# CMI Critical Illness Investigation

Current Issues in Healthcare
12 December 2007, Staple Inn

*David Heeney, Chairman, CMI Critical Illness Committee*
*and*
*Dave Grimshaw, Secretary, CMI Critical Illness Committee*

# Agenda

- **CI Investigation Objectives and Progress**

- **Key Challenges**

- **Recent Progress**

- **Next Steps**

# Where are we going?

| Age $x$ | Duration 0 | Duration 1 | Duration 2 | Duration 3 | Dur |
|---|---|---|---|---|---|
| 17 | 0.000193 | 0.000251 | 0.000294 | 0.000337 | 0.0 |
| 18 | 0.000194 | 0.000251 | 0.000295 | 0.000338 | 0.0 |
| 19 | 0.000195 | 0.000253 | 0.000297 | 0.000340 | 0.0 |
| 20 | 0.000196 | 0.000254 | 0.000298 | 0.000342 | 0.0 |
| 21 | 0.000197 | 0.000256 | 0.000300 | 0.000344 | 0.0 |
| 22 | 0.000199 | 0.000258 | 0.000302 | 0.000347 | 0.0 |
| 23 | 0.000200 | 0.000260 | 0.000305 | 0.000350 | 0.0 |
| 24 | 0.000202 | 0.000263 | 0.000308 | 0.000353 | 0.0 |
| 25 | 0.000204 | 0.000265 | 0.000311 | 0.000357 | 0.0 |
| 26 | 0.000207 | 0.000269 | 0.000316 | 0.000362 | 0.0 |
| 27 | 0.000211 | 0.000274 | 0.000321 | 0.000368 | 0.0 |
| 28 | 0.000214 | 0.000278 | 0.000326 | 0.000374 | 0.0 |
| 29 | 0.000220 | 0.000285 | 0.000334 | 0.000383 | 0.0 |
| 30 | 0.000227 | 0.000294 | 0.000344 | 0.000394 | 0.0 |
| 31 | 0.000237 | 0.000306 | 0.000357 | 0.000409 | 0.0 |
| 32 | 0.000250 | 0.000320 | 0.000373 | 0.000426 | 0.0 |
| 33 | 0.000264 | 0.000337 | 0.000391 | 0.000446 | 0.0 |
| 34 | 0.000280 | 0.000355 | 0.000412 | 0.000469 | 0.0 |
| 35 | 0.000297 | 0.000376 | 0.000435 | 0.000494 | 0.0 |
| 36 | 0.000315 | 0.000398 | 0.000459 | 0.000521 | 0.0 |

# How do we get there?

| Age $x$ | Duration 0 | Duration 1 | Duration 2 | Duration 3 | Dur |
|---------|-----------|-----------|-----------|-----------|-----|
| 17 | 0.000193 | 0.000251 | 0.000294 | 0.000337 | 0.0 |
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Raw experience

Grossing-Up Factors

# Progress to date (1)

- **Results for 1999, 2000, 2001, 2002 & quad released in May 2005**

- **Working Paper 14:**
  - **Detailed methodology underlying 1999-2002 results**
  - **Estimate of overall grossing-up factor**

- **Working Paper 18:**
  - **Responses to feedback on WP14**
  - **Reasons for not graduating (yet)**

- **1999-2002 data available to CMI members**

- **Working Paper 19: "Per-Policy" data submission**

# Progress to date (2)

- **2003 Results released in April 2006:**
  - **Covered "quad offices"**
  - **data from several "new" offices not included**

- **Health Claims Forum guidelines published in November 2006**

- **Error in 2003 data from one office**
  - **highlighted in 2004 submission**
  - **Error corrected and new offices added**
  - **"2003 revised" results released in April 2007**

- **2004 results released in April 2007:**
  - **Same offices as in "2003 revised"**

- **Working Paper 28 published in July 2007**

# Agenda

- **CI Investigation Objectives and Progress**

- **Key Challenges**

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# Key Challenges

- **claim date definitions**
- **claim development**
- **business growth**

**The key challenge facing the CI investigation is that we collect settled claims, but want to measure experience in terms of diagnosed claims**

# Health Claims Forum consultation

**Definition:**

The date of diagnosis is **the date at which the critical illness definition was fulfilled**

**Key Points:**

- **Interpretation specified for April 2006 ABI definitions**
- **Companies asked to adapt these for older and non-ABI definitions -**
  - **Where there is a clear event date – use that (e.g. Heart Attack)**
  - **Where it is a degenerative disease then allow for permanence to be established**
- **Adoption date: 1st January 2007**

# Health Claims Forum Consultation – the future

- **Adoption of HCF guidelines will:**
    - **improve consistency between offices**
    - **improve consistency over time with offices**
    - **increase recording of 'Date of Diagnosis'**
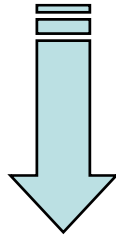
*Lower risk of error due to estimating diagnosis dates from settled claims*

# Claims typically take 6 months to settle

- Approx. observed intervals between claim dates:

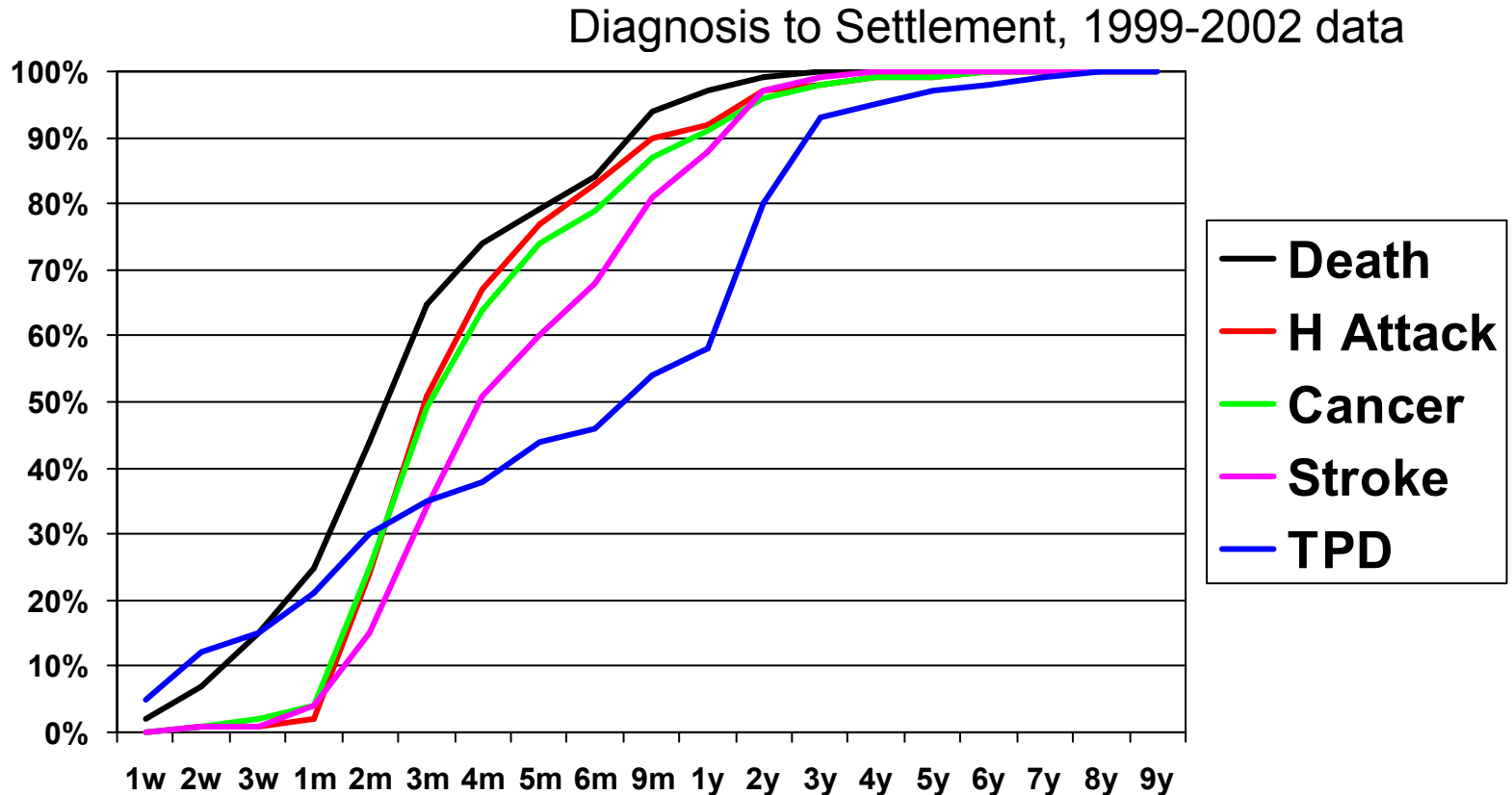  - Date of Diagnosis

    114 days

  - Date of Notification

    55 days

  - Date of Admittance

    7 days

  - Date of Settlement

**The Actuarial Profession**
making financial sense of the future

# But development patterns vary by cause



Diagnosis to Settlement, 1999-2002 data

Legend:
- **Death** (black)
- **H Attack** (red)
- **Cancer** (green)
- **Stroke** (magenta)
- **TPD** (blue)

# And often we only have settlement date

- Date of diagnosis is estimated where not known
- The date of diagnosis is used to correctly calculate the age and duration but not to re-allocate claims in or out of the analysis
- This would not be a major issue with a stable portfolio
- BUT VOLUMES HAVE INCREASED RAPIDLY
- The effect of this is that 1999-2002 results are under-stated by a factor of the order of 15%
- This factor will vary between offices according to the growth rate in their claims portfolio

# Growing Exposure 1999-2004



Exposure
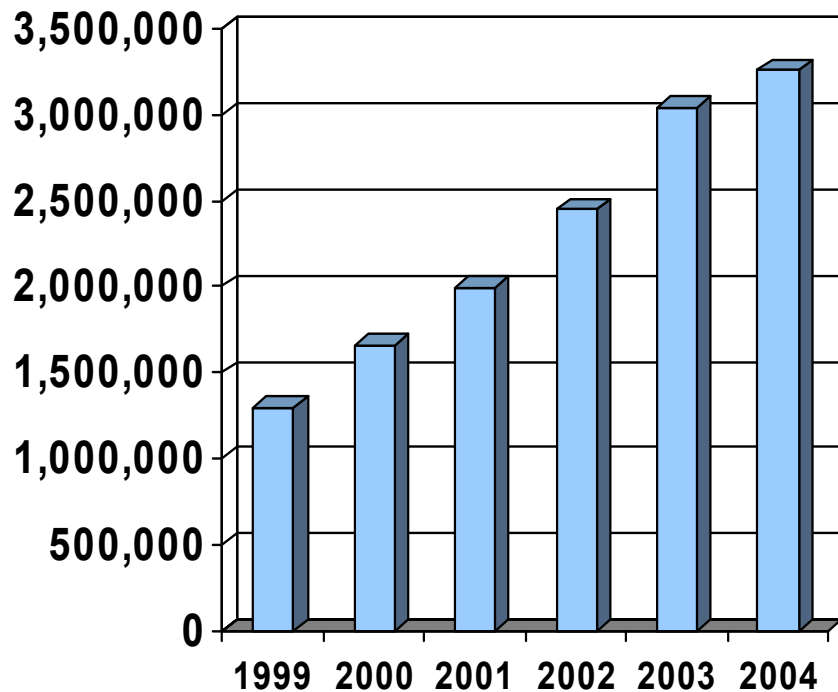
Settled Claims
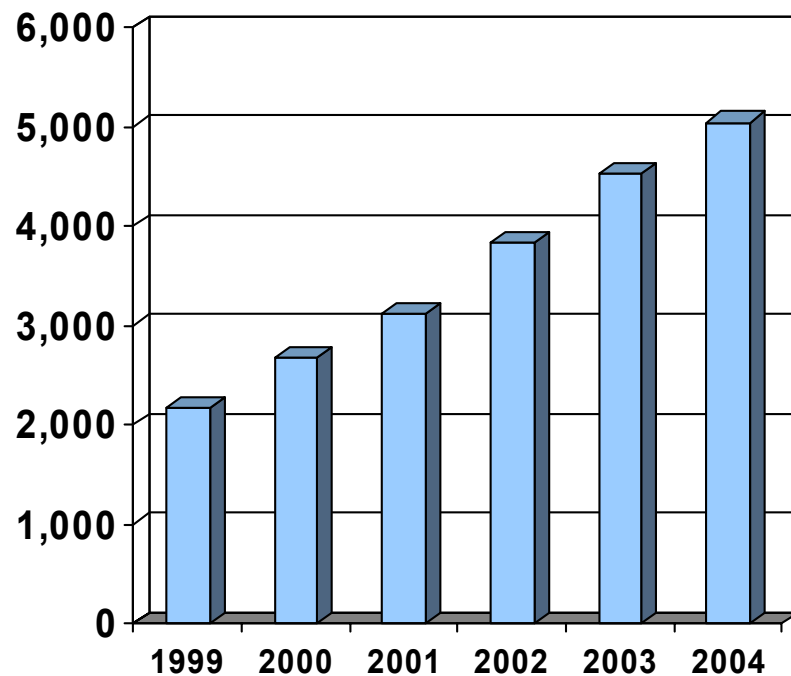
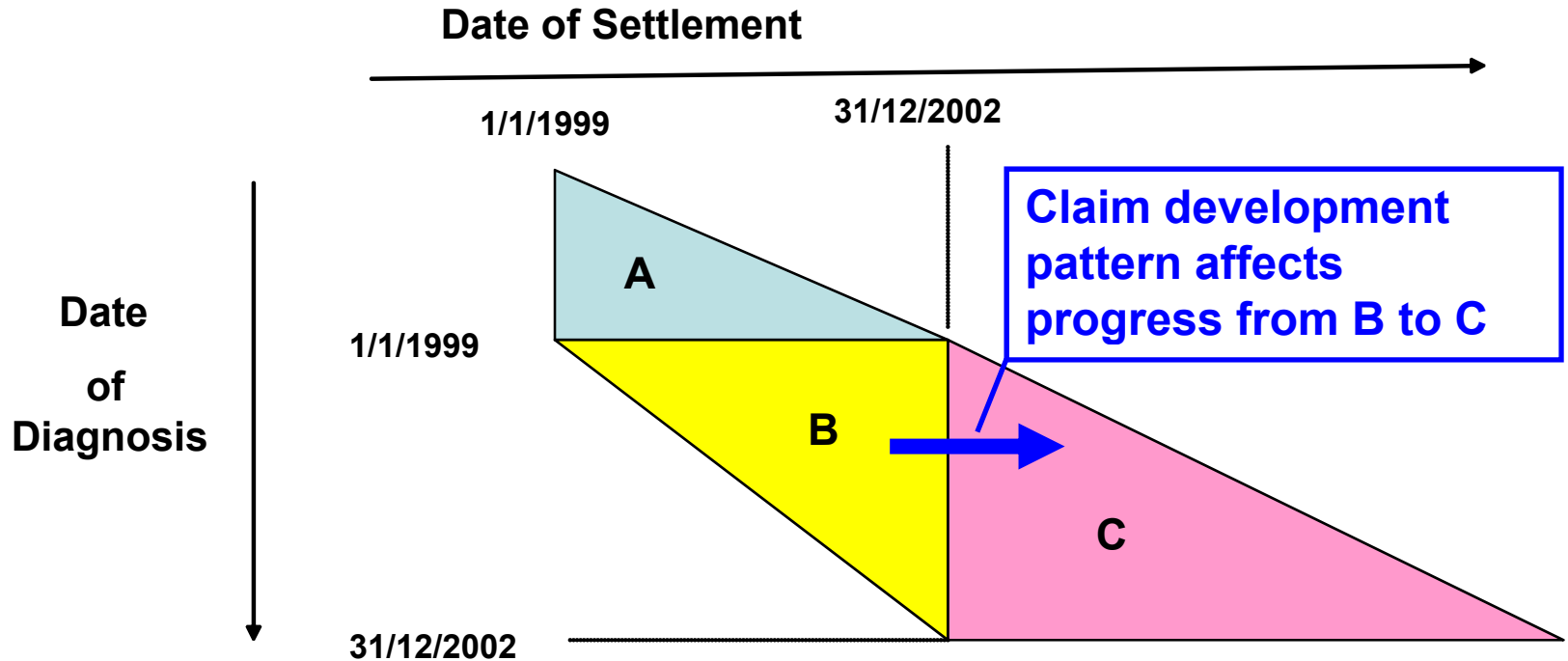The title has changed to 1999-2004 rather than 1999-2003.

The graphs have been revised in respect of 2003 and 2004 numbers have been added.
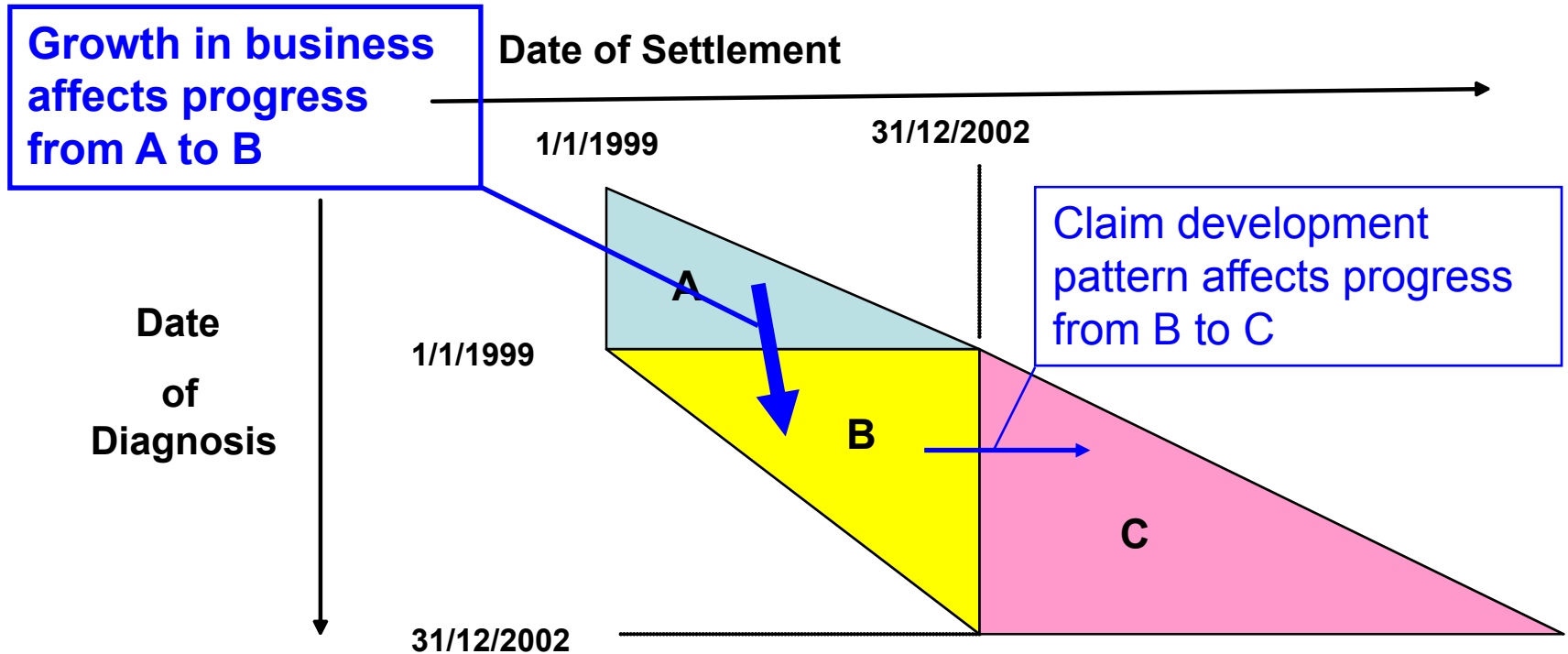
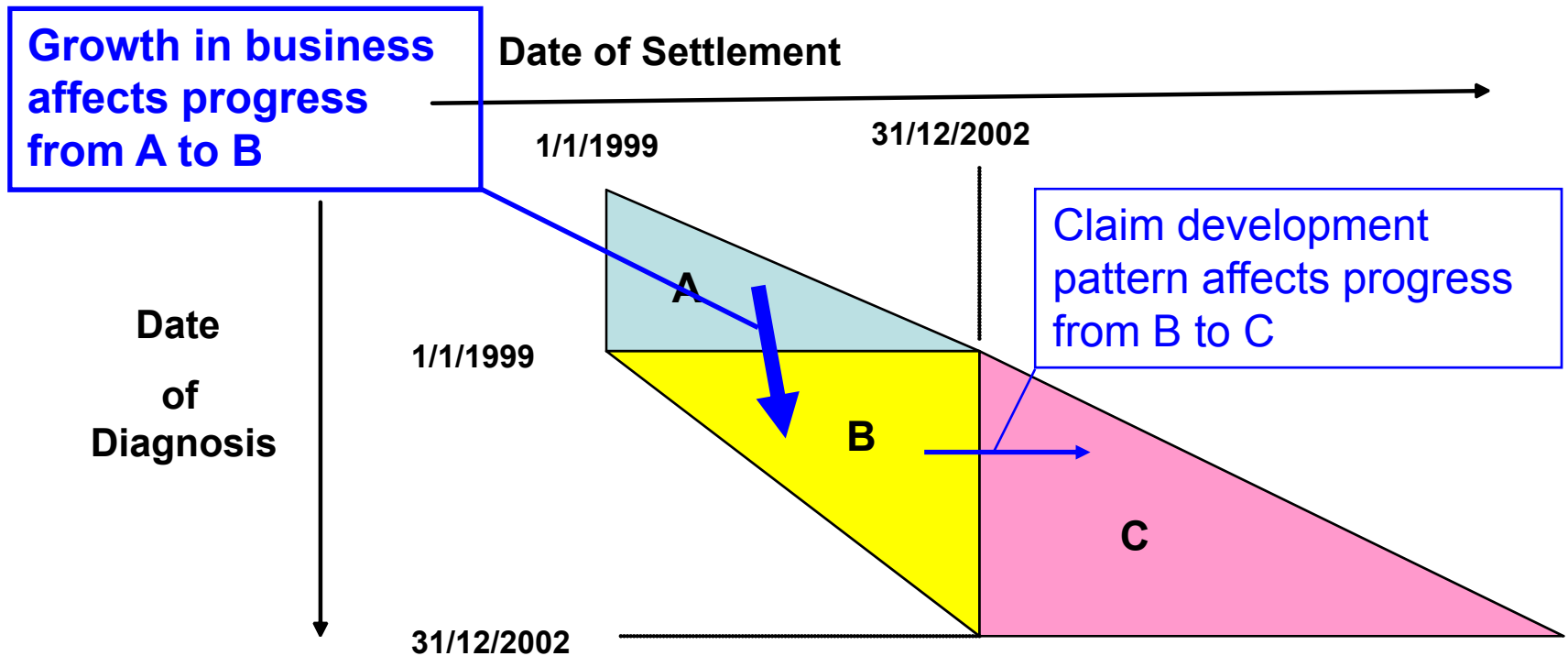jxb, 03/04/2007

# Date of Diagnosis v Date of Settlement
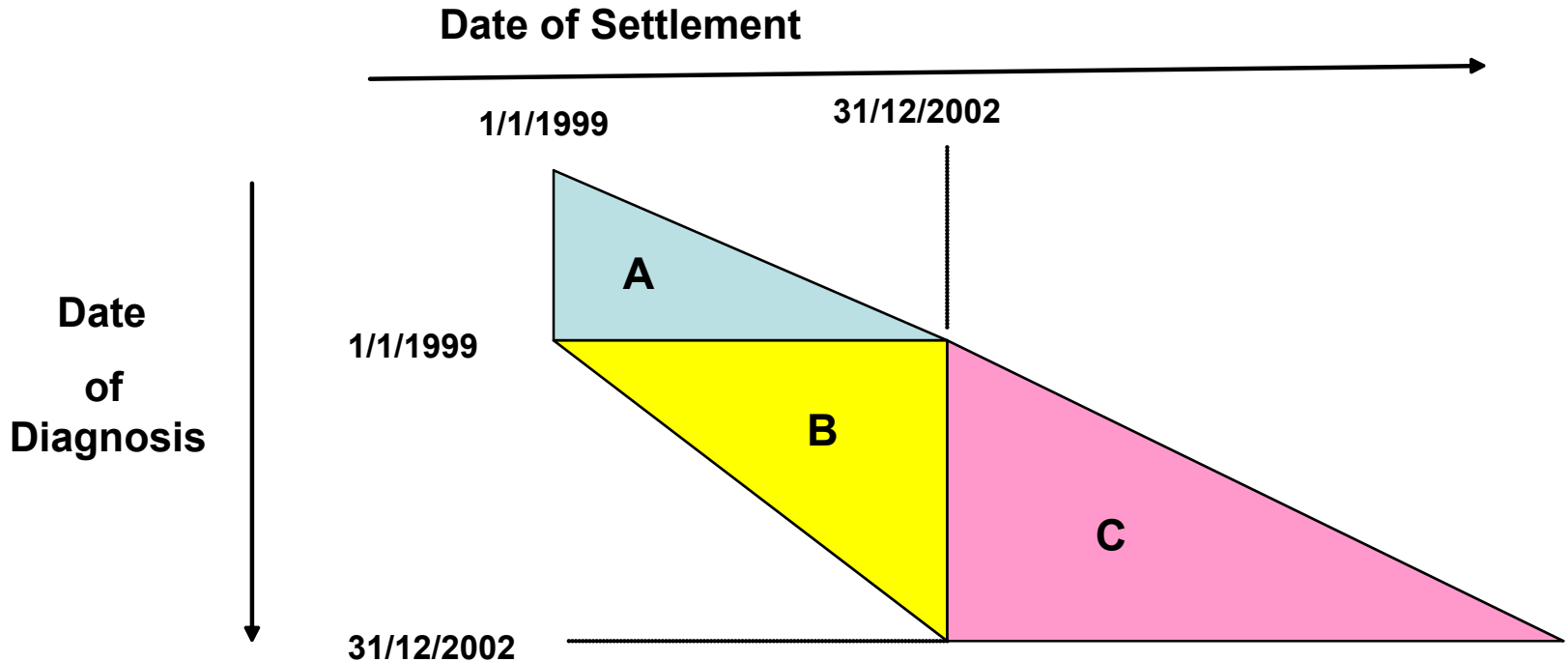
# Date of Diagnosis v Date of Settlement

# Date of Diagnosis v Date of Settlement

Growth in business affects progress from A to B

Date of Settlement

1/1/1999

31/12/2002

Claim development pattern affects progress from B to C

Date

of

Diagnosis

1/1/1999

A

B

C

31/12/2002

# Date of Diagnosis v Date of Settlement

**Growth in business affects progress from A to B**

Date of Settlement

1/1/1999

31/12/2002

Date of Diagnosis

1/1/1999

31/12/2002

A

B

C

**Claim development pattern affects progress from B to C**

**(A + B) x (1 + grossing-up factor) = (B + C)**

# Impact of growth in exposure on Grossing-Up Factors

- **Guidelines provided in Working Paper 14:**

| Annual rate of growth in expected claims | Approximate grossing-up factor |
|---|---|
| Nil | 100% |
| 10% | 107% |
| 20% | 112% |
| 30% | 117% |
| 50% | 124% |
| 75% | 132% |
| 100% | 139% |

# Estimation of Grossing-Up Factors

- **Using development patterns derived from data from 1999-2003, overall GUF for 1999-2002 estimated to be <span style="color:red">15.9%[1]</span>**

- **But, using development patterns derived from data from 1999-2002, overall GUF for 1999-2002 estimated to be <span style="color:red">17.8%</span>**

- **Overall GUF for 2003 estimated using this approach and development patterns derived from data from 1999-2003 is <span style="color:red">14.3%</span>**

- **Corresponding GUF for 2004 is just <span style="color:red">1.9%</span> due to significant downturn in business volumes**

- *Are GUFs too unstable?*

- *Is there a better way?*

[1]15.9% for 1999-2002 is new estimate following correction of the 2003 data error.
Previous estimate was 14.8% (quoted at Staple Inn Seminar; Dec 2006)

# Agenda

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- **Recent Progress**

- **Next Steps**

# New Methodology

**The key challenge facing the CI investigation is that we collect settled claims, but want to measure experience in terms of diagnosed claims**

- **Grossing-up factors attempted to allow for this, but …**
  - **Difficult to interpret, as mix growth in business and claim development,**
  - **Difficult to apply to subsets of the data, and**
  - **The new approach makes better use of the data we have**

# New Methodology

- **The approach starts with estimating prior years' in force data and hence exposure**

- **… from which we estimate diagnosed claims in each year (at each age and duration) using an initial set of claim rates**

- **… we then apply a claim development distribution to estimate settled claims in each year**

- **… these can be compared to known settled claims to release more accurate results**

- **… and equating estimated settled claims with known settled claims will generate a set of diagnosed claim rates**

# New Methodology

- **The approach starts with:**
  - **the known in force data (1/1/1999 to 1/1/2003) and**
  - **the known settled claims (1999 to 2002)**
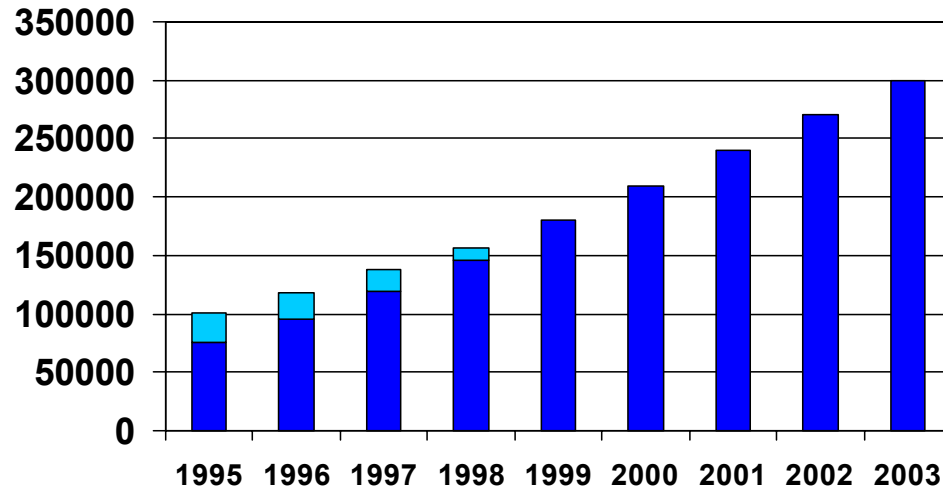
**In Force at 1 Jan**
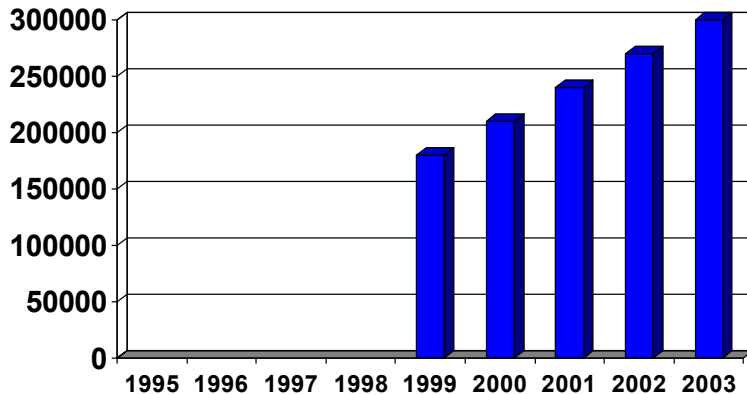


**Settled Claims**
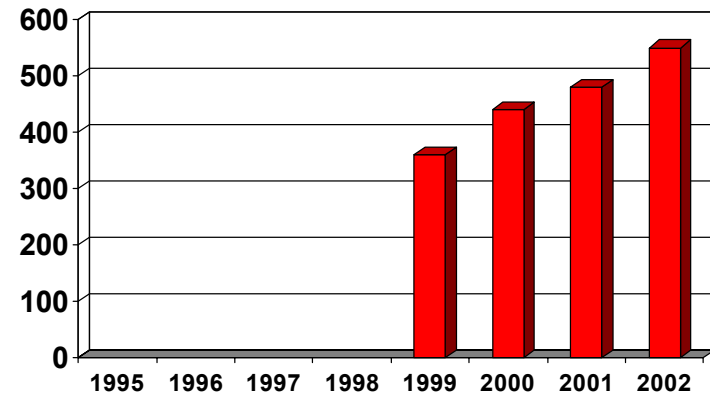
# New Methodology

- **From the known in force, we estimate prior years' in force data:**
    - **Part of this is a roll-back of known data** *(including adjusted age and duration)*
    - **And part is an estimate of the business that went off before data submitted to CMI**
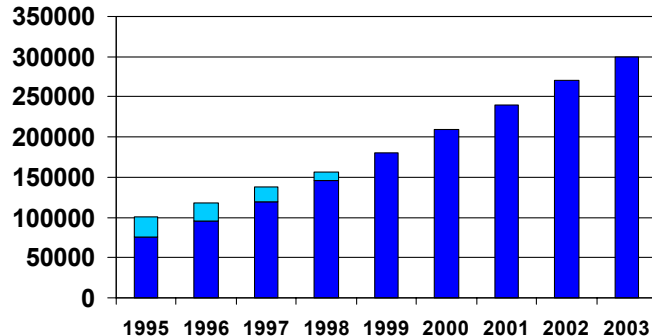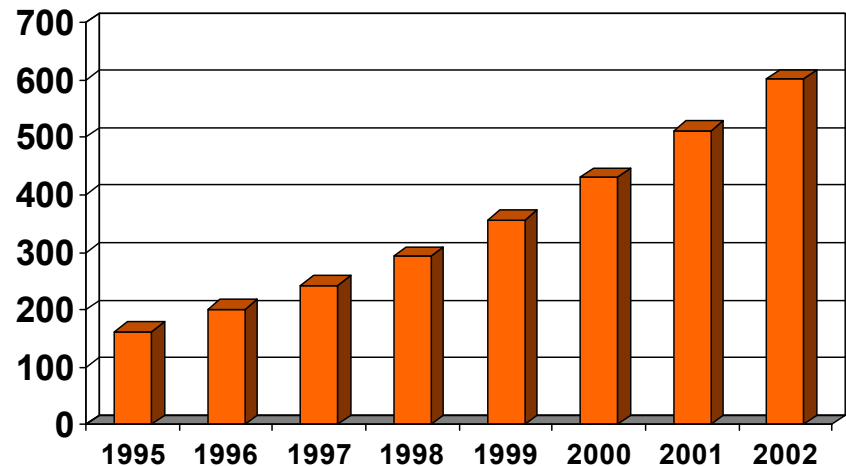- **Hence exposure in each year**

**In Force**

# New Methodology

- **From the estimated exposure in each year we estimate diagnosed claims in each year (at each age and duration) using an initial set of claim rates**
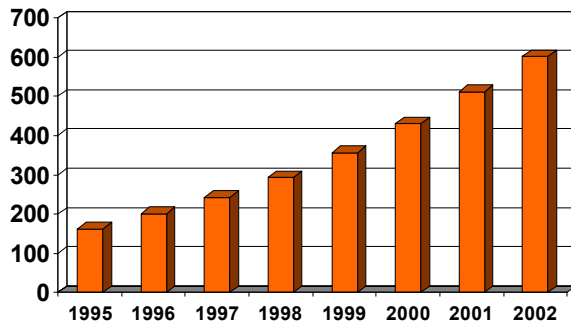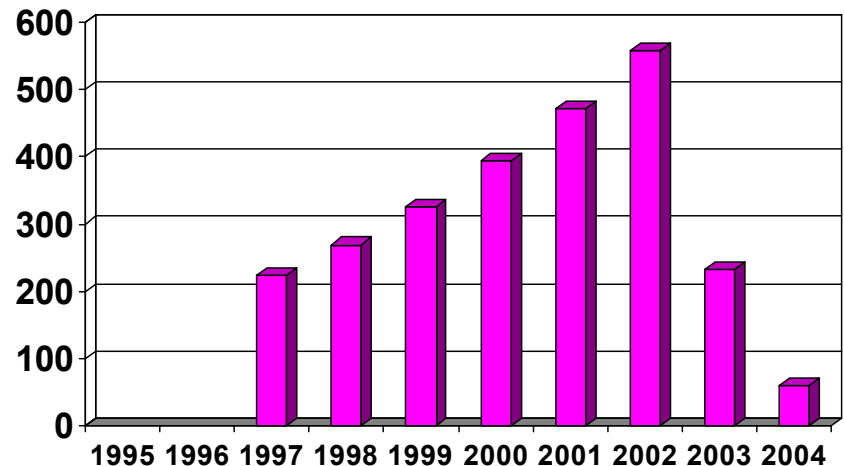
**In Force**



**Diagnosed Claims**

# New Methodology

- **From the estimated diagnosed claims in each year we can estimate settled claims in each year (at each age and duration) using an assumed claim development distribution**
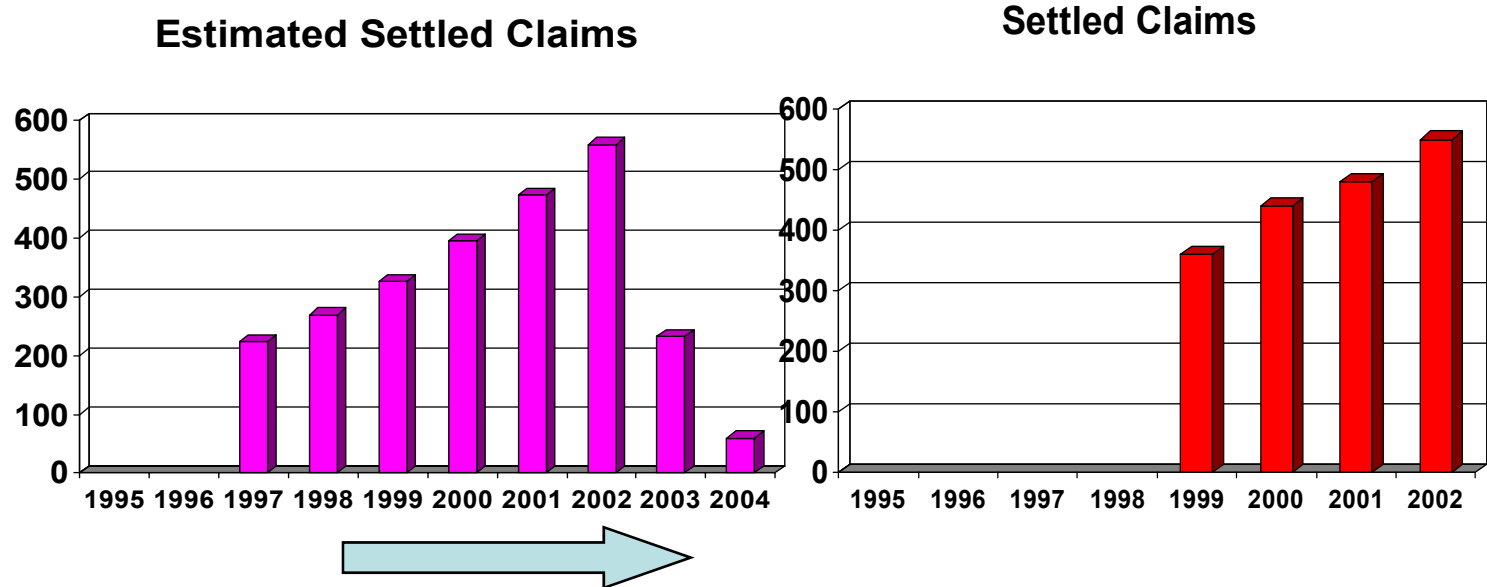
**Diagnosed Claims**



**Estimated Settled Claims**



NB Max interval from diagnosis to settlement = 2 years in this illustration

# New Methodology

- **We then compare estimated settled claims in 1999-2002 with known settled claims in 1999-2002 (at each age and duration)**

**Estimated Settled Claims**

**Settled Claims**



- **This can be used to present the results (for a given base table and claim development distribution)**
- **Or we can amend our assumption regarding claim rates to get the best fit and a set of diagnosed claim rates**

# New Methodology

**Working Paper 28:**

- **Explanation of new methodology**

- **Example of an initial application**

  - **Focus on the roll-back of in force**

  - **Results only - didn't go as far as claim rates**

- **Demonstration that results are not overly sensitive to the assumptions (especially off rates)**

# New Methodology

**Subsequently:**

- **Limited feedback on Working Paper 28**

- **"System" developed to allow a full implementation**
  - **WP28 used simplistic spreadsheet application**
  - **More accurate calculation of exposure, using actual dates of commencement, affects duration 0 results (in particular)**

- **Claim development distribution**
  - **WP28 used a single distribution (from WP14)**
  - **GLM analysis suggests cause of claim and office are significant but need to assess for other factors**
  - **Parametric model**

# New Method: Claim development distribution

- **Features of a parametric model:**
    - **Smooth fit**
    - **Probability of settlement for every delay**
    - **Entire distribution can be easily summarised**
    - **Provides mean, variance, etc**
    - **Goodness of fit can be tested**
    - **Fit can be obtained from limited data**
    - **Predictive power (?)**

# New Method: Claim development distribution

- **Parametric modelling focused on distribution between diagnosis and settlement**

- **Calculation complicated by:**
  - **Left censoring because diagnosed in prior year and "exposed to settlement" before investigation period**
  - **Right censoring because diagnosed in investigation period and "exposed to settlement" in subsequent years**
  - **Investigation period varies between offices**
  - **Increasing % of dates of diagnosis recorded over time**
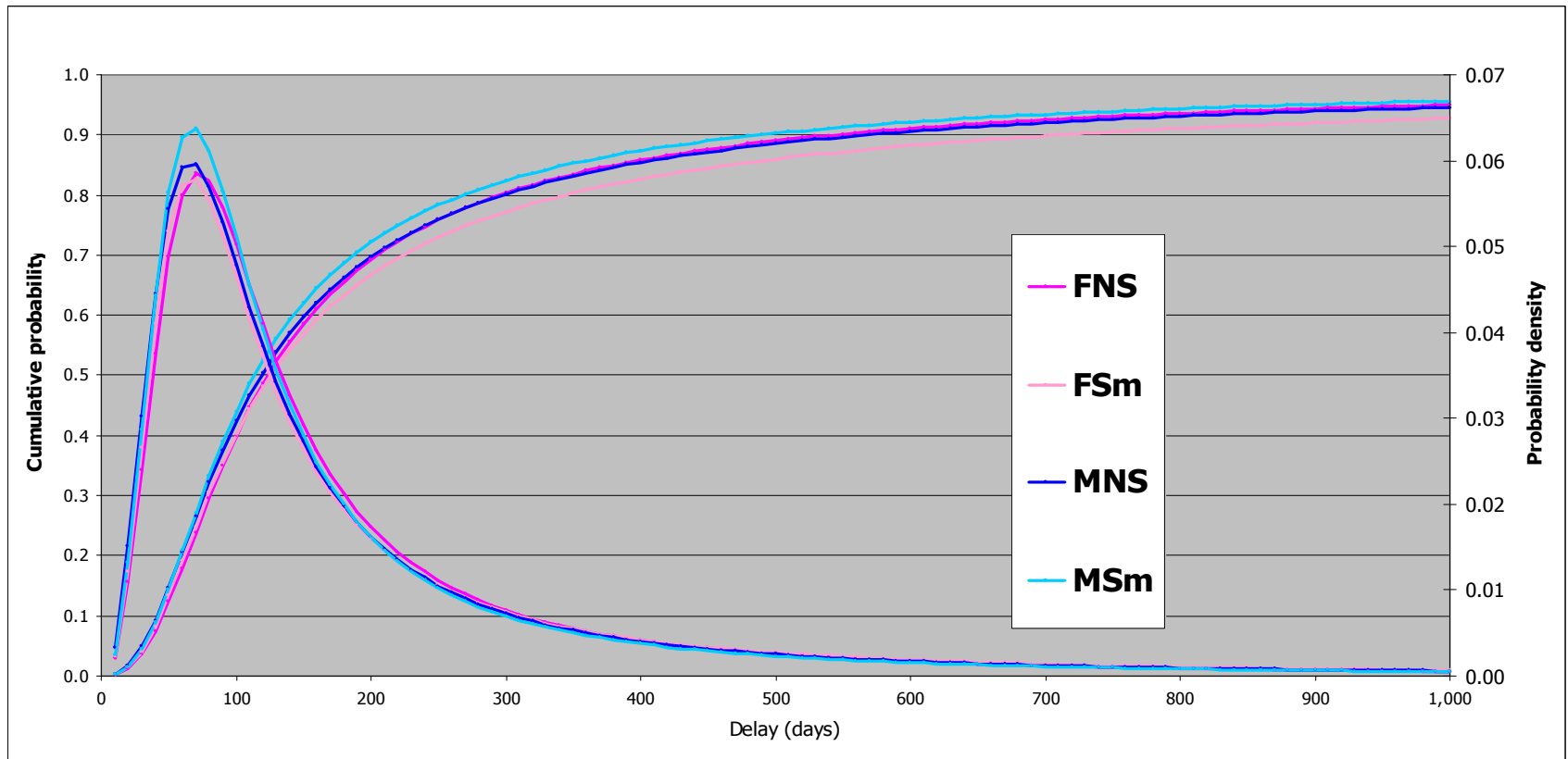
# New Method: Claim development distribution

- **Initial findings from parametric modelling:**
  - **Burr distribution provides reasonable fit**
  - **Probability density function:**

$$f(x) = \frac{\alpha \gamma \lambda^{\alpha} x^{\gamma-1}}{(\lambda + x^{\gamma})^{\alpha+1}}$$

  - **3 parameters give reasonable flexibility over:**
    - **Peak rate of settlement (α)**
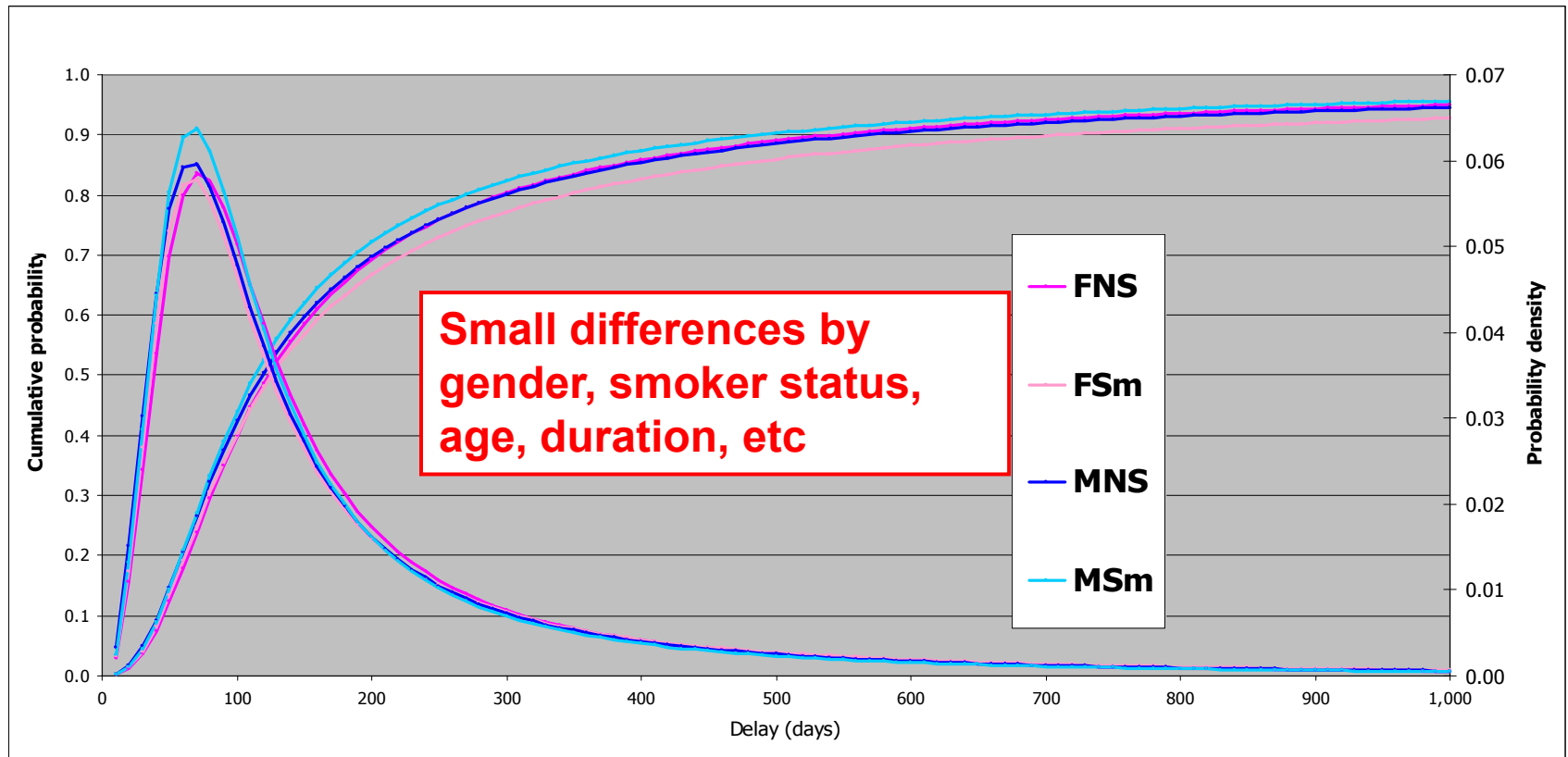    - **When peak rate occurs (λ), and**
    - **Thickness of tail (γ)**

# New Method: Claim development distribution

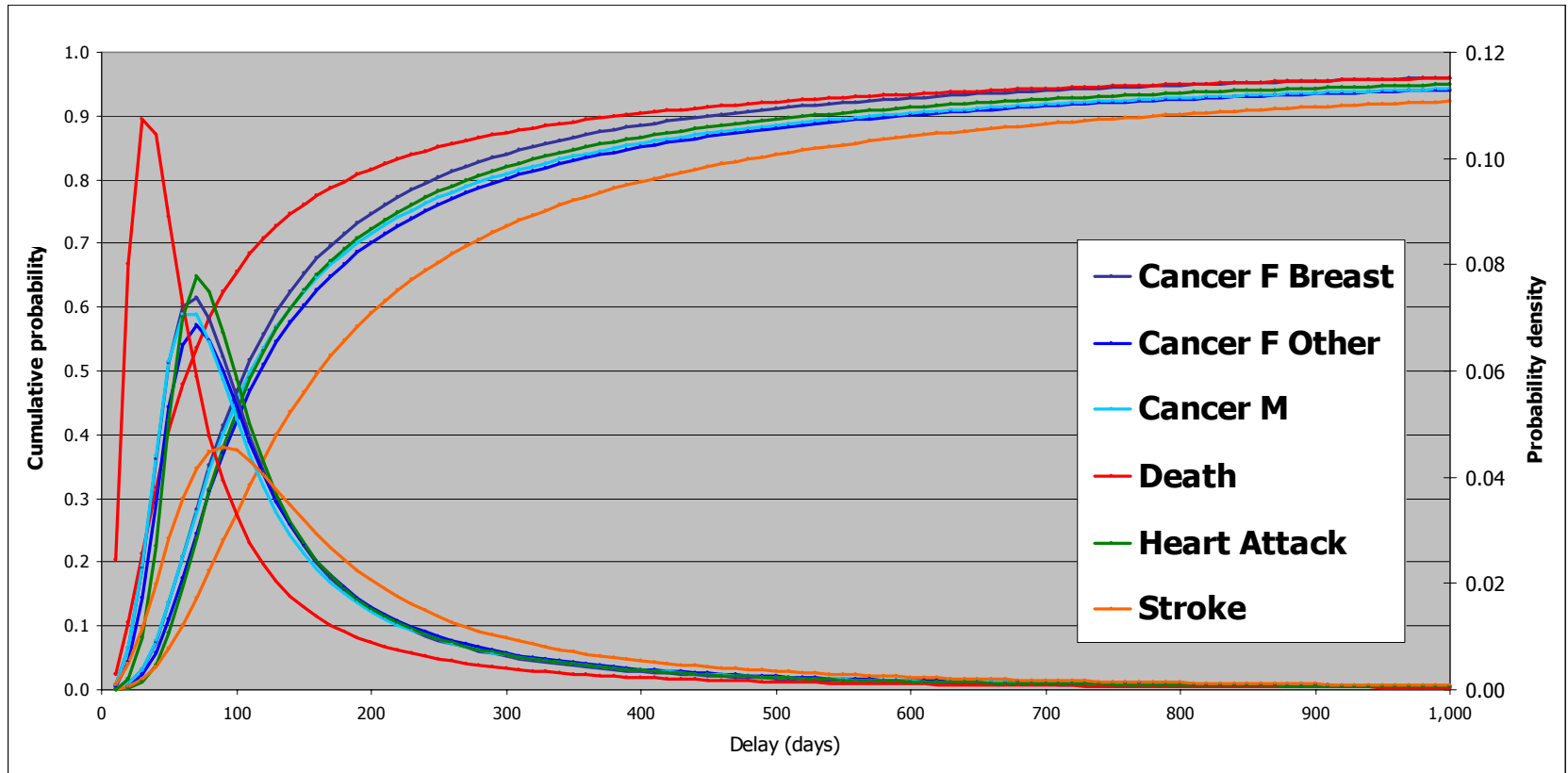- **Initial findings from parametric modelling:**



**1999-2004 data; accelerated business only**

# New Method: Claim development distribution

- **Initial findings from parametric modelling:**



**Small differences by gender, smoker status, age, duration, etc**

Legend: FNS, FSm, MNS, MSm

**1999-2004 data; accelerated business only**

# New Method: Claim development distribution

- **Initial findings from parametric modelling:**



**1999-2004 data; accelerated business only**

# New Method: Claim development distribution

- ## Initial findings from parametric modelling:



**1999-2004 data; accelerated business only**
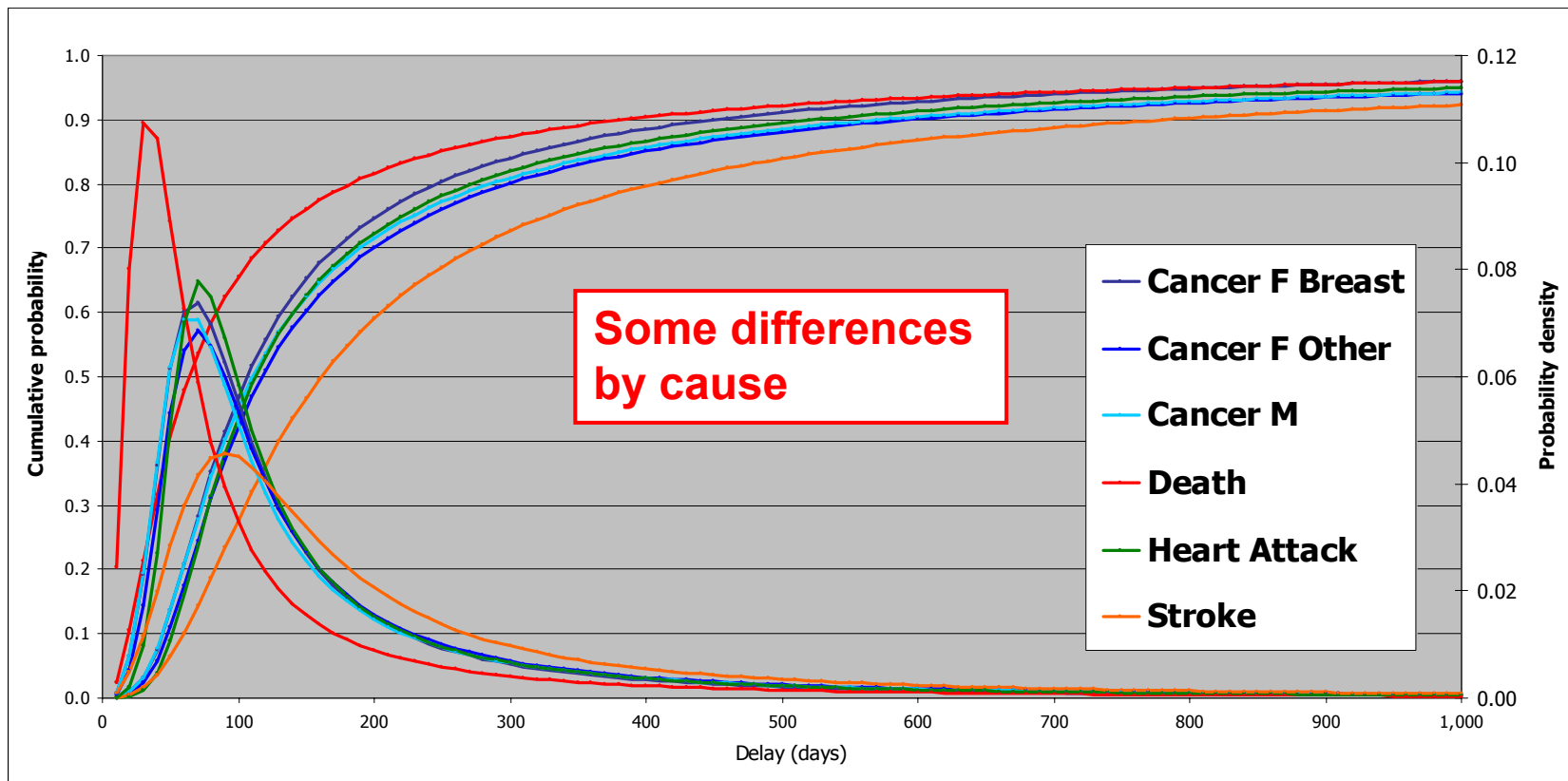
# New Method: Claim development distribution

- **Initial findings from parametric modelling:**

- **Little variation by most risk factors**
  - **May mean we can legitimately use a single claim development distribution within the new methodology at an "All Causes" level**

- **Significant variation by cause:**
  - **Death shorter, stroke longer**
  - **Can also apply the new methodology at a "Cause Specific" level and derive cause-specific claim rates**
  - **Cause-specific should of course sum to all causes….**

# Agenda

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# Next Steps (1)

- **Claim Delay distribution**
  - **Complete work on parametric model**
  - **Document with other analyses of data**
  - **Working Paper – March/April 2008?**

- **Full implementation**
  - **More robust application using monthly time intervals for a more accurate calculation of exposure**
  - **Need to reconcile with spreadsheet approach in WP28**
  - **Single development distribution to produce more accurate "All Causes" results for all years to date**
  - **Issue to member offices – March/April 2008?**
  - **All Causes & Cause-specific claim rates to follow**

# Next Steps (2)

- **Assumptions in current work:**
  - **Further analysis of 'off' rates?**
  - **"Backward" application of claim development distribution? (see 7.17 of WP28)**

- **Further analysis:**
  - **Amounts experience**
  - **Other factors: sales channel, product type, benefit amount, commencement year, office, …**
  - **Stand-alone business**

- **Releasing 2005 results**

# CMI Critical Illness Investigation

Current Issues in Healthcare
12 December 2007, Staple Inn

*David Heeney, Chairman, CMI Critical Illness Committee*
*and*
*Dave Grimshaw, Secretary, CMI Critical Illness Committee*