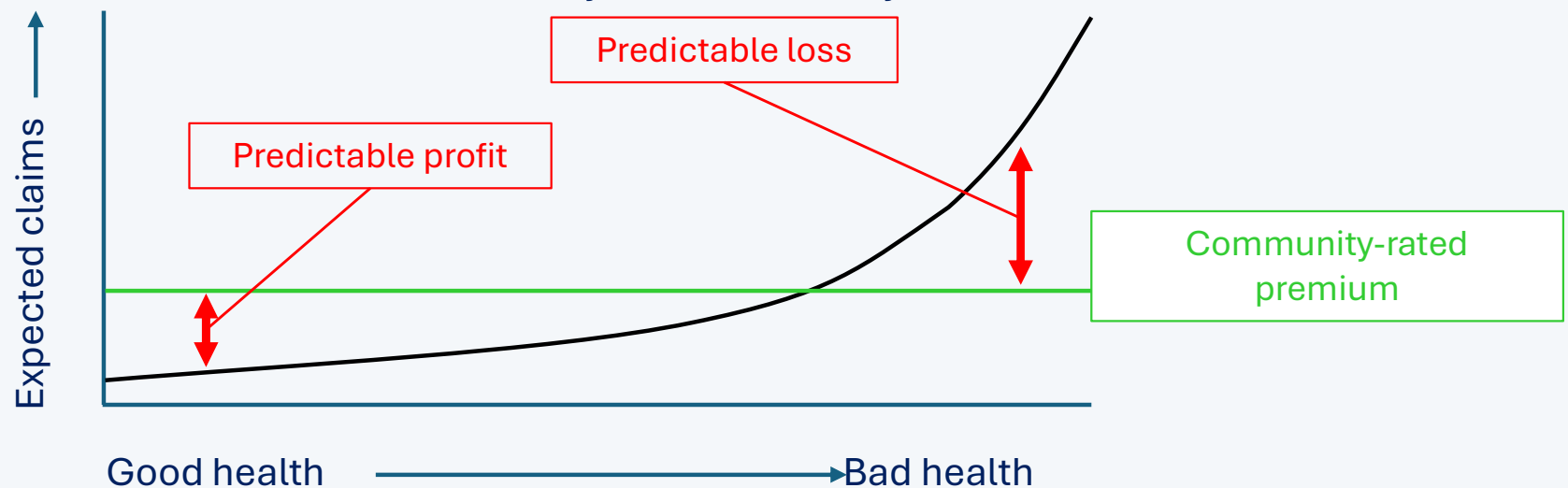
TABLE 1.5 Regulator's Tools for Structuring and Managing Individual Health Insurance Markets

General tools	Examples of specific regulation
Regulation of coverage	• Standardization of benefits • Standardization of consumer cost-sharing • Network requirements
Regulation of enrollment	• Insurance mandate • Open enrollment • Standardized contract length • Central entry point for enrollment
Management of market entry	• Screening of insurers (e.g., in terms of solvency) • Screening of plans (e.g., in terms of transparency) • Screening of provider networks (e.g., in terms of quality)
Market support and surveillance	• Promotion of transparency • Quality measurement • Antitrust supervision • Solvency requirements • Monitoring of risk selection
Regulation of health plan payment	• Premium regulation • Risk equalization • Risk sharing • Subsidies (e.g., to consumers, health plans, employers and/or providers of care)

Why Risk Adjust? The Core Problem

Due to fairness considerations, typically countries with competitive healthcare systems establish community-rating of premiums – that is- a flat rate regardless of consumer characteristics. But it comes with a challenge...

From the perspective of insurers, community-rating creates **predictable profits** on the young and healthy and **predictable losses** on the elderly and chronically ill.



→ Incentives for insurers to engage in risk selection.

Tools to Mitigate Risk Selection

Tools for mitigating predictable profits/losses and reducing incentives for risk selection include:

Risk Adjustment

Redistributes revenues based on predicted healthcare costs of enrollees various indicators such as demographic and morbidity indicators.

✓ Preserves efficiency incentives

✗ More complex to design & implement

Risk Sharing

Payments based on actual realised costs of enrollees (e.g., proportional risk sharing, reinsurance above threshold).

✓ Simple to implement

✗ Reduces cost-control incentives

Why Risk Adjustment Matters: Practical Implications

Risk selection and cost control incentives, when left unchecked, have wide-reaching consequences for patients, insurers, and the health system as a whole:



Reduced incentives to serve specific needs

Risk selection reduces incentives to meet the preferences and needs of people with specific medical conditions — the patients who need care most are least profitable.



Product proliferation to circumvent community rating

To get around community rating restrictions, insurers design products that implicitly attract healthier individuals. Evidence from Australia and Ireland shows this proliferation in practice.



Selection becomes more attractive than efficiency

If risk selection incentives exist and are profitable, they can become a more attractive strategy for insurers than genuinely improving the efficiency and quality of care.



Community rating principles at stake

Risk adjustment is essential for maintaining community rating — the principle that premiums should be affordable and accessible for vulnerable groups, regardless of health status.



Cost containment keeps members healthy

Cost containment incentives encourage insurers to invest in preventive care — keeping members healthier reduces future expenditure, aligning insurer and patient interests.



Lower spending = affordable premiums

Reducing unnecessary health expenditure allows premiums to remain affordable for the whole population — a key goal of regulated insurance markets.

Designing Feasible and Effective Risk Adjustment in Competitive Healthcare Systems

Ellis, Martins, Rose (2018) state the three elements guiding risk adjustment model design:

Efficiency

"A central objective is to maintain adequate incentives for the efficient provision of care."

Feasibility

"Some risk adjusters may be desirable but infeasible to implement. Data availability can change through regulation, and data provision responds to financial incentives."

Equity

"Regulators may want to achieve a certain concept of fairness in individuals' contributions to the health insurance system."

The three principles are interconnected and must be balanced in any risk adjustment model design.

Source: Ellis, Martins & Rose (2018). Risk Adjustment for Health Plan Payment. In McGuire & van Kleeef (Eds.), Elsevier.

What We Know



Demographic adjusters (age & sex) — Low predictive power

Statistically, age and sex explain only a small share of spending variance ($\sim 5\%$ R^2). They are essential as a baseline but insufficient on their own to prevent risk selection.



Sociodemographic adjusters — Moderate, but complex

Similar limitations in predictive power. Additional complication: higher-income individuals may over-utilise care. Is it fair to allocate more resources to them? Including SES adjusters risks perpetuating existing inequities.



Morbidity variables — The strongest predictors of spending

In various forms — simple (e.g., prior hospitalisation: yes/no) or sophisticated (Diagnosis Cost Groups — DCGs, or Pharmacy Cost Groups — PCGs) — morbidity-based adjusters are the most powerful predictors of healthcare expenditure.

Risk Adjustment in Competitive Systems: Country Practice

Countries vary significantly in the sophistication of their risk adjustment models — from simple demographic cells to complex morbidity-based systems:

SIMPLE

Demographic cell models

Age, sex, and geographic location as the main adjusters. Countries: Australia (Paolucci et al., 2018), Chile (Velasco et al., 2018), Israel (Brammli-Greenberg et al., 2018), Colombia (Bauhoff et al., 2018).

INTERMEDIATE

Adding prior utilisation

Switzerland used cell models without diagnosis data for many years, recently adding prior hospitalisations and pharmacy cost groups (PCGs) (Beck et al., 2020). A growing middle ground.

SOPHISTICATED

Morbidity-based systems

Netherlands (Van Kleeef, Eijkenaar et al., 2018), Germany (Wasem et al., 2018), USA Medicare Advantage (Pope et al., 2011). Include DCGs, PCGs, etc, socioeconomic adjusters, and constrained regression.

← Less complex / Lower data requirements

More sophisticated / Higher predictive power →

Last 10 Years of Research: Three Main Themes

Since 2014–15, the literature on risk adjustment model improvement has focused on three main themes:

01

New or Modified Risk Adjusters (Variables)

Research has explored new types of risk adjuster information — including socioeconomic status, self-reported health, physiotherapy groups, etc.— and modifications to how existing adjusters are specified (e.g., thresholds, hierarchies, interactions between conditions). Key question: Complexity vs improvements vs unintended consequences (e.g., gaming, upcoding)?

02

The Role of Risk Sharing in RA Systems

Growing recognition that risk adjustment alone cannot fully eliminate selection incentives, particularly for high-cost patients. Risk sharing (reinsurance, proportional sharing) is increasingly used as a complement to RA. Key finding: Modest risk sharing combined with RA can significantly reduce selection incentives without substantially weakening cost-control incentives.

03

New Estimation Methodologies — Including Machine Learning

Emerging use of constrained regression, penalised models (LASSO), regression trees, and machine learning to estimate RA payment weights. The goal is to optimise not just statistical fit (R^2) but also equity and incentive objectives. Key limitation: Most RA variables are binary (0/1), which limits the marginal gain from complex ML over well-specified regression models.

Risk Adjustment in Competitive Systems: Example of Australia



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Policy innovation in voluntary hospital private health insurance: Combining risk adjustment and risk sharing in Australia

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Health Policy

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Table 3

Outcomes for the current payment system and alternative models that include only risk adjustment.

	Current model	Alternative models with risk adjustment based on:		Alternative models with reinsurance (90 % sharing of claims costs above 20k) and risk adjustment based on:		
		Age and gender	Age, gender and morbidity based on prior year hospital episodes	Age and gender	Age, gender and morbidity based on prior year hospital episodes	
Payment System Fit Over/Under Compensation		76 %	5 %	7 %	71 %	72 %
Age	0–54	191	0	0	0	0
	55+	–391	0	0	0	0
Gender	Female	–67	0	0	0	0
	Male	71	0	0	0	0
Prior hospitalization based on episodes	0	229	349	0	240	0
	1	–485	–468	1273	–415	781
	2	–1085	–1456	193	–1106	27
	3	–1849	–3080	–1484	–2129	–1032
	4+	–4388	–8514	–6950	–5075	–4000
Incentives for cost control						
Claims costs affected by risk sharing		47 %	0 %	0 %	23 %	23 %

PART III

Risk Adjustment in Non-Competitive National Health Systems / Providers Payments

Risk Adjustment in National Health Systems: Key Features

In non-competitive NHS-type systems, RA addresses geographical allocation to meet patient needs rather than insurer selection incentives.

Decentralised allocation

Central government allocates budgets to local governments (LG) or health authorities (LHA). Individuals 'belong' to the LG/LHA of residence.

Equity objective

Primary goal: equal access for equal need across regions. No insurer competition; risk selection less prominent (due to geographically based enrolment and funding).

Budget constraint

Strong focus on budget control and cost control incentives

Rationing Incentives

Prospective capitation and tight budgets can incentivise selective rationing. Tools include benefit design, provider supply limits, queuing, copayments, and gatekeeping.

Centralisation vs Decentralisation

Greater Regional/LHA autonomy can increase selective rationing, leading to variation in access and potentially inequitable outcomes.

Comparative Overview: RA in National Health Systems

Country	Units	Morbidity Adjustment	Rurality	SES	Data Level
Sweden	20 counties	✓ Matrix (employment, income)	✓ Explicit	Partial	Individual
Norway	4 regions	✓ Survey + registry	✓ Distance	✓ (index)	Municipal
New Zealand	20 DHBs	✓ Ethnicity, deprivation	✓ Explicit	✓ NZDep	Individual
Italy	20 regions	✗ Age only (social deprivation indicators, and premature mortality rate below 75).	✗	✗	Regional
UK NHS	42 ICBs	Partial (SMR, QOF)	Partial	✓ Deprivation	Area-level
Canada	Provinces	✗ Per capita	Partial	✗	Provincial
Spain	17 ACs	✗ Not transparent	Partial	✗	Regional

Sources: Peter Smith presentation in RAN Meeting The Hague 2017.

Italy: Regional Allocation in the Servizio Sanitario Nazionale

Servizio Sanitario Nazionale — universal coverage, regionally organised, funded from general taxation

SYSTEM STRUCTURE



Universal coverage

Mostly free at point of use; defined benefit package (LEA – Livelli Essenziali di Assistenza) guaranteed to all residents.



Decentralised delivery

LHAs (AUSL) deliver the LEA through provider networks. Significant North–South disparities in fiscal capacity and service quality.

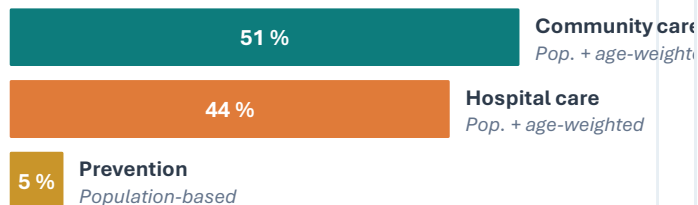


Data fragmentation

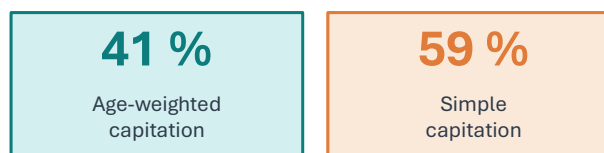
Heterogeneous information systems across Regions create inconsistent data completeness, hindering effective analysis and comparison.

RESOURCE ALLOCATION FORMULA

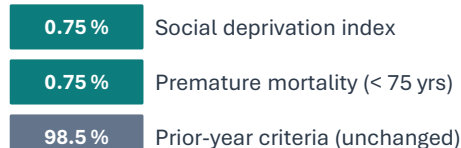
LEA spending envelope (since 2011)



Capitation split



Recent adjustments (Dec 2022)



SELECTION CHALLENGES



Age-only formula → selection incentives

Demographic weighting fails to account for morbidity and deprivation. High-risk, high-cost populations remain undercompensated.



Interregional patient mobility

Patients seeking care in northern Regions generate unconstrained revenue for receiving providers — while Southern Regions pay for their residents' care elsewhere.



North–South fiscal asymmetry

Disparities in regional fiscal revenue compound underfunding in the South, limiting LHA purchasing capacity and reinforcing inequities.



Stalled reform trajectory

1996 proposals for epidemiological weighting were never implemented. Despite a 2014–16 agreement on socioeconomic parameters, 98.5 % of funding remains age-and-population-only.

Sources: Ferré et al. (2014); de Belvis et al. (2022); Berta et al. (2021); Cichetti et al. (2021); Fantozzi et al. (2025); Bruzzi et al. (2022); Skrami et al. (2020)

Italy: Regional Allocation in the Servizio Sanitario Nazionale



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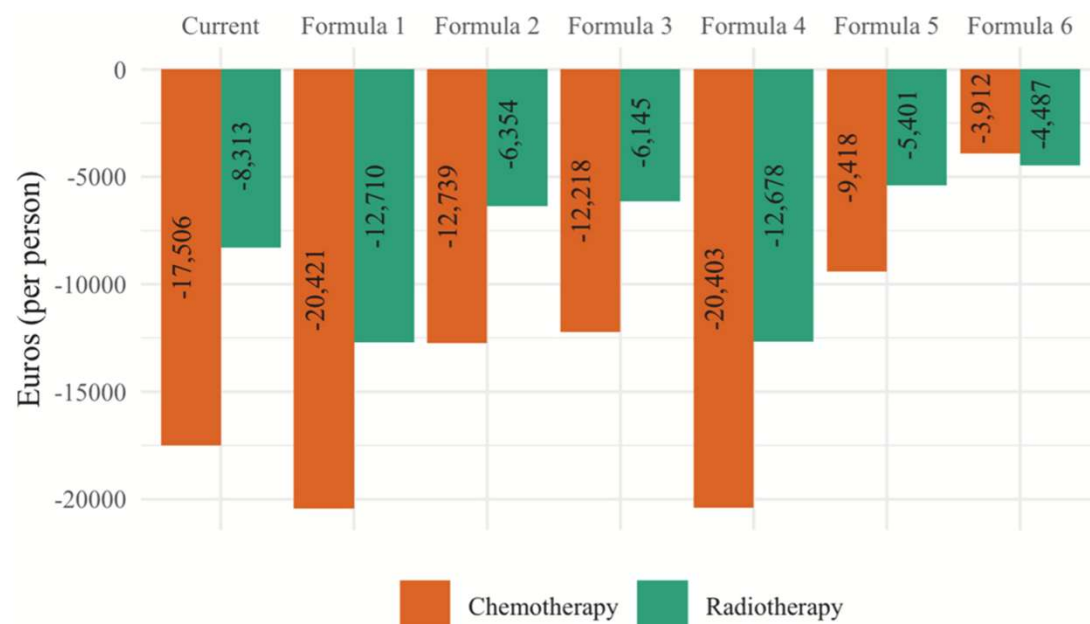


Risk adjustment to improve fairness and efficiency of resource allocation: a case from the Emilia Romagna region in the decentralized Italian SSN

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Italy: Regional Allocation in the Servizio Sanitario Nazionale

Payment to each region based on the current and alternative formulas (in millions, Euros).

Region	0-14	15-64	65+	Current formula	Formula 1	Formula 2	Formula 3	Formula 4	Formula 5	Formula 6
Region 1	12.6	64.2	23.2	414.22	411.18	408.39	409.03	410.97	409.92	410.62
Region 2	11.8	62.2	25.9	109.66	111.83	112.42	112.63	111.84	112.66	112.47
Region 3	11.6	62.1	26.2	272.01	277.21	275.93	275.88	277.22	275.95	276.48
Region 4	11.7	61.6	26.8	63.67	65.33	65.32	65.54	65.34	64.94	64.80
Region 5	12.1	62.9	25.0	9.03	9.15	9.32	9.31	9.13	9.41	9.39
Region 6	10.7	60.4	28.9	114.19	119.30	119.70	119.46	119.28	120.11	119.80
Region 7	12.8	63.8	23.4	724.22	718.75	717.91	718.23	718.78	720.26	719.42
Region 8	11.7	61.8	26.4	316.49	322.88	322.55	322.46	322.93	321.24	320.51
Region 9	12.4	63.1	24.5	325.47	326.08	326.15	326.25	326.21	326.39	327.32
Region 10	11.4	61.7	26.9	88.89	91.50	91.57	91.20	91.38	91.95	92.74
Region 11	14.4	63.8	21.8	77.35	75.23	75.24	75.14	75.23	75.00	75.06
Region 12	12.4	63.5	24.1	353.62	354.15	354.64	354.33	354.30	354.85	354.39
Region 13	11.9	62.8	25.3	94.02	94.87	93.90	93.95	94.82	93.55	93.57
Region 14	12.3	63.9	23.8	285.04	284.20	284.04	283.88	284.14	283.53	283.97
Region 15	11.3	63.8	24.9	39.39	39.95	40.51	40.35	39.95	40.72	40.45
Region 16	12.8	63.6	23.6	134.62	133.70	134.16	134.06	133.75	133.40	133.47
Region 17	13.8	65.6	20.6	397.56	384.18	386.18	386.37	384.27	385.68	384.51
Region 18	10.8	62.7	26.5	21.34	22.22	22.30	22.12	22.25	22.24	22.26
Region 19	10.4	63.3	26.3	117.20	120.31	120.38	120.38	120.26	120.01	120.02
Region 20	13.3	63.8	22.9	347.70	343.52	345.36	345.38	343.44	343.08	342.98
Total				4,305	4,305	4,305	4,305	4,305	4,305	4,305

Note: Formula 1: sex*age groups; Formula 2: sex*age groups + n. of hospitalizations; Formula 3: sex*age groups + n. of hospitalizations + n. of drug prescriptions; Formula 4: sex*age groups + citizenship + degree of urbanization + income; Formula 5: sex*age groups + citizenship + degree of urbanization + income + group of ICD-9 codes; Formula 6: sex*age groups + citizenship + degree of urbanization + income + group of ICD-9 codes + group of ATC codes.

RISK ADJUSTMENT: PROVIDER vs INSURER PAYMENTS

Same tool, different problem — and different design implications?



RA for Insurer Payments

Who receives payment?

Health insurers

Who is the payer?

Government / social health insurance fund

Core problem addressed

Risk selection — insurers avoid enrolling high-risk individuals

Unit of adjustment

Enrolled individual (capitation per member)

Risk pool concern

Composition of insurer's enrolled population

Key incentive distortion

Risk selection across insurance markets



RA for Provider Payments

Who receives payment?

Hospitals, GP practices, integrated care providers

Who is the payer?

Insurer, government, or purchaser (Region, LHA)

Core problem addressed

Cream-skimming & selective rationing — providers avoid or under-treat complex patients

Unit of adjustment

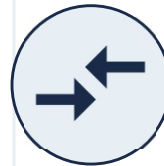
Episode, patient encounter, or enrolled patient

Risk pool concern

Case-mix of patients actually treated

Key incentive distortion

Under-provision and patient selection at point of care



Key distinction: Insurer RA corrects market competition; Provider RA corrects care delivery incentives — both are necessary in a well-designed health system.

Risk Adjustment in Health Care Systems

Key Takeaways

- RA is essential in both competitive (insurer payment) and non-competitive (NHS budget allocation) health systems, and providers payments — but with 'different' objectives (two sides of the same coin).

- In competitive systems: RA prevents risk selection, (= increases fairness) whilst increasing efficiency;

- In non-competitive systems / providers payments: RA ensures geographic fairness and adequate needs-based allocation and efficiency.

- RA even if imperfect is the best instrument to address the inherent trade-offs between fairness-efficiency-selection-quality.