The Actuarial Profession
making financial sense of the future

Investigation of the Influence of Socio-economic status on Morbidity Status for Dread and Chronic Diseases

Chronic Disease Working Party

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Background/Introduction

Our Objectives:

- To learn about chronic diseases: their prevalence, cost and progression.
- To further actuarial knowledge in this area using non-standard techniques.
- To avoid constraints brought about by the usual product silos.

Methodology/Data

Data:

- Islington PCT data – snapshot data covering 25,000 lives (kick-started by PCT and now extended by the working party).
- THIN data – GP encounter data over a number of years covering approx 2m patients.
- Literature search to assess body of health economic literature in this area.

Context: Why bother?

Some background facts:

- Circulatory disease accounts for over 40% of all deaths in the UK and a big cause of premature death
- Life style factors are known to be important in accelerating the onset of chronic disease, especially smoking, exercise and diet
  - modifying lifestyle cuts risk of diabetes by over a half
  - diabetes raises risk of CHD in women by up to 8 times
  - obesity raises risk of hypertension by 30%
  - hypertension raises risk of CHD by 2-3 times
- Chronic disease can strike at relatively young ages but especially over 50
- As the population ages chronic disease could become a crippling burden on the UK economy and health care services
- Insurers, government, health care providers, actuaries need better information for managing chronic disease, and reducing its incidence over time

Methodology/Data

Methodology:

- Risk Ladders put together by Cass, by matching PCT data to household data.
- Analysis of medical records to give summaries by service utilisation, age and survival probabilities
- Results benchmarked by literature.

Key Messages

Results so far:

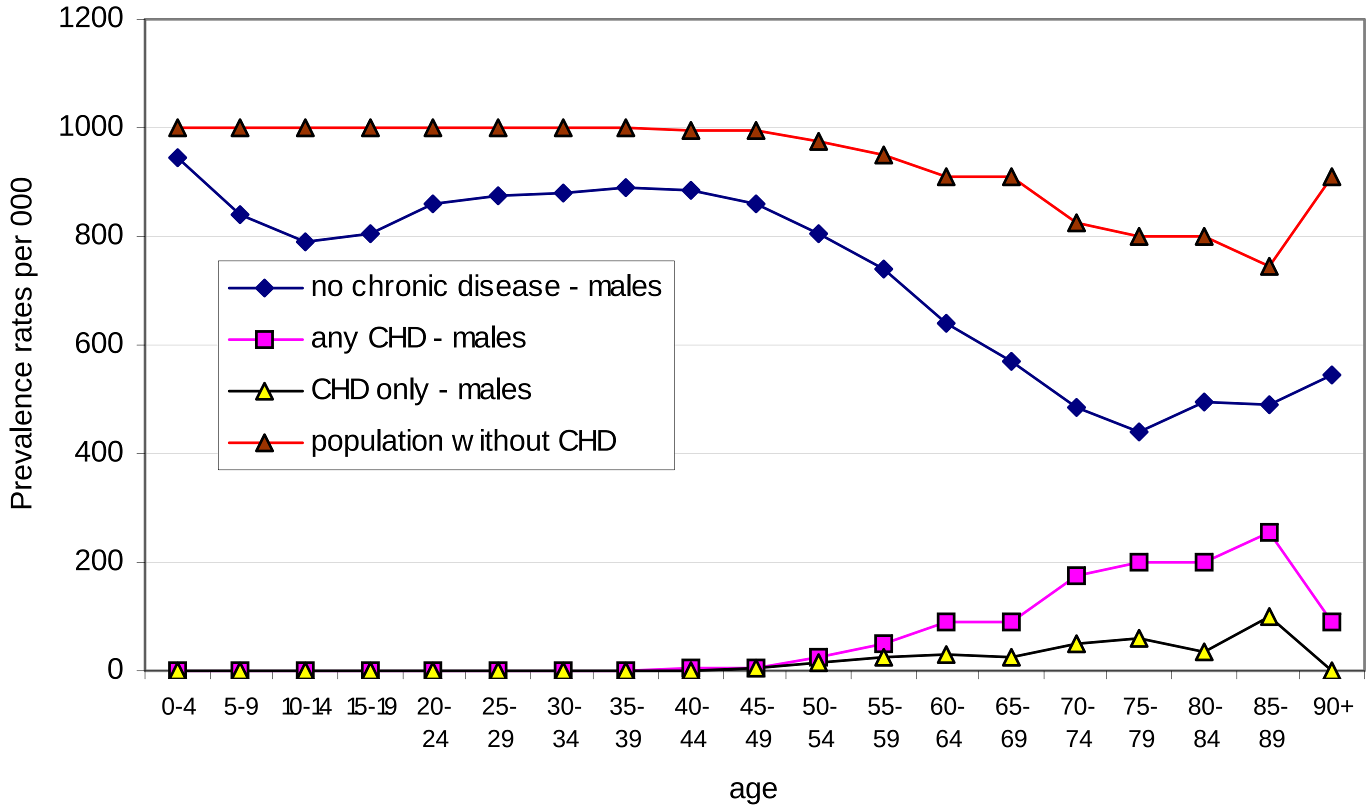
- Our results are consistent with the literature but go further by providing insights into the effects of social factors;
- We have shown it is possible to establish estimates of the prevalence of co-morbidity by age and gender;
- Risk ladders have been produced for CHD, diabetes, and hypertension, and stroke;
- We have started our analysis of the THIN data set and have produced some very encouraging results and possible tools for use by health actuaries

Results of Cass Analysis

Areas of focus:

- Co-prevalence
- Risk factors
- Disease combinations
- Pathways to chronic disease
- Neighbourhood analysis

Example 1: Prevalence and co-prevalence of CHD by age (Males)



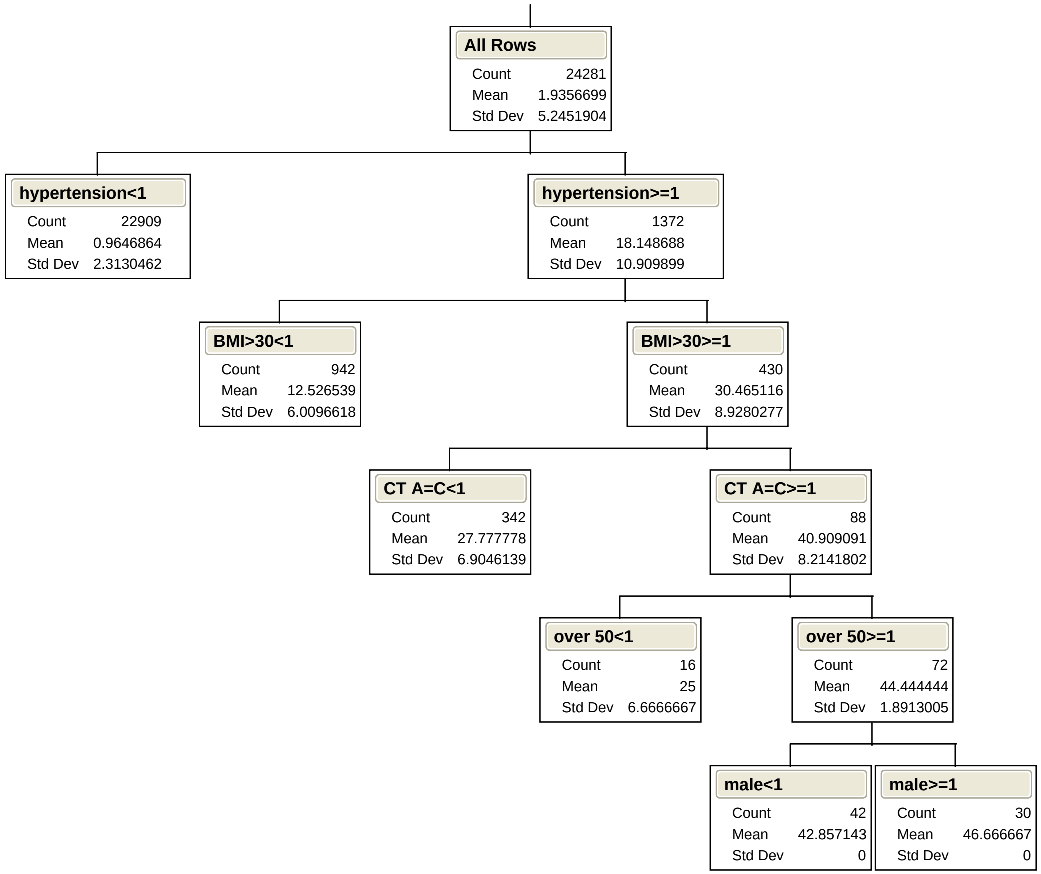
Example 2: CHD risk ladder

Number	Number of factors	Number of patients	Gender	CT A-C	BMI>30	Current smoker	Diabetes	Hypertension	Risk of CHD
1	3	14	Y				Y	Y	50.0
2	5	8	Y	Y		Y	Y	Y	50.0
3	4	5		Y		Y	Y	Y	40.0
4	5	20		Y	Y	Y	Y	Y	35.0
5	4	3	Y	Y			Y	Y	33.3
6	5	20	Y	Y	Y	Y		Y	30.0
7	4	42	Y			Y	Y	Y	26.2
8	2	12					Y	Y	25.0
9	5	44	Y		Y	Y	Y	Y	25.0
10	6	16	Y	Y	Y	Y	Y	Y	25.0
11	2	17				Y	Y		23.5
12	4	37	Y	Y		Y		Y	21.6
13	3	11		Y			Y	Y	18.2
14	4	51			Y	Y	Y	Y	15.7
15	4	97	Y		Y	Y		Y	15.5
16	3	23				Y	Y	Y	13.0
17	2	31	Y				Y		12.9
18	3	31	Y	Y				Y	12.9
19	2	78		Y				Y	12.8
20	4	32	Y		Y	Y	Y		12.5
21	2	179	Y					Y	11.7
22	3	176	Y			Y		Y	10.8
23	3	150			Y	Y		Y	9.3
24	4	11		Y	Y	Y	Y		9.1
25	3	26		Y		Y		Y	7.7
26	3	106		Y	Y	Y			7.5
27	3	41	Y			Y	Y		7.3
28	4	16	Y	Y		Y	Y		6.3
29	4	81	Y	Y	Y	Y			6.2
30	2	137				Y		Y	5.8
31	1	246						Y	5.3
32	3	255	Y	Y		Y			5.1
33	1	22					Y		4.5
34	3	412	Y		Y	Y			3.6
35	3	28			Y	Y	Y		3.6
36	4	32		Y	Y	Y		Y	3.1
37	2	196		Y		Y			2.6
38	2	1672	Y			Y			2.0
39	2	528			Y	Y			1.5
40	1	1081				Y			1.1
41	2	1208	Y	Y					0.7
42	1	1274		Y					0.5
43	1	7903	Y						0.4
44	0	8006							0.3
	Total	*24401*	*12330*	*3457*	*1636*	*5372*	*470*	*1458*	*379*

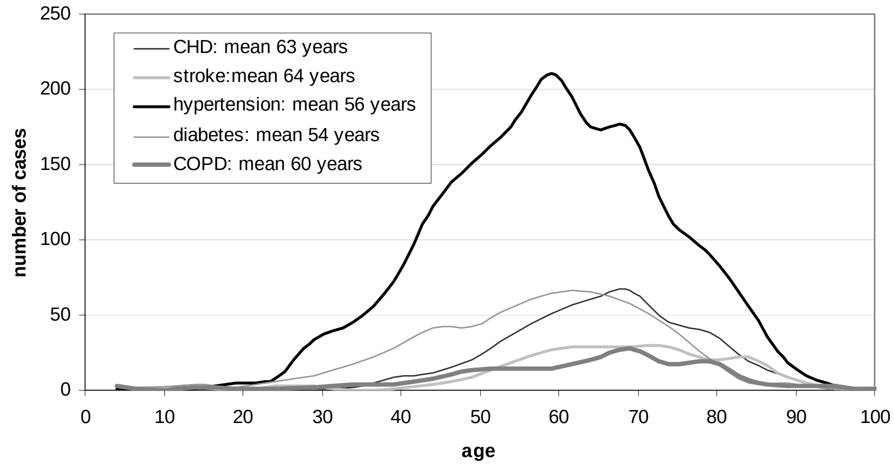
The risk ladder for CHD shows that in this population:

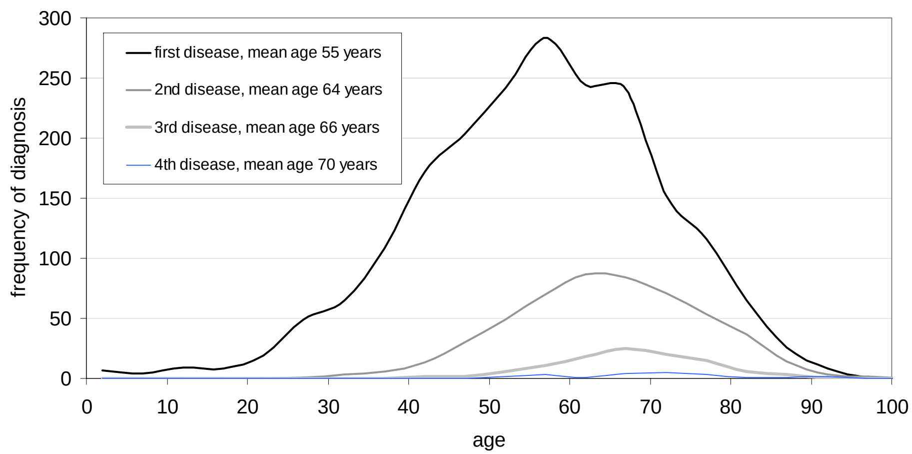
- Female risk of having CHD with no factors present is 0.3% whereas male risk is 0.4% (population sizes 8006, and 7903)
- For a smoker with a high BMI male risk increases to 3.6% and female risk to 1.5% (population size 412, and 528)
- Living in a property banded A-C increases the risk of CHD for males and females with no other factors to 0.7% and 0.5%
- Risk increases substantially if hypertension or diabetes is present. Thus a male smoker with diabetes has a 7.3% risk which increases to 12.5 % if he has a BMI of over 30. This increases to 15.5% if diabetes is replaced by hypertension.
- Those in the highest risk categories have most risk factors associated but the sample sizes are small.

Example 3: Diabetes risk tree



Example 4: The age dimension





Example 5: Pathways

Our results indicate that the following pathways occur more often than would be suggested by chance:

3 diseases in order of occurrence

- diabetes, hypertension, CHD – 12cases
- diabetes, CHD, hypertension – 11 cases
- hypertension, diabetes, CHD – 9 cases
- CHD, hypertension, diabetes – 8 cases
- CHD, diabetes, hypertension – 6 cases
- Hypertension, CHD, diabetes – 6 cases

2 diseases in order of occurrence

Hypertension and CHD occur frequently together, although there is little difference in the chance of hypertension being diagnosed before CHD (59 cases versus 46 cases).

Stroke occurs relatively infrequently in any sequence. About half of all CHD cases occur with other diseases. CHD by itself occurs less frequently than would be suggested by chance (156 cases).

About the THIN data set

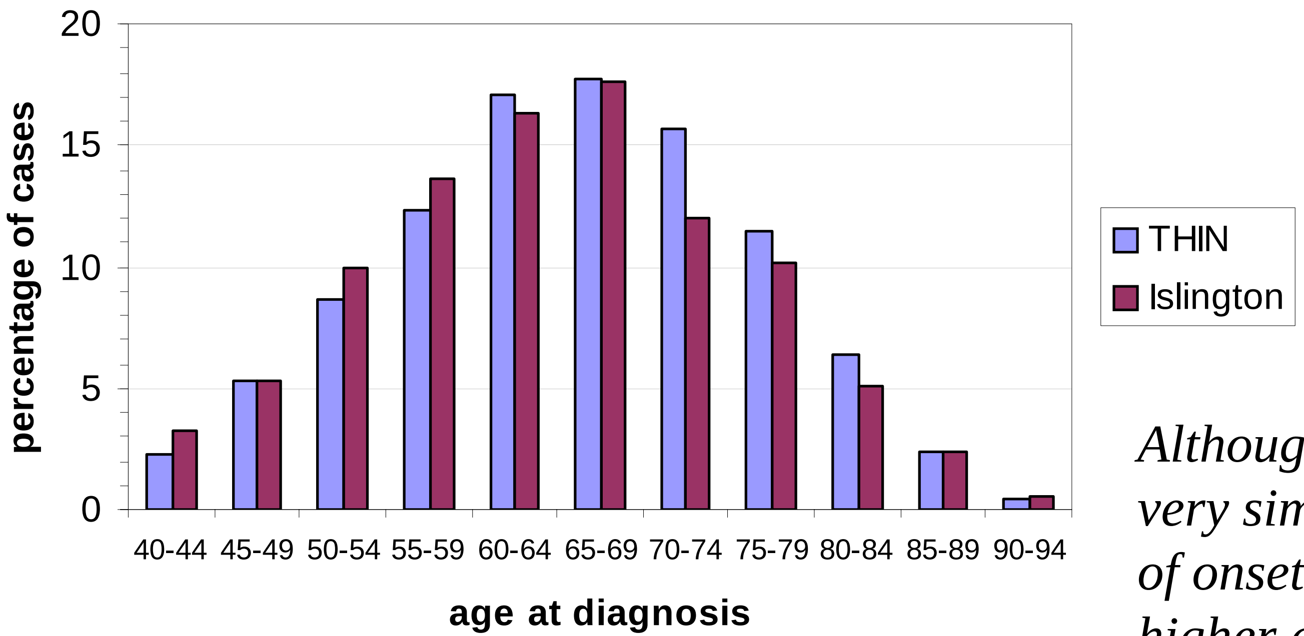
- The Health Improvement Network data
- GP Patient registrations, Medical Records (READ codes), Prescription Drug Records and therapeutic values (height, weight, BP, smoker)
- 8m anonymised registrations, but not all unique
- Some bias in sample

Examples of results of THIN Analysis

Text:

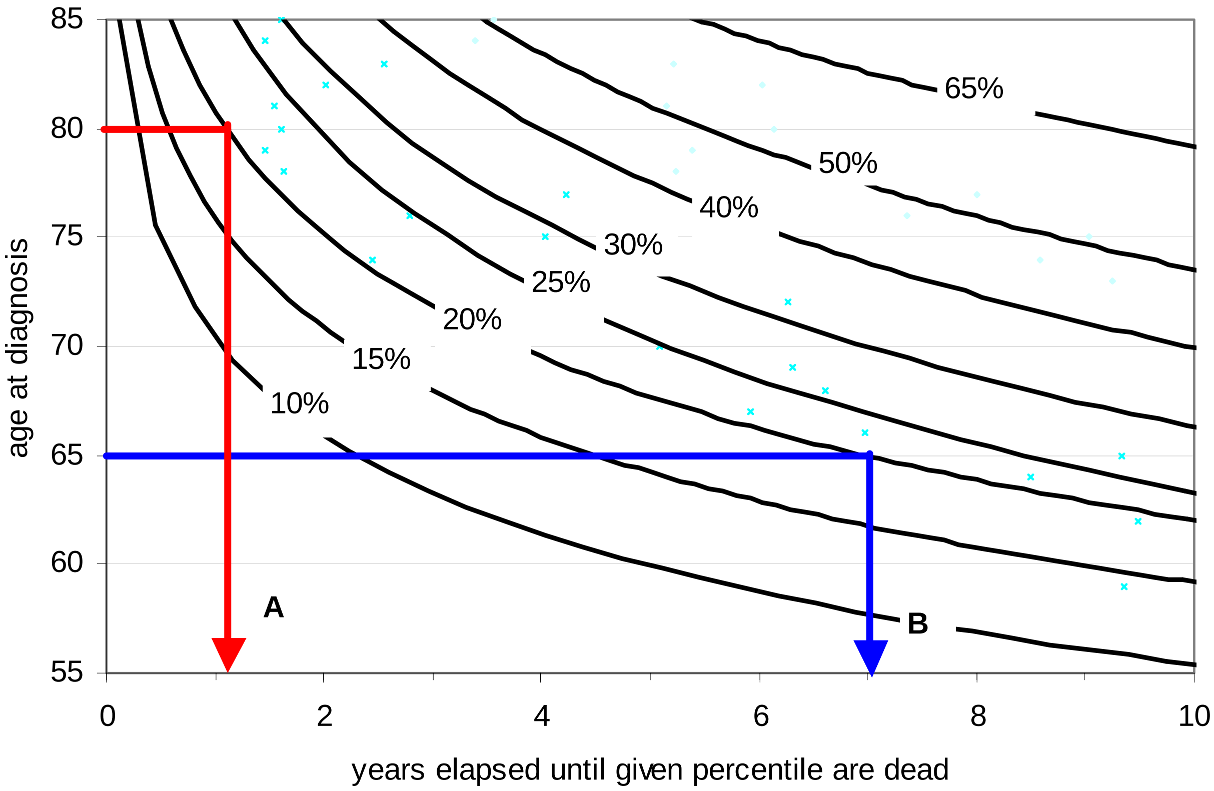
- Comparison and validation with Islington data
- Survival analysis using example of CHD
- Use of health services based on number of diagnoses

Correspondence between THIN data and Islington data – example of CHD and % of male cases diagnosed at different ages



Although distribution is very similar, mean age of onset in Islington is higher and also prevalence

CHD survival analysis based on THIN data using best fit curves

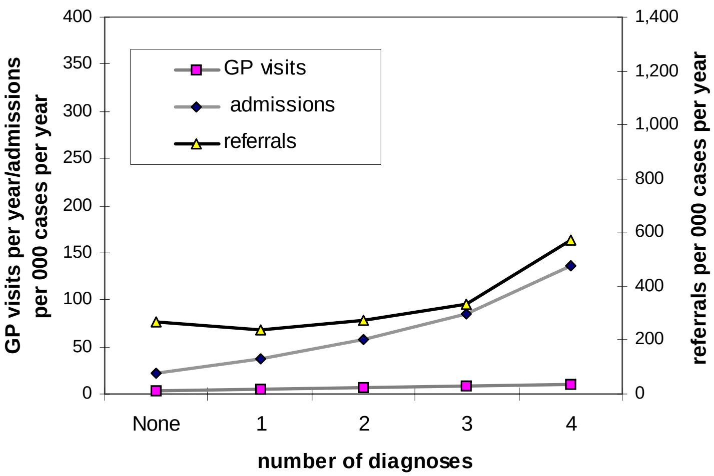


Examples:

20% of males diagnosed with CHD at age 80 can expect to die within about a year (point A); if aged 65 20% can expect to die within 7 years (point B).

Effect of chronic diseases on the utilisation of health care services –non-smokers

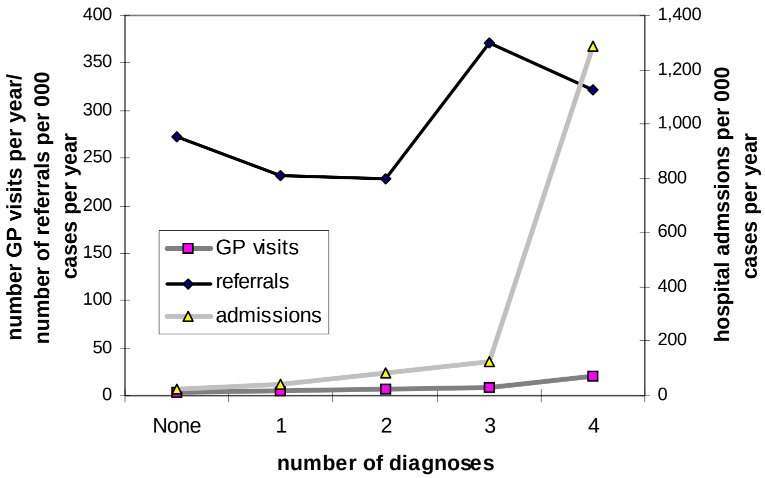
Males (all)				
Chronic diagnoses	Number of cases sampled	GP visits per year	Referrals per year per 000 cases	Hospital admissions per year per 000 cases
None	320,012	3.3	268	23
1	292,756	5.0	239	37
2	43,915	6.8	275	59
3	4,763	8.5	334	84
4	352	10.2	574	136



The more chronic diseases that are diagnosed the greater the use of health care services.

Effect of chronic diseases on the utilisation of health care services -smokers

Males (smoke 20+ perday)				
Chronic diagnoses	Number of cases sampled	GP visits per year	Referrals per year per 000 cases	Hospital admissions per year per 000 cases
None	24,346	3.2	273	24
1	18,018	4.8	232	41
2	2,202	6.4	228	82
3	159	7.7	372	126
4	9	19.9	321	1,285



Smokers are in deep trouble!

Possible Applications
Life & Critical Illness Insurance

- Refining underwriting systems
  - Disability Discrimination Act

    "All your decisions must be based on relevant information or data available at the time which will form the basis of your underwriting manual. This includes:
    - actuarial or statistical data
    - medical research information
    - medical reports about an individual

    You should review your underwriting manual periodically to ensure that it is based on reliable, up-to-date information that it is reasonable for you to rely on."

    An Insurer's Guide to the Disability Discrimination Act 1995 – ABI, January 2003.

- Buyback costing

- Pricing distribution channels
  - Bancassurers: price based on council tax band?

Possible Applications
Other Insurance Products

- Income Protection
  - Occupation rating
- Long Term Care
  - Survival analysis
- Annuities
  - Impaired annuity pricing
- PMI
  - Occupation rating
  - Directing preventative treatment
  - **Designing/Pricing primary care insurance products**

Possible Applications: Healthcare Resources

- Government / NHS
  - GP resource targeting and budget planning
  - Authoritative guide for GP's on relative risks
  - Costing sickness benefit
  - Regional planning

- Employers
  - Future sickness burden of a company
  - Absence management

What now?

Examples:

- Extend the analysis to all the main chronic diseases looking at both morbidity, co-morbidity etc
- Further the work on morbidity and service utilisation bringing in a cost dimension
- Develop transition matrices to improve our understanding of 'pathways' and thence develop predictive models
- Produce risk ladders for whole population where appropriate and feasible
- Work up cost effective disease prevention strategies based on the evidence
- Work on other possible applications in different fields of insurance and health care
- Write up and disseminate results

Special acknowledgements

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