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SUMMARY

Life insurance is a key element of the UK social structure in terms of family protection and house purchase; it thus needs to be viewed in this broad context, rather than solely as a commercial activity. Insurers have not so far actively requested genetic tests for life insurance, but have insisted on knowing of and being able to act on existing genetic test information. The main reason given for this has been to avoid serious adverse selection; however, this has never been adequately estimated. Review of the different major categories of Mendelian genetic disorders suggests that the scope for adverse selection is extremely limited and that insurers would lose little, and possibly gain more, by foregoing the disclosure and use of this information in relation to life insurance policies of 'normal' size and nature. The likely future use in service of genetic tests based on susceptibility or population screening makes it especially important that the issue is rapidly resolved for Mendelian disorders; so far there is no sign that insurers are willing to achieve this.

1. INTRODUCTION

The use of genetic information in relation to life insurance remains a controversial topic. Although the insurance industry has not so far actively requested genetic tests, it has been reluctant to move from its established position of considering genetic tests as no different from other medical information; that it needs to know all existing results and, where appropriate, to act on them. The industry has also been reluctant to have serious discussion on the issue with professionals in medical genetics, despite long-standing calls for this, and has maintained that the freedom to underwrite is an essential feature of life insurance provision (Association of British Insurers 1996). By contrast, medical geneticists, and those representing families with genetic disorders, have highlighted the danger to those at risk from genetic disorders of being deterred from potentially beneficial tests for fear of insurance penalization and possible wider disclosure of sensitive information (Harper *et al*. 1993).

The UK Parliamentary Select Committee on Human Genetics was critical of the insurance industry for its refusal to face up to the important issues involved. Their report, issued in July 1995 (House of Commons Science and Technology Committee 1995), suggested a one-year period in which to resolve the situation, after which legislation might be considered. While this has not so far been acted upon through the Government's response to the report (Government response to House of Commons Science and Technology Committee report 1996), insurance industry bulletins have stated their intention to fulfil the report's recommendation (Association of British Insurers 1996).

The principal concern of the insurance industry relates to 'adverse selection', the term applied to financial losses incurred as a consequence of an applicant having information to which the insurance company does not have access. This is a genuine concern, but there are no valid estimates as to its likely extent either at present or in the future, in genetic testing.

As a starting point to obtain an estimate of adverse selection, I outline here the main categories of genetic disease and the extent to which adverse selection is likely to be important in them. Hopefully, these general data can be converted by others into more detailed costs, based on actuarial data. It should be noted specifically that this discussion relates to life insurance, not to health insurance, critical illness cover or other special schemes, and to clearly genetic (i.e. 'Mendelian' disorders), not to susceptibility testing for 'multifactorial' conditions. The insurance industry has itself stressed that it considers tests in this latter group to be insufficiently validated to apply in life insurance at present (Association of British Insurers 1995), though its attitude towards this may now be changing.

2. CATEGORIES OF GENETIC DISORDER

Table 1 lists the main groups of genetic disorder used by clinical geneticists and others. Leaving aside the 'multifactorial' category, only one subgroup—dominantly inherited disorders of late onset—is likely to be significant in terms of adverse selection. It is thus important to explain in some detail why the other groups, accounting for most serious genetic disease, are not relevant.

(*a*) *Autosomal recessive disorders*

These include many serious childhood diseases which cause early mortality and major morbidity. It is this early onset that minimizes their relevance to life insurance—healthy sibs reaching adult life without clinical features are unlikely to become affected later, at least to any degree affecting mortality. Also, it is

Table 1. *Life insurance and the main types of genetic disorder*

category of genetic disorder	relevance to life insurance
autosomal dominant	important subgroup with late onset and progressive course; those with early onset of little relevance
autosomal recessive	little relevance; genetic risks largely confined to sibs, often early onset, numerous healthy carriers
X-linked	risks mainly to male relatives; serious disorders usually have early onset
chromosomal abnormalities	usually early onset, not progressive, carriers normally healthy
'multifactorial' disorders	common; genetic testing of uncertain significance at present, but likely to be important in future

only sibs, not offspring or more distant relatives that are at significant risk. Most genetic tests on healthy relatives are done in relation to reproductive risks to establish whether an individual is a heterozygous carrier, which generally carries no health implications but which could easily be misinterpreted if the information had to be declared for insurance purposes.

(*b*) *X-linked disorders*

Numerically, these are much less frequent than autosomal conditions. This group nevertheless contains some serious diseases. However, for life insurance purposes, the implications are again few. Most fatal disorders are early in onset (e.g. Duchenne muscular dystrophy), while even those giving serious problems in adult life (e.g. haemophilias A and B, Becker muscular dystrophy) are usually obvious by the end of adolescence. Others, such as fragile X mental retardation syndrome, are not life threatening. As with autosomal recessive disorders, most genetic tests on healthy adults are done in relation to carrier status, with no significant implications for the health of the individual. I have not been able to find any X-linked disorder, apart from a few very rare conditions, that would give a likelihood of serious adverse selection in relation to genetic tests.

(*c*) *Chromosomal disorders*

Chromosome analysis remains the most frequent form of genetic test, but is of little relevance to life insurance. Disorders of autosomes with a visible defect are generally severe and obvious at birth or in infancy, whereas those of sex chromosomes do not significantly affect later health. As with the previous groups, testing of healthy adults is done for reproductive rather than health reasons. Adverse selection is therefore not an issue in this group.

Table 2. *Autosomal dominant disorders relevant to life insurance*

disorder	comments
Huntington's disease (HD)	healthy individuals only tested in context of family history
hereditary ataxias (late onset)	as for HD
other rare, late onset CNS degenerations	all very rare; combined frequency unlikely to exceed that of HD
myotonic dystrophy	mutation variable; many tested in later life will have insignificant disease
adult polycystic kidney disease	little current demand for genetic testing; early diagnosis by ultrasound
familial colon cancer (polyposis and non-polypotic)	mortality much reduced by early detection
familial breast cancer (BRCA1 and 2)	important implications if population screening introduced
other rare familial cancers	all very rare; some treatable
Marfan syndrome	usually evident clinically; genetic testing secondary
hypertrophic cardiomyopathy	interpretation of tests and risks uncertain
familial hypercholesterolaemia	common, but usually detected by serum cholesterol, not genetic tests

(*d*) *Autosomal dominant disorders*

This is the only group where there is potential for serious adverse selection, and this is the case only where the disorder is late in onset but progressive and fatal in nature. Early onset dominantly inherited disorders will not give significant risks for apparently healthy relatives, and many will be isolated cases resulting from new mutations.

Some of the most important members of the late onset, progressive group are listed in table 2. It includes progressive neurodegenerative diseases, such as Huntington's disease and allied disorders, cardiovascular disorders such as Marfan syndrome, with a risk of sudden death in later life, and several forms of familial cancer. Careful study of McKusick's *Mendelian inheritance in man* (McKusick 1992) shows that the number of disorders in this group, other than those that are exceedingly rare, is limited. Those listed comprise the principal ones, though it is possible that in a particular geographical area, some others might be sufficiently common to join the list.

Several of the disorders listed are, currently at least, less of a problem in relation to life insurance than might be thought likely at first sight. Thus, Marfan syndrome can almost always be diagnosed or excluded in adult life by careful clinical assessment, while adult polycystic kidney disease can similarly be recognized presymptomatically by ultrasound. Genetic tests are currently little used in either. Variability and heterogeneity may also limit interpretation of genetic

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testing, as in hypertrophic cardiomyopathy where ultrasound examination is again a more helpful guide to future clinical abnormality than are genetic tests.

A feature common to all the disorders in table 2 is that the great majority of cases occurs within the context of a family history of the condition; pre-symptomatic genetic testing is performed almost exclusively in the presence of such a history. Since most life insurance proposal forms request information about parents, and since proposals are currently usually declined or severely loaded in the presence of such a family history, it is clear that the scope for adverse selection is extremely limited.

3. TREATMENT AND EARLY DIAGNOSIS OF GENETIC DISORDERS

One of the main concerns of medical genetics professionals is that worries about insurance may deter those at risk of a treatable genetic disorder from early genetic tests that could improve their prognosis, a situation that would also be against the interests of the insurance industry. Data on the outcome of such early-detected diseases are few, even where treatment exists, but table 3 indicates through selected examples how the availability of treatment might affect the situation. The familial cancers provide the most promising example, notably adenomatous polyposis coli; evidence for benefit of early diagnosis of familial breast cancer is at present less secure.

The insurance data in table 3 are taken from the industry's own handbook (Brackenridge & Elder 1992). The data are approximate, and more detailed actuarial data may be available, or could be collected for these examples and for other relevant diseases. The insurance industry should itself be able to estimate the financial consequences corresponding to the data.

Table 3 lists other factors necessary to estimate accurately the potential for adverse selection. Clearly, this will be affected by the uptake of genetic testing and the frequency of the disorder; the estimates given are approximate, and are based mainly on the author's own centre and on the pooled data available through the UK prediction consortium for Huntington's disease. It also should be remembered that the majority of tests will be normal, since age and other factors will mean that the true risk for many being tested will be considerably less than 50%. This will especially be so if non-genetic investigations (e.g. ultrasound, colonoscopy) have already detected many of the asymptomatic gene carriers. Table 3 also shows that the current cautious approach of the industry to insuring healthy relatives means that the difference between a person with an abnormal test result and one with no (or an unknown) result is often small.

4. DIAGNOSTIC GENETIC TESTING

The life insurance issues discussed here have all presumed that the individual concerned is clinically healthy. Since specific tests for genetic mutations have become available, these are increasingly used *diagnostically* in symptomatic patients who have or are likely to have a particular genetic disorder, but where its precise

Table 3. *Genetics and life insurance—illustrative examples*

disorder	Huntington's disease	familial adenomatous polypopsis	adult polycystic kidney disease
early treatment impact on mortality	nil (at present)	major	moderate
frequency	~ 1 in 10000	1 in 10000	1 in 1000
current insurance penalty for healthy young adult at risk because of family history	not insurable under 21 years; extra 7 per million, 21–35 years; Brackenridge & Elder (1992)	extra 5 per million if under 35 and colonoscopy normal; probably uninsurable without colonoscopy; Brackenridge & Elder (1992)	extra 5 per million at age 25 after normal ultrasound; Brackenridge & Elder (1992)
current insurance penalty for clinically affected person	not insurable; Brackenridge & Elder (1992)	not insurable (without surgery)	not insurable when renal function affected; Brackenridge & Elder (1992)
mortality without early detection	close to 100%	40% (10-year survival)	mean survival 35 years at age 25; Levey *et al.* (1983)
mortality excess (with early detection)	no change	93% (10-year survival)	significantly improved
current uptake (% of those at risk requesting genetic testing)	15–20%	90%	low
no. of tests per year in UK	~ 500 (UK HD prediction consortium data)	400	100 (maximum)
proportion of tests normal	~ 60% (consortium data)	> 50%	> 50%
no. of abnormal test results per year in UK	~ 200	160	40

nature may be in doubt. In this situation, genetic testing is not directly relevant to life insurance, in contrast to *predictive* or *presymptomatic* testing, where the person is healthy but at risk from serious disease in later life. It is important to distinguish the two types of genetic testing since the implications are quite different, even though the technology may be identical.

5. DISCUSSION

The information given above makes it clear that the great majority of genetic diseases and genetic tests are of little or no relevance to the life insurance industry. Even in the small number of diseases that are of importance, genetic testing is relevant in only a small proportion. Further, in some cases, the possibility of early diagnosis or treatment could directly benefit the insurance industry by reducing mortality, while normal results will generate new potential customers. Even in those very few remaining situations where adverse selection is a real possibility, genetic testing will usually only be done in the context of a clear family history (usually an affected parent). This automatically minimizes the likelihood of unsuspected adverse selection.

On the other hand, should the life insurance industry persist in its current position of requiring all genetic test results to be declared, it will have to construct a detailed and complex system for assessing the very large and rapidly increasing amount of data relating to tests done primarily for reproductive reasons, where the implications for the health of the individual tested are either minimal or absent. Deciding whether such information might be significant would require a large amount of specialist knowledge (several thousand Mendelian genetic disorders are documented, many of which are extremely rare (McKusick 1992) and would be likely to generate confusion and misinterpretation. Even in the few disorders where this information was potentially important (e.g. those in table 2), interpretation could be extemely difficult. Therefore, a 'minimal' mutation for myotonic dystrophy might have insignificant health implications, but definition of this would be extremely complex. Increasing data on correlation of phenotype with type of mutation (e.g. in cystic fibrosis) would also have to be taken into account and could be controversial.

So, while I have not attempted to give an accurate estimate of potential adverse selection here, it can be seen that the scope for it is extremely limited; most adverse selection that might occur could be avoided by restrictions on large or 'critical illness' policies and by other simple and uncontroversial measures. The situation is of course entirely different to that for health insurance, though it is likely that the attitude of life insurance bodies in the UK has been influenced by this, particularly by the American situation.

Genetic testing in medical practice is at present almost entirely confined to tests for monogenic disorders, an important and numerically significant group when considered as a whole, even though few should be relevant to life insurance, as indicated above. Susceptibility testing for multifactorial disorders is currently too uncertain in terms of accurate risk prediction to be used in service, though rapid advances in identifying the genetic component of common disorders is likely to change this and lends urgency to resolving the more clear-cut issues involving monogenic disorders. Genetic testing is likewise confined at present to those with a clear family history of a specific disorder. Should widespread population screening be undertaken, this might also significantly alter the situation for adverse selection.

In first writing about this topic five years ago (Harper 1992), I stated that there was a limited time for the industry to adopt reasonable policies on genetic testing and life insurance before applications became widespread. The House of Commons Select Committee report likewise emphasized the urgency of finding an agreed solution. I have attempted to show here that the factor of adverse selection is not likely to be a limiting factor in reaching such a policy, that life insurance companies could, with little loss, forego the use of or knowledge of genetic test results other than in exceptional situations, and that the industry could indeed benefit from avoiding the need to assess an increasing volume of complex and largely irrelevant data.

If the industry does not itself attempt to reach a solution in consultation with those working in the field, it seems likely that legislation, as already introduced in an increasing number of countries and at an advanced stage of preparation by the European Union, will result in much more restrictive use of genetic test information than is necessary or desirable either for the industry or for families with genetic diseases.

REFERENCES

Association of British Insurers 1995 *Evidence to House of Commons Select Committee on Human Genetics*. London: Her Majesty's Stationery Office.

Association of British Insurers 1996 *Public affairs newsletter*. No. 4.

Brackenridge, R. D. C. & Elder, W. J. 1992 *Medical selection of life risks*. Stockton Press.

Government response to House of Commons Science and Technology Committee report 1996. London: Her Majesty's Stationery Office.

Harper, P. S. 1992 Genetic testing and insurance. *J. R. Coll. Physicians* **26**, 184–187.

Harper, P. S. 1993 Insurance and genetic testing. *Lancet* **341**, 224–227.

House of Commons Science and Technology Committee 1995 *Human genetics: the science and its consequences*. London: Her Majesty's Stationery Office.

Leigh, S. 1996 *The freedom to underwrite*. London: Institute of Actuaries.

Levey, A. S., Pauker, S. G. & Kassirer, J. P. 1983 Occult intracranial aneurysms in polycystic kidney disease. *New Eng. J. Med.* **308**, 986–994.

McKusick, V. A. 1992 *Mendelian inheritance in man*, 10th edn. Johns Hopkins University Press.