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USING ACTUARIAL TECHNIQUES TO SOLVE THE ROI PUZZLE

May 7, 2007

DM COLLOQUIUM

AGENDA

1. "Standard" Methodology – a refresher.
2. Power of Population Methods.
3. Healthcare Cost Trend.
4. Benefit Adjustment.
5. Risk Adjustment.
6. Validation.
7. Questions?

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Introductions

- Ian Duncan, FSA, MAAA. President, Solucia Inc.
- 30 years of health actuarial experience, including PwC Management Consulting.
- Former General Manager of a small DM company – actually implemented program and managed nurses.
- Our practice focuses on care management financial issues ("the economics of care management"). We also offer care management automation software and predictive modeling solutions.
- Clients include several large Blues and health insurers, TPAs and care management companies.
- Recently completed a three-year study of care management evaluation and outcomes, funded by the Society of Actuaries.

Quick refresher: standard methodology

The prevalent industry methodology is a trend-adjusted historical control (pre- post) population methodology.

Simple example:

Estimated Savings due to reduced pmpy =	
Baseline Cost pmpy * Cost Trend	$6,000 * 1.12 = $6,720
Minus: Actual Cost pmpy	$6,300
Equals: Reduced Cost pmpy	$420
Multiplied by: Actual member years in	
Measurement Period	20,000
Equals: Estimated Savings	$8,400,000

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Quick refresher: standard methodology

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Standard methodology is full of actuarial concepts:

- **Trend**
- **PMPY**
- **(Actuarial) Equivalence**

Estimated Savings due to reduced pmpy =	
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Population Methods

Why this method?

Advantages
- Objective definitions of populations;
- Population Method; avoids worst features of regression to the mean and selection bias;
- Practical;
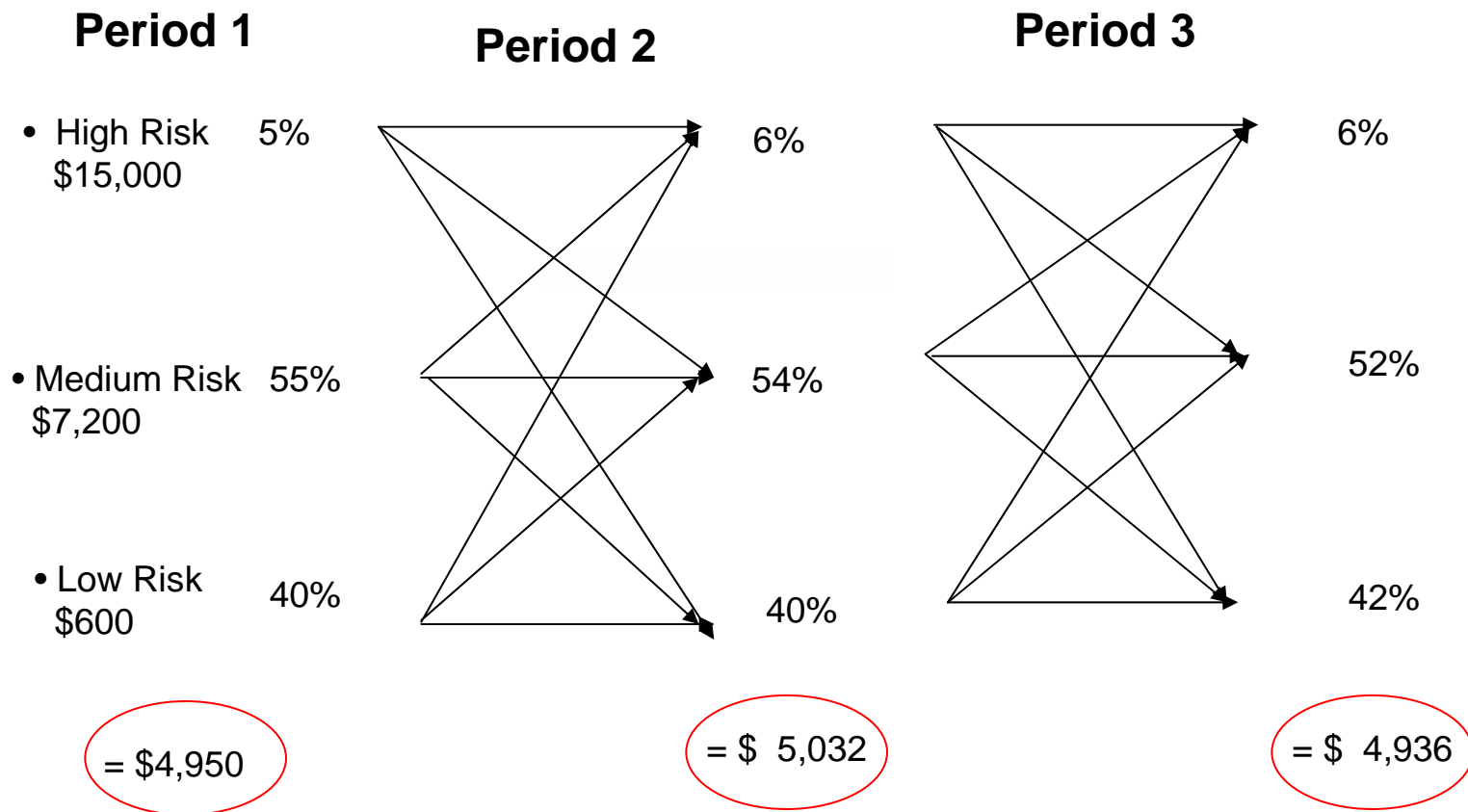- Gets to an answer (without costing more than the program).

Disadvantages
- Needs some adjustment (trend; benefits; risk);
- Sensitive to assumptions, timing;
- Year 2/3 problems.

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Population Measurement
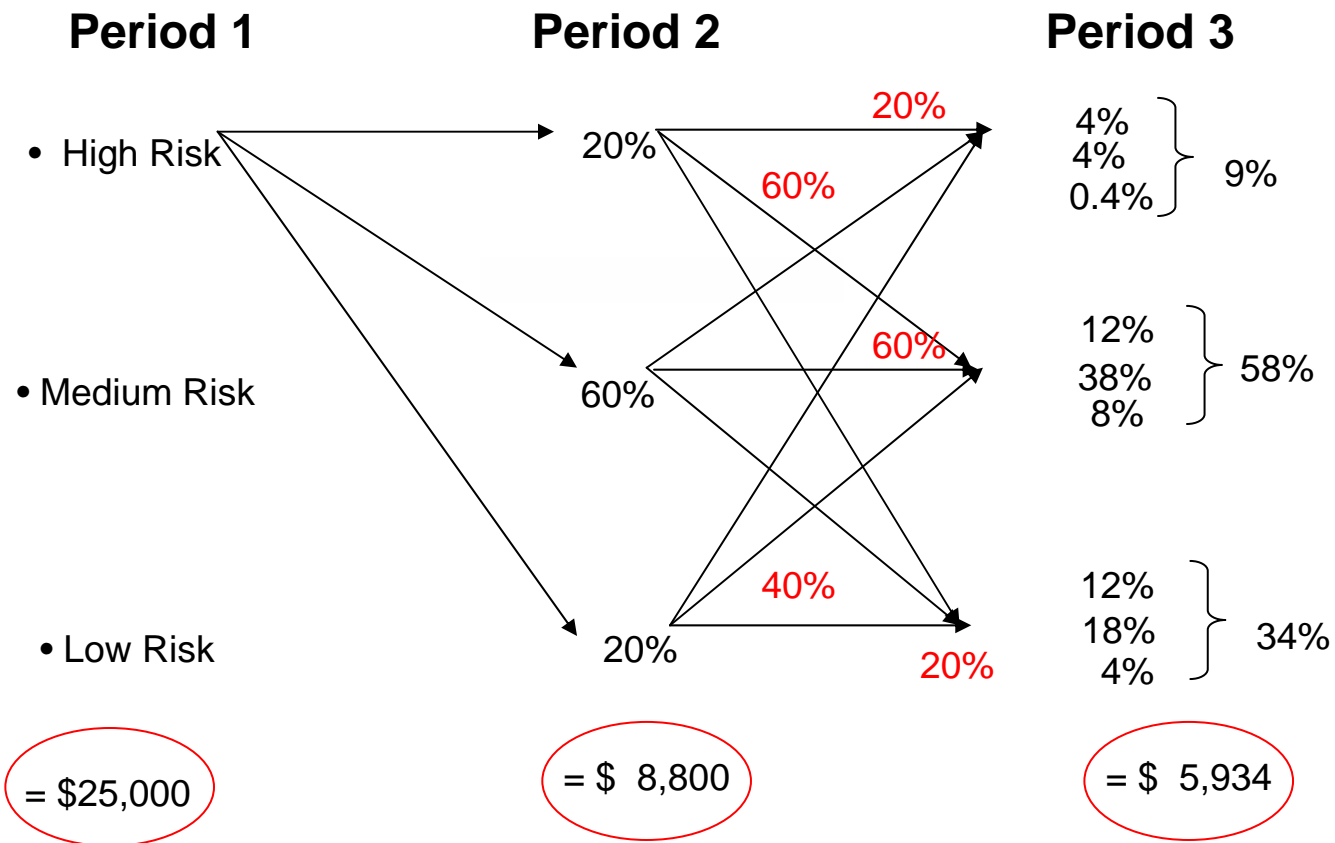
The power of the population methodology

Period 1   **Period 2**   **Period 3**

- High Risk   5%   6%   6%
  $15,000

- Medium Risk 55%   54%   52%
  $7,200

- Low Risk
  $600   40%   40%   42%

= $4,950   = $ 5,032   = $ 4,936

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Population Measurement

Problems when a sub-population is tracked

Period 1	Period 2	Period 3
• High Risk	20%	4% / 4% / 0.4% → 9%
• Medium Risk	60%	12% / 38% / 8% → 58%
• Low Risk	20%	12% / 18% / 4% → 34%

20% 20% 60% 60% 40% 20%

= $25,000   = $ 8,800   = $ 5,934

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Population Methodology

- The previous slide illustrates how transition probabilities (20%/60%/20%) assign Period 1 high risk members to Period 2 and 3's risk categories.

- This is a cohort example, not a population example.

- Regression to the mean inherent in a cohort is clearly evident: Period 1 costs start at $25,000 but fall to $5,934 by Period 3.
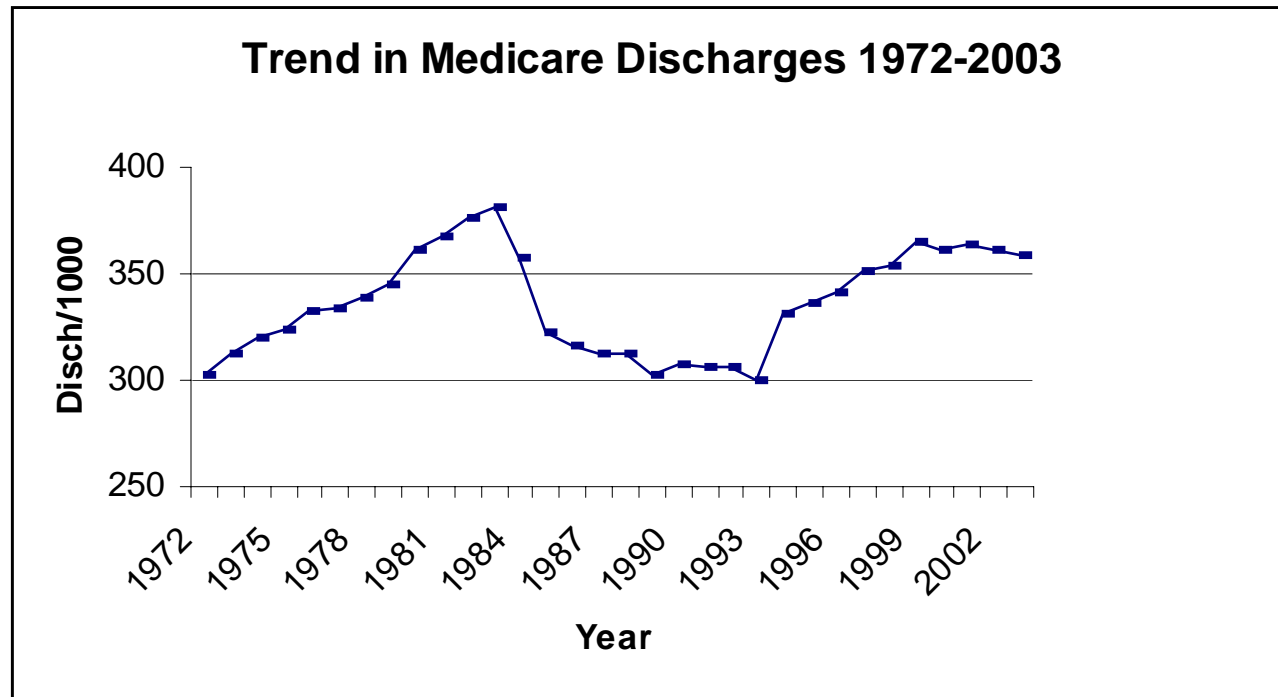
Let's look at 3 actuarial concepts

- Trend Adjustment
- Benefit Adjustment
- Risk Adjustment

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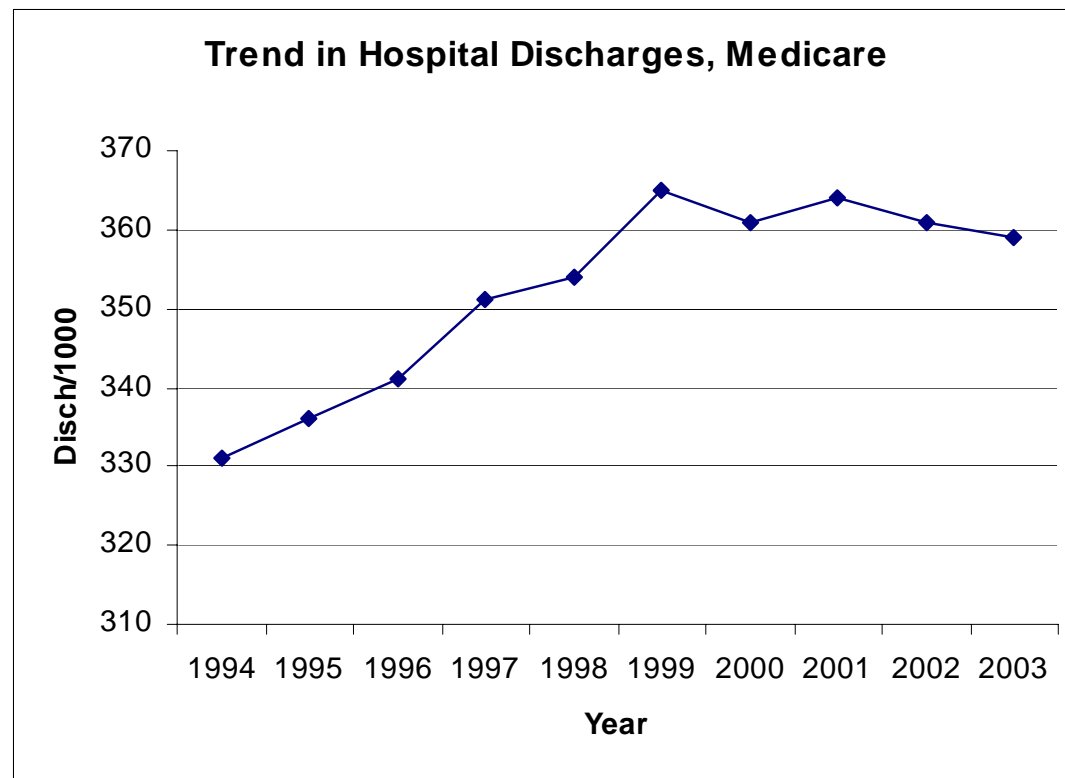
Trend is tough to understand and measure

- Is there a trend in the following data?
- What is it?

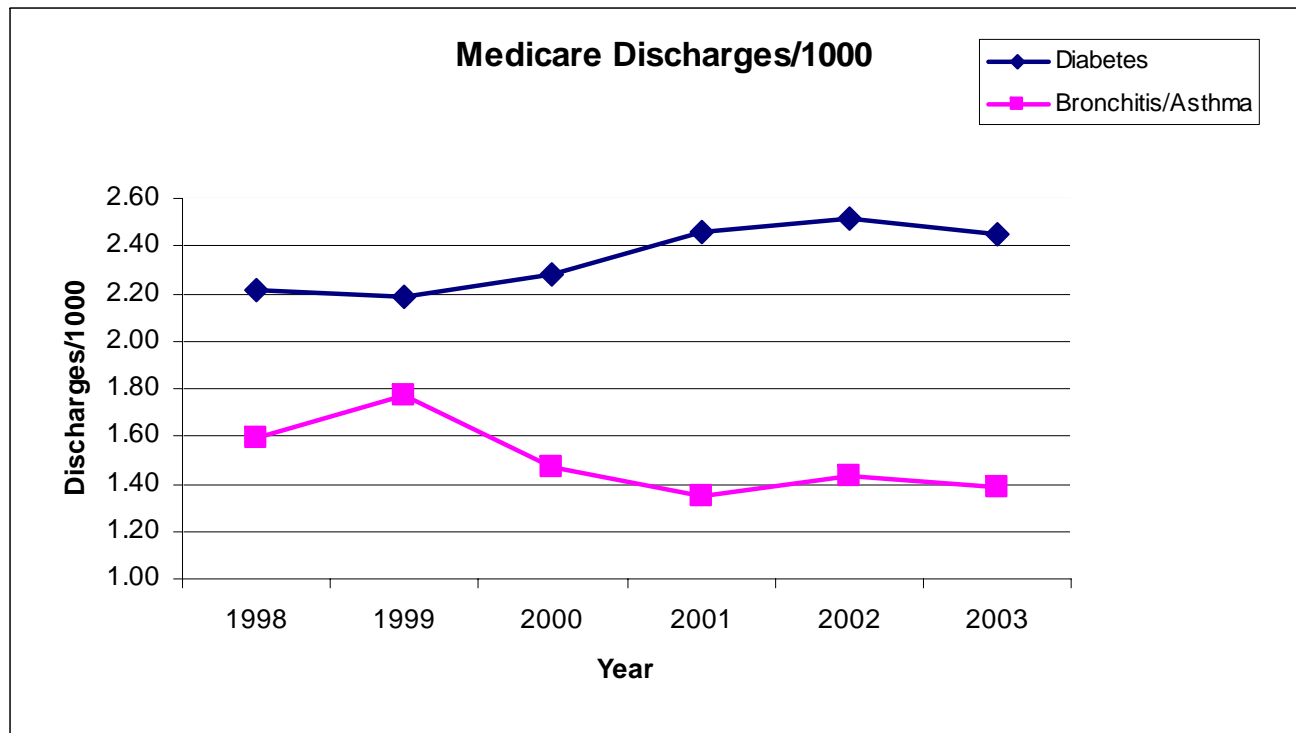### Trend in Medicare Discharges 1972-2003

Inpatient Admission Trend data

Even in a consistently defined dataset.

Trend in Hospital Discharges, Medicare

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What do we mean by "Trend"?

"Trend" is an annualized rate of change.
It is not the absolute change except over an annual period.

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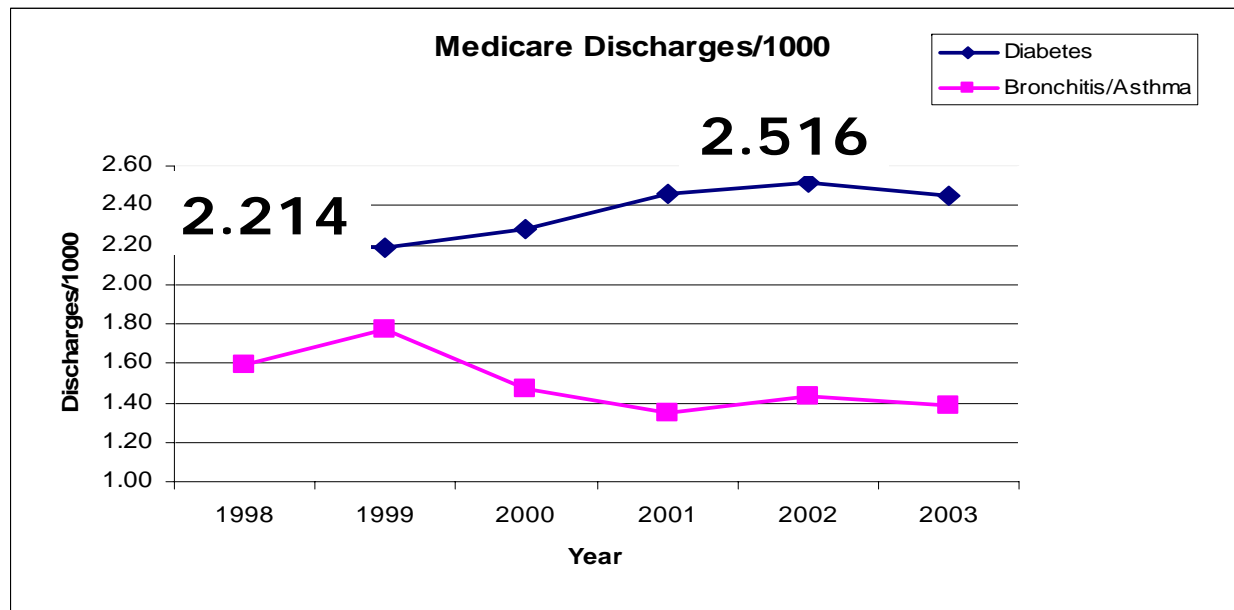Diabetes Trend *is not* 13.6% (2.516/2.214)
Diabetes Trend *is* 3.2% annually $(2.516/2.214)^{.25}$

What do we mean by "Trend"?

The previous slide shows, at least with respect to Diabetes, that a trend adjustment for utilization (increase in the number of admissions that would have occurred, absent the program) is appropriate.

This is not always true, as the asthma case shows (trend is -2.8% annually).

From which we learn 2 things:

- With the "right" degree of movement within risk categories, applied to the whole population with the condition, it is possible that the underlying average cost of a population will not change much (except for the "genuine" things like utilization and price changes).

BUT

- Even small changes in mix of risk can have an effect on average PMPM, and thus trend.

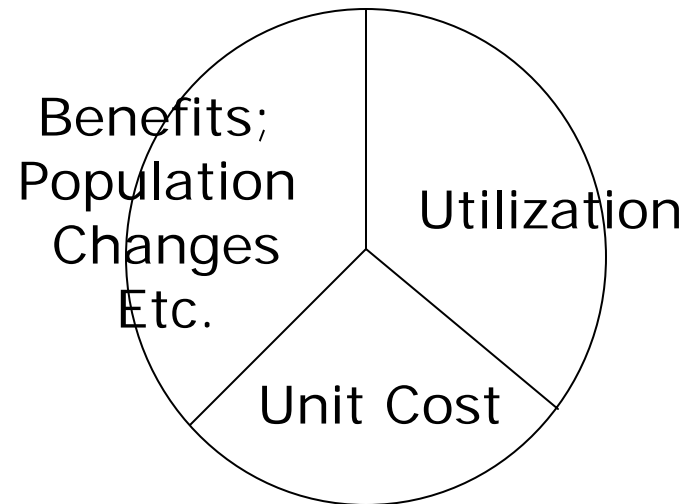| $ 4,950 | $5,032 | $4,936 |
| Trend: | 2% | - 2% |

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Major Drivers of Trend

Benefits;
Population
Changes
Etc.

Utilization

Unit Cost

Strictly speaking, trend adjusters should be normalized for benefit and population changes (or you should know what the impact of these factors is).

Quick refresher: trend components

A 12% trend consists of two major components:

- 2% utilization trend, and
- 10% unit cost trend.

Other factors can affect trend, for example leveraging of cost-sharing.

We can address the confounding effect of cost-sharing by using either:

- **Allowed charges (no cost-sharing); or**
- **A separate calculation of allowed + cost-sharing, from which we can derive net paid claims.**

Quick refresher: trend components

- Critics of the use of Cost trend adjustment in DM suggest that it "inflates" savings. However, for the purpose of calculating a PMPM cost-savings measure, a unit cost measure is required, to convert utilization changes into $'s.

- While unit cost trend isn't the only way to introduce unit costs, it is consistent with the "projected baseline" approach.

- Trends in allowed charges are not subject to benefit plan design features, and are more stable over time.

See example, next page.

Simple Example:

	Units Per 1000
Baseline	100.00
Utilization Trend	1.02
Trended Baseline	102.00
Actual	99.00
Reduction	3.00

But you need a unit cost to convert to $ savings

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Calculation based on Utilization...

Simple Example:

	Units Per 1000	Unit Cost
Baseline	100.00	$8,000.00
Trend	1.02	1.10
Trended Baseline	102.00	$8,800.00
Actual	99.00	$8,800.00
Reduction	3.00	$8,800.00

**Current Period Unit Cost
(= Prior Period's Unit
Cost + Unit Cost Trend)**

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Calculation based on Utilization...

Simple Example:

	Units Per 1000	Unit Cost	Cost PMPM
Baseline	100.00	$8,000.00	$66.67
Trend	1.02	1.10	1.12
Trended Baseline	102.00	$8,800.00	$74.80
Actual	99.00	$8,800.00	$72.60
Reduction	3.00	$8,800.00	$ 2.20

You get the same answer whether you apply a PMPM trend to a PMPM baseline, or a Utilization Trend + Current Unit Cost.

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Hypothesis Underlying DM Population Measurement

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- It is possible to measure a population and its utilization accurately and unambiguously over time.

- Corollary: it is possible to separate the effect of an *intervention* from the underlying tendencies of a population.

- Conundrum: Switching to a utilization-based measure (e.g. Admissions) doesn't eliminate the need to understand the long-term trends in the population you are managing.

Inpatient Admission Trend data - mixed

- In Medicare, Total Discharges/1000 peaked in 1999 and have been declining slightly since then (<1% p.a.).

- Overall, trend has been positive over the last 10 years (data prior to 1994 not comparable).

Trends in Medicare discharges

MEDICARE DISCHARGES PER 1000 BY CONDITION*

Year	Diabetes	Renal Failure	Bronchitis & Asthma	COPD	Heart	Syncope
DRG	294	316	096	088	132-144	141-142
1998	2.214	2.455	1.597	10.254	17.954	3.283
1999	2.187	2.566	1.773	10.617	17.738	3.367
2000	2.280	2.768	1.470	9.925	18.744	3.608
2001	2.458	3.001	1.352	10.047	19.949	3.915
2002	2.516	3.174	1.428	10.275	19.682	4.089
2003	2.450	3.984	1.385	10.335	18.706	4.259
Annualized Trend	2.1%	10.2%	-2.8%	0.2%	0.8%	5.3%

* Actuarial Trend, i.e. per member per month

Source: CMS reports

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Inpatient Admission Trend data - mixed

Commercial data are more difficult to assess.

- Populations and contracts are more volatile. Employees enter and leave; groups churn.
- Commercial plans and employers constantly change product and benefit designs, vendors and administration.
- Commercial plans change network providers.
- Newly-identified member issue.

What about Chronic Trends?

Chronic and Non-chronic Trends

Average 3-year trends*

Chronic	5.6%
Non-chronic	13.8%
Population	16.0%

* Prospective chronic identification

From Bachler, R, Duncan, I, and Juster, I: *"A Comparative Analysis of Chronic and Non-Chronic Insured Commercial Member Cost Trends."* North American Actuarial Journal (forthcoming) October 2006.

Chronic and Non-chronic Trends

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Average 3-year trends*

Chronic	16.3%
Non-chronic	17.2%
Population	16.0%

*Retrospective chronic identification

From Bachler, R, Duncan, I, and Juster, I: *"A Comparative Analysis of Chronic and Non-Chronic Insured Commercial Member Cost Trends."* North American Actuarial Journal (forthcoming) October 2006.

Chronic and Non-chronic Trends

Our findings (NAAJ paper) included the presence of "migration bias" that means that non-chronic (or overall) trend isn't a very good proxy for unmanaged chronic trend.

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Benefit Adjustments

An advantage of the historical trend-adjusted method is that you can perform the analysis at the Allowed Charge level* (before deductibles, coinsurance, etc.) so much of the impact of benefits on trend can be ignored.

Sometimes, benefit differentials have to be taken into account, for example when concurrent populations are compared. Actuaries have many good tools available for estimating the impact of different benefit designs on cost (PMPM). We can also estimate the effect on specific utilization.

* Permitted by DMAA Guidelines

Risk Adjustment

Risk Adjustment* is an actuarial response to the principle of equivalence.

Any population will change its risk profile over time. Trends calculated in populations subject to change in risk will be distorted, as will utilization comparisons.

There are different methods developed to ensure equivalence. Risk Adjustment is prevalent in health plans, where it is used in Medicare reimbursement, provider reimbursement and underwriting.

* Permitted by DMAA Guidelines

Risk Adjustment

Risk Adjustment is a reasonable correction to the effect of changes in the underlying *non-chronic* population, if you are using the non-chronic population trend as the adjuster.

However, it is not appropriate to risk-adjust the chronic population, because the intervention may be responsible for the reduction in risk.

In the chronic population, adjustment for the mix of conditions, and duration (incident and prevalent chronic members) may be appropriate.

Validation

It is a good idea to validate any dollar savings estimates, because there needs to be a demonstrable source of any dollar savings.

Primarily, savings should be expected from inpatient admissions.

Using whole population admissions for primary chronic conditions only may introduce a reconciliation problem, however.

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Validation

In a Commercial population, the number of members actually managed, and their associated admissions, is small.

Because the affected admissions is small, the number is also at risk of being affected by exogenous factors.

Sensitivity of Admission Measures

Members	100,000
Diabetics (2.5%)	2,500
High Risk	750
Engaged in Yr 1*	375
Average exposure in Program Yr.	0.75
Deferral Period	6 months
Life years in Program	94
Diabetes Admits/1000	100
Expected Admits, Population	250
Expected Admits, High Risk	125
Admit reductions*	15%
Admit reductions*	2.3
Effect on Population Admits	0.9%

* If you are good at it

Sensitivity of Admission Measures

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- You only need 2 claims to be coded differently to change the outcome from success to failure.

- What happens if 30 high-risk Diabetics develop a heart condition (and are classified under "heart")?

- What happens if a large new employer group is added? If the employer group does not offer your drug coverage?

- What happens if the geographic concentration changes (since utilization is influenced by geographic treatment variations)?

P.S.: It only takes 30 new High Risk Diabetics to be added to the pool to add 2 more admissions.

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Thank you for your time and attention!

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