Aspects of Underwriting for Actuaries

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Introduction

- This presentation does not set out to be comprehensive on the broad subject of life underwriting. Instead, it addresses a couple of areas of underwriting practice which are both topical (in the sense that they give rise to issues that Indian life companies may have to deal with now or before too long) and in which life company actuaries may well get involved.
- The topics have been chosen because they are very practical. They give rise to real-world problems on which actuaries may be asked to advise.
- A further aim is to illustrate that there are synergies to be found if actuaries and underwriters work together to solve problems which, although of an underwriting nature, are tractable by an actuarial approach

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Aspects of underwriting for actuaries - overview

- Protective Value (or cost-effectiveness) of underwriting
  - which applicants for insurance should be underwritten using particular underwriting tools ?
  - what is the marginal effectiveness of using an additional underwriting tool ?
- Simplified Underwriting
  - what are the implications for mortality experience ?
  - how far can the process be simplified without jeopardising the portfolio ?

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Protective Value

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Value and cost of underwriting tools

- Life underwriting 'tools' include:
  - Proposal form
  - Medical examination / doctor's report
  - Agent's report
  - Additional questionnaires
  - Financial statements
  - Urinalysis / blood tests / oral fluids
  - ECG / CXR / Treadmill test
  - etc ....

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The value of using an underwriting tool

- The marginal information provided by the tool to improve the assessment of mortality (or morbidity) risk
  - information is only of value of it adds to that provided by other tools in use
  - so the value of a particular tool will depend on the context in which it is used and the other tools also in use
  - additional clinical details are only helpful to the extent that they help to quantify the risk of premature death (or insured morbidity)
- The sentinel effect has value
  - deterrent for applications from impaired lives

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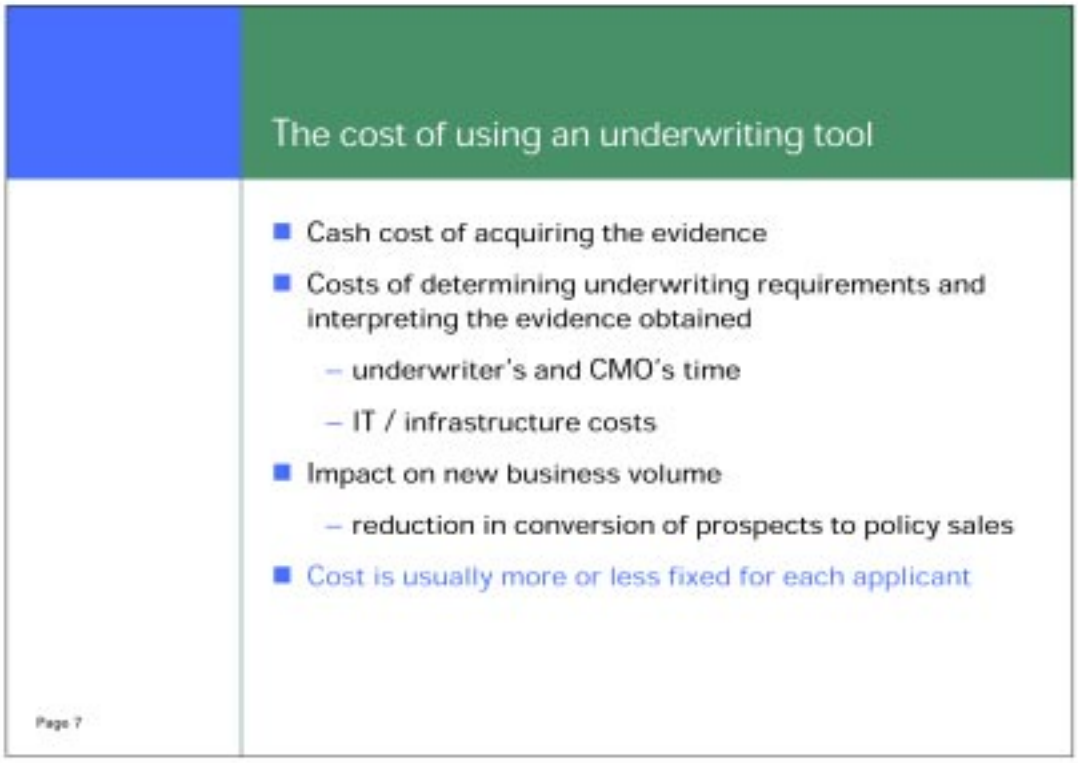
The cost of using an underwriting tool
Cash cost of acquiring the evidence
Costs of determining underwriting requirements and interpreting the evidence obtained
– underwriter's and CMO's time
– IT / infrastructure costs
Impact on new business volume
– reduction in conversion of prospects to policy sales
Cost is usually more or less fixed for each applicant
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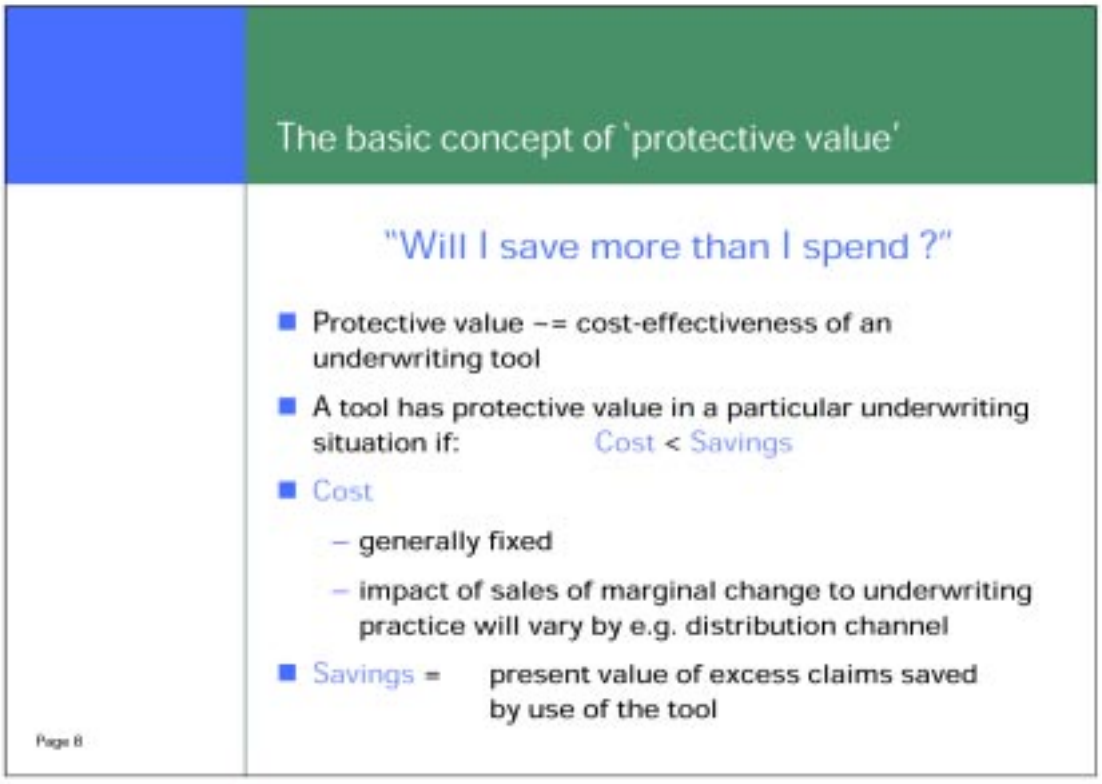
The basic concept of 'protective value'
"Will I save more than I spend ?"
Protective value –= cost-effectiveness of an underwriting tool
A tool has protective value in a particular underwriting situation if: Cost < Savings
Cost
– generally fixed
– impact of sales of marginal change to underwriting practice will vary by e.g. distribution channel
Savings = present value of excess claims saved by use of the tool
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The value of future mortality / morbidity savings

Depends on .....

- Prevalence of the impairment in the group of applicants 'tested'
- Sensitivity of the tool to identify the impairment
- Uniqueness of the information provided
  - i.e. proportion not identified by other tools
- Net present value (NPV) of excess cost of impaired lives' mortality / morbidity

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Prevalence of the impairment

- Low prevalence may mean that it is not cost effective to screen all applicants
- Prevalence, and therefore sum assured threshold above which to use a tool, may vary by e.g.
  - Age
  - Geography
  - Sum Assured
  - Socio-economic grouping
  - Sub-group of applicants - e.g. applicants declaring significant medical history on the proposal form

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Sensitivity of the underwriting tool

- Protective value is reduced in proportion to false negatives
- So, multiply Prevalence * Sensitivity
- False positives don't increase the protective value *per se* but might lead to an additional margin in the pricing

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Uniqueness of the information

- Only those impairments uniquely picked up by use of the tool being assessed truly contribute to savings
- Model this with an exclusivity factor

  0 <= exclusivity factor <= 1

- The protective value of a tool depends on which other tools are being used

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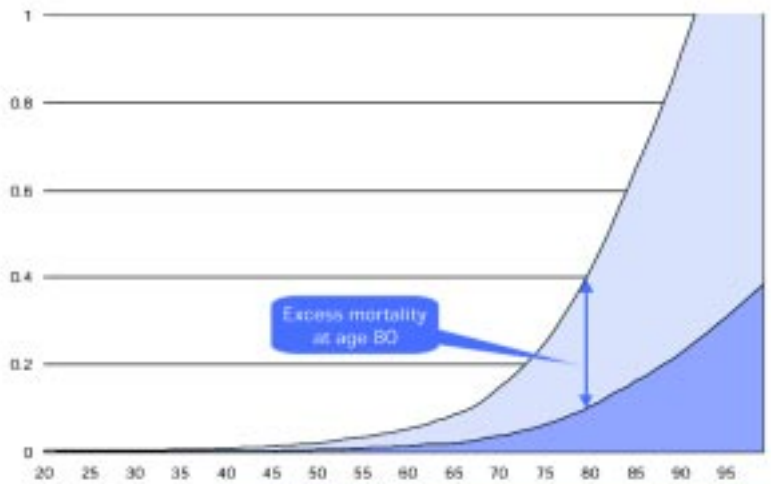
NPV of excess mortality / morbidity cost



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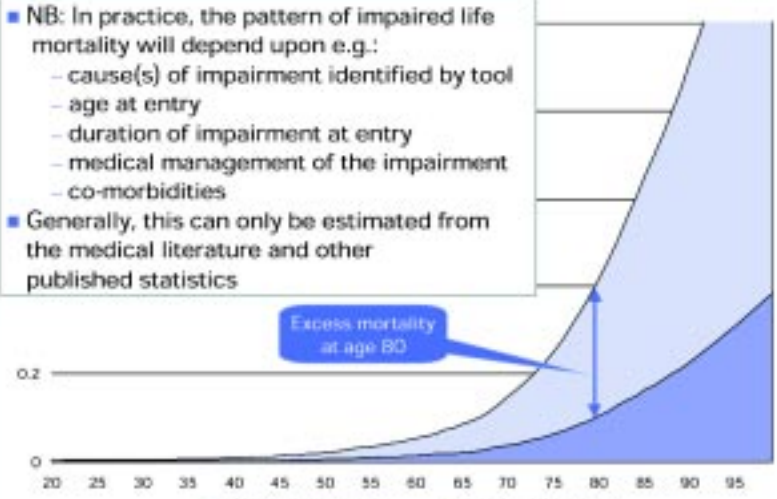
NPV of excess mortality / morbidity cost

- NB: In practice, the pattern of impaired life mortality will depend upon e.g.:
  - cause(s) of impairment identified by tool
  - age at entry
  - duration of impairment at entry
  - medical management of the impairment
  - co-morbidities
- Generally, this can only be estimated from the medical literature and other published statistics



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NPV of excess mortality / morbidity cost

The NPV of all future excess mortality / morbidity costs of a policy issued at age x –=

$$\sum_{n=0}^{\infty}\{K_{x+n} * [\ {}_{n}p'_{x} * q'_{x+n} - {}_{n}p_{x} * q_{x+n}\ ] / (1+i)^{n}\}$$

Probability of death of an **impaired** life at age $x+n$

Probability of death of a **standard** life at age $x+n$

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Some measures of protective value

(i) NPV of [Savings *less* Costs]

(ii) Breakeven threshold sum assured

(iii) Return on investment

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Net present value of [Savings *less* Costs]

- Savings =

  Prevalence * Sensitivity * Exclusivity Factor * {NPV of XS claims costs} * {Sentinel Effect multiplier}

- Protective value exists if savings exceed costs, for a *particular group of applicants* and considering the *other underwriting* done

- This implies that the protective value will depend substantially on the policy term, a factor that is often ignored when specifying underwriting requirements

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Break-even threshold sum assured

$$= \frac{\text{Costs of underwriting}}{\text{Savings}^*}$$

[* per unit sum assured]

- Defines the sum assured, *which is likely to vary by age*, above which it is cost-effective to include the underwriting tool in question

- Since the prevalence of most impairments increases with age, it will be cost-effective to do particular types of underwriting investigations at lower sums insured.

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Return on investment

- Calculate the discount rate i that satisfies:

Costs of u/w = Sum Assured * Savings

NPV of excess mortality / morbidity cost

$$\sum_{n=0}^{\infty} \{ K_{x+n} * [{}_{n}p'_{x} * q'_{x+n} - {}_{n}p_{x} * q_{x+n}] / (1+i)^{n} \}$$

- Allows comparison of the relative value of different tests, particularly if the budget for underwriting is constrained

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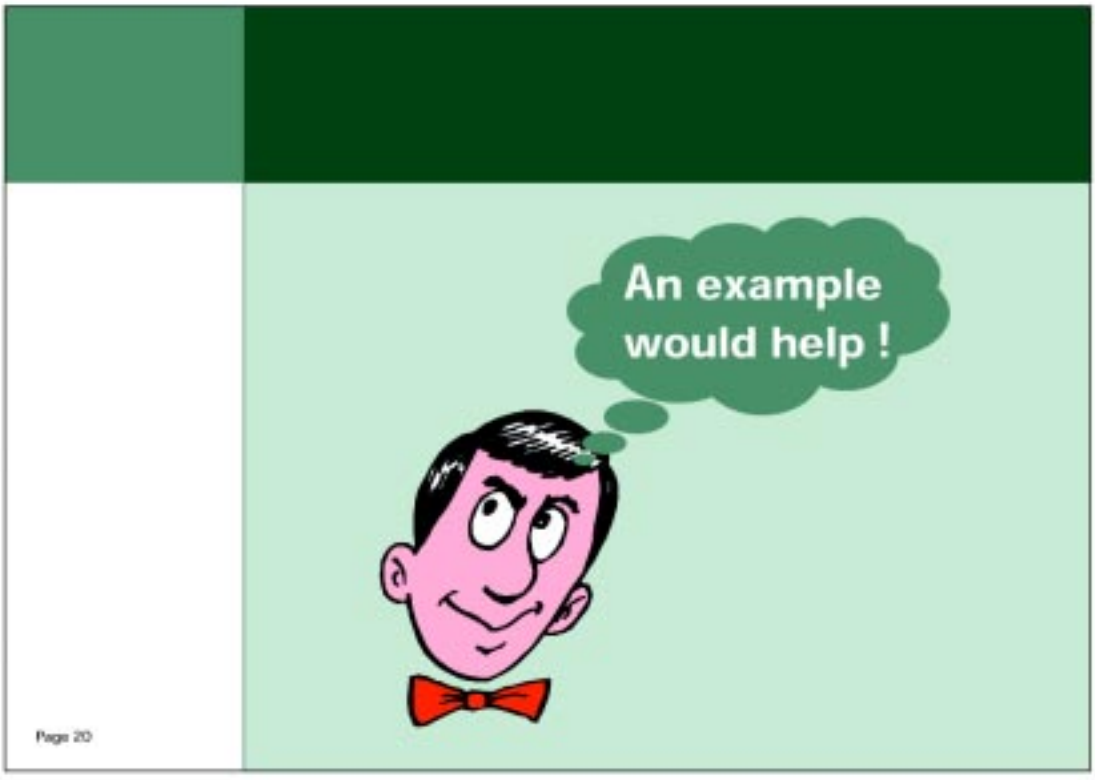

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EXAMPLE - 'Hepatitis Q'

- Hepatitis Q is a *hypothetical*, infectious disease, which leads to premature death in a high proportion of infected individuals
- The additional mortality is approximately equal to +100% of standard mortality, regardless of the age of infection (☹ unlikely, but makes the maths easier ☺)
- Prior infection with the hepatitis Q virus can only detected by an antibody test, which costs Rs. 250 and has a sensitivity of 90%
- The prevalence of HQV antibodies in applicants for insurance is estimated to be 3% at age 30 and 5% at age 50
- Testing is not readily available, so infected individuals are generally unaware of their HQV status

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EXAMPLE - 'Hepatitis Q'

- We wish to consider the protective value of HQV antibody testing as a screening tool for all applicants for 20-year, life policies for sums assured of Rs.100,000 and Rs. 1,000,000 at ages 30 and 50

NPV of excess mortality cost (per 1,000 sum assured) over 20 years =

Age 30: 18.24 *

Age 50: 88.02 *

[* Mortality - 100% LIC 1994-96 ; Interest - 8%]

So .....

- Cost = 250 (kit) + 100 (estimated overhead cost) = Rs. 350
- Savings = *[Prevalence]* 0.9 (sensitivity) * 1 (exclusivity) * [NPV XS cost / unit sum assured]* [Sum Assured]*

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EXAMPLE - 'Hepatitis Q'

- Savings:

Age	Sum Assured 100,000	Sum Assured 1,000,000
30	49	492
50	396	3,960

- Protective Value:

Age	Sum Assured 100,000	Sum Assured 1,000,000
30	(301)	142
50	46	3,610

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EXAMPLE - 'Hepatitis Q'

- Savings:

Age	Sum Assured 100,000	Sum Assured 1,000,000
30	49	492
50	396	3,960

- Threshold sum assured to test:

  Age 30: = 350 / 0.000492 = Rs. 711,000

  Age 50: = 350 / 0.003961 = Rs. 88,000

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EXAMPLE - 'Hepatitis Q'

Return on Investment:

- Set discount rate i for excess mortality cost such that:

$$350 = [Prevalence] * 0.9 * 1 * [NPV\ XS\ cost/unit\ S.A.]_i * [S.\ A.]$$

Age	Sum Assured 100,000	Sum Assured 1,000,000
30	N/A	12.1%
50	9.5%	105.2%

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Conclusions of example protective value study

- HQV testing costs Rs. 350 per test done, regardless of the size of the insurance policy.
- HQV testing saves on mortality costs. Savings exceed the cost of testing except for Age 30 / Rs.100,000.
- The threshold sum assured above which it is cost-effective to test varies with age at entry. It is high (Rs.711,000) at age 30 and low (Rs. 88,000) at age 50.
- At age 50 / Rs.1,000,000 sum assured, the protective value (Rs. 3,610 per applicant tested) and return on investment (105.2%) is very high. HQV testing is clearly worthwhile.
- For age 30 / Rs.1,000,000 and age 50 / Rs.100,000, the return on investment is borderline and could be compared with the return from other uses of the underwriting budget.

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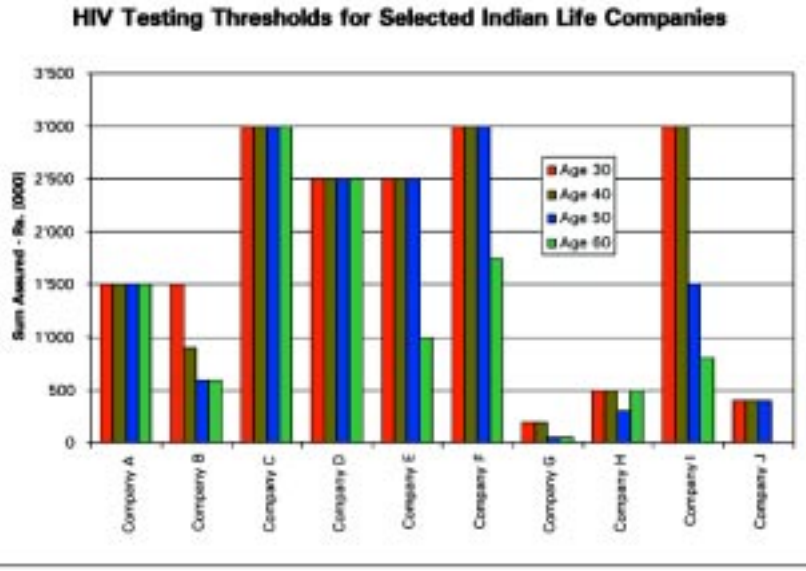
Protective value of HIV testing in India ?



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Simplified Medical Underwriting

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Traditional life underwriting

- Traditionally, applications for life insurance are subjected to 'full underwriting' although the extent of underwriting will typically depend on the sums at risk, age at entry and other factors
- Full underwriting means:
  - proposal form
    - ~20 medical questions
    - financial details
    - details of occupation, avocations, habits, etc
  - +/- medical report / examination / investigations

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Issues with full medical underwriting

- Insurer's perspective:
  - Costs
    - Medical examination fees
    - Underwriters' salaries etc
    - Opportunity cost for business lost
  - Time to complete the sale
- Applicant's perspective:
  - Reluctance to answer certain questions
  - Reluctance to attend for medical examination and undergo investigations
  - Reluctance to be rated or declined for insurance
  - Time to complete the purchase

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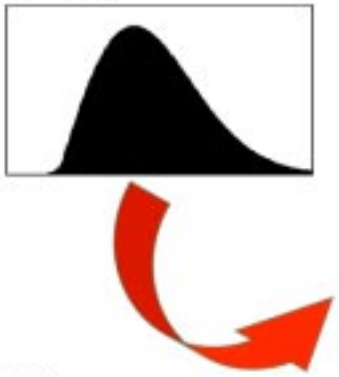
Expected mortality of applicants for insurance - the impact of underwriting

Distribution of expected mortality of applicants for insurance



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Simplified underwriting

- Objectives:
  - to simplify the process of issuing new policies
  - to reduce the costs of acquiring new business
  - to reduce the time to close a sale and the risk that it does not close because of administrative delays
- Concept:
  - confine underwriting of medical impairments to a carefully chosen set of broad health-related questions on the application form
  - other risk management techniques may be used to control the insurer's exposure to non-health related risks

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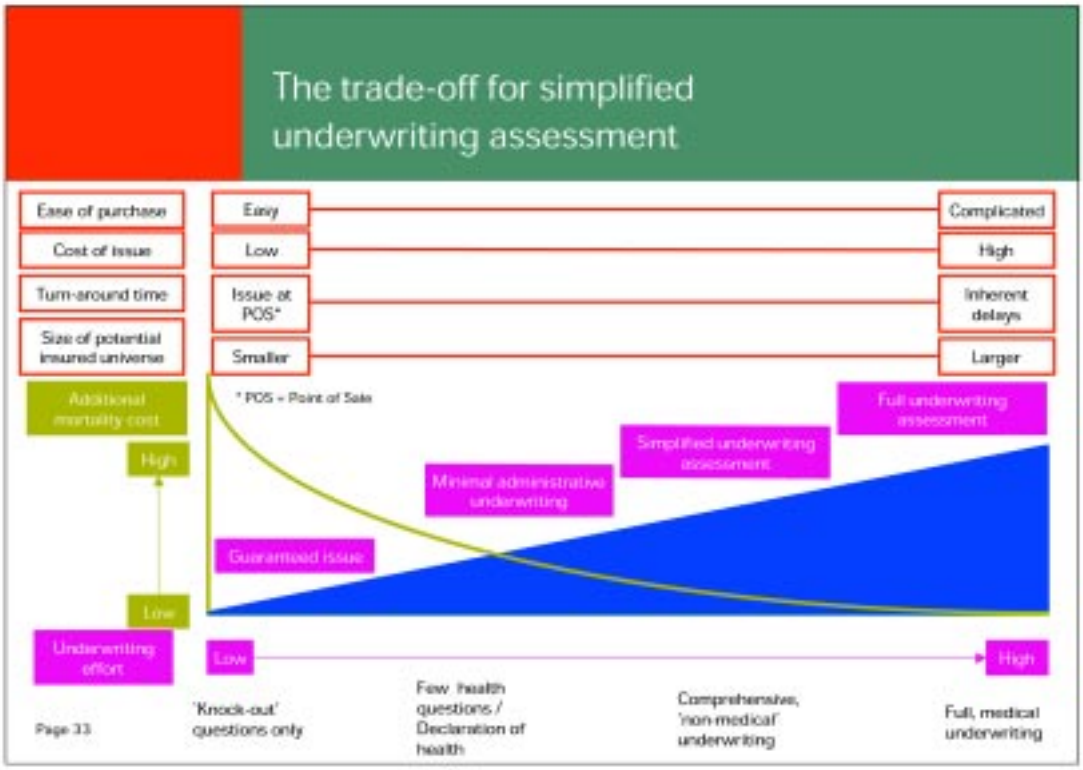
The trade-off for simplified underwriting assessment
Ease of purchase
Cost of issue
Turn-around time
Size of potential insured universe
Easy
Low
Issue at POS*
Smaller
Complicated
High
Inherent delays
Larger
* POS = Point of Sale
Additional mortality cost
High
Low
Underwriting effort
Low
High
Full underwriting assessment
Simplified underwriting assessment
Minimal administrative underwriting
Guaranteed issue
'Knock-out' questions only
Few health questions / Declaration of health
Comprehensive, 'non-medical' underwriting
Full, medical underwriting
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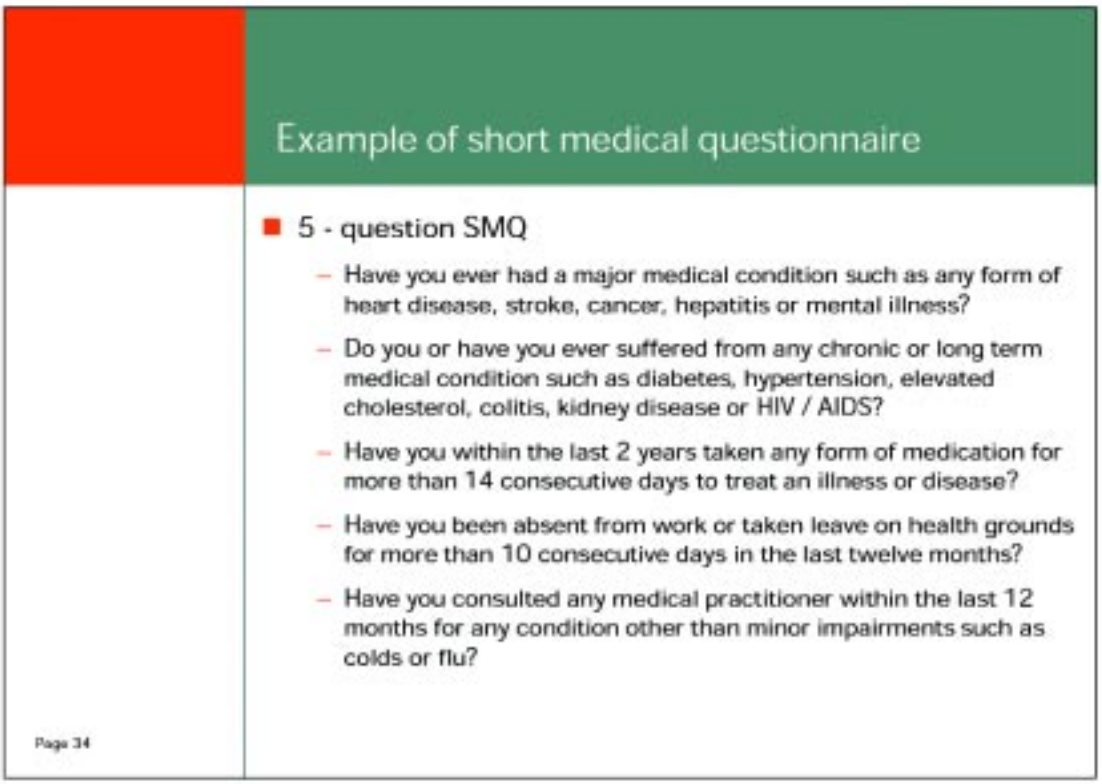
Example of short medical questionnaire
5 - question SMQ
Have you ever had a major medical condition such as any form of heart disease, stroke, cancer, hepatitis or mental illness?
Do you or have you ever suffered from any chronic or long term medical condition such as diabetes, hypertension, elevated cholesterol, colitis, kidney disease or HIV / AIDS?
Have you within the last 2 years taken any form of medication for more than 14 consecutive days to treat an illness or disease?
Have you been absent from work or taken leave on health grounds for more than 10 consecutive days in the last twelve months?
Have you consulted any medical practitioner within the last 12 months for any condition other than minor impairments such as colds or flu?
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Examples of (very) short medical questionnaire

- 2 - question SMQ
  - Have you within the last twelve months:
    - spent more than 5 consecutive days in hospital?
    - been absent from work or taken leave on health grounds for more than 10 consecutive days?
- Alternative 2 - question SMQ (possibly lower acceptance rate but better mortality experience):
  - Have you ever had a heart condition, stroke, cancer, diabetes, mental illness, hepatitis, HIV infection or AIDS.
  - Have you been absent from work or taken leave on health grounds for more than 10 consecutive days in the last twelve months?

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The pricing actuary's predicament

- A key question (THE key question ?) for the pricing actuary relates to the expected impact on mortality claims costs of moving from full underwriting to a simplified underwriting approach
- Usually, there will be little directly relevant insured mortality experience on which to base the pricing assumptions
- Generally, simplified underwriting will lead to a decision either to accept or reject the application. Insufficient health information is acquired to be able to determine ratings for applicants who 'fail' one or more of the health questions
- So, how can the 'standard rate' for this business be determined ?

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A practical approach [1]

- One practical approach is to consider the distribution of underwriting decisions given to fully underwritten business of a similar type
  - Say, for example, the underwriters expect to make decisions according to the following table:

DECISION	FREQUENCY
Standard	v %
+50% EMR	w %
+100% EMR	x %
+200% EMR	y %
Decline	z %
TOTAL	100%

- An experienced underwriter can estimate which categories of rated lives would (typically) be unable to answer successfully a particular health questionnaire

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A practical approach [2]

- Alternatively, a representative sample of actual, rated cases can be reviewed to determine whether the proposed SMQ could be answered successfully
- Say, for example, it is determined that lives acceptable at +100 or better would be able to 'pass' the SMQ under consideration. The implied adjustment factor to fully underwritten, standard mortality would (for the example quoted on the previous slide) be:

$$(v + 1.5*w + 2*x) / (v + w + x)$$

- This gives an initial indication of the expected impact on claims costs, assuming all other factors remain unchanged

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A practical approach [3]

- In practice, other factors to consider include:
  - impact on propensity of applicants to anti-select
  - (possible reduction in) the sentinel effect
  - the accuracy of responses to SMQ, which its nature is not corroborated by medical examination results
  - differences in the risk characteristics of applicants for fully-underwritten and simplified issue business (related to e.g. the mode of distribution, different sum assured issue limits etc)
- Judgement is required to allow appropriately for these factors

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Guaranteed issue business

- Experience has shown that guaranteed issue, individual business is subject to significant anti-selection, especially at younger issue ages
- Alternative risk control measures are required to offset the anti-selection potential:
  - distribution mode (generally, directly marketed)
  - 'accident-only' cover for an initial moratorium period
  - low sum assured issue limit
  - significant savings component (e.g. WoL)
  - policy exclusions (e.g. HIV/AIDS, hazardous avocations)

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About the Author :

Dr. David B. Muiry

David Muiry represents Swiss Re in India, with responsibilities for developing its life and health reinsurance business in the Indian market.

By training, he is an actuary and a medical doctor. After qualifying in medicine at Guy's Hospital, London in 1985 and practising clinical medicine for six years, he changed professional direction towards life insurance and actuarial work. David became a Fellow of the Institute of Actuaries in 1995 and a Fellow of the Actuarial Society of India in 2000. In recent years, David has been active in the professional activities of both the UK and Indian actuarial professional bodies. Currently, this includes the role of convenor of ASI's Investigations Sub-Committee.

David has worked for Swiss Re since 1997. He joined the global head office of Swiss Re's Life & Health Division in London, working initially as a health product actuary and latterly in a broader product risk management role. In both of these roles, he provided technical support for Swiss Re's life and health operating units world-wide. Latterly, much of his time was devoted to work for the Indian market.

David relocated to India in December 2000 to take up his current role in Swiss Re's representative office in Mumbai.

Before working for Swiss Re, David trained and practised as an actuary in a variety of roles with Legal & General and NatWest Life, both UK direct life offices.