# What happens when the private sector plans hospital services for the NHS: three case studies under the private finance initiative

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> We aim to promote efficiency, to improve services and to stimulate fresh flows of investment. We want to harness the private sector's management expertise and resources, bringing a new approach to investment in a whole range of activities and services traditionally regarded as the exclusive domain of the public sector.
>
> Kenneth Clarke, *chancellor of the exchequer, November 1993*

The private finance initiative (PFI) for public sector projects was launched by the government in 1992 to transform "public sector organisations from being owners of assets and direct providers of services into purchasers of services from the private sector."[1] The types of projects funded under the scheme range from the building and operation of trunk roads, computer systems, and vehicle fleets to the construction of hospitals and delivery of NHS support systems.[2] New hospitals are leased back to the NHS at market rates for 20-60 years. NHS land and buildings are often sold to the private companies as part of the deal.

We consider here some of the implications of the use of private capital to fund NHS hospital developments, based on the plans produced for those schemes that have reached an advanced stage (table 1). We look at three of these in detail. A second wave of trusts already negotiating contracts include trusts in Glasgow, Newcastle, and the Midlands. Given the speed with which trusts have taken up the private finance initiative, it is important to examine the assumptions underlying the projects and the impact these projects will have on health services in their localities. First wave schemes will affect around 5% of acute NHS beds in England and almost a quarter in Scotland. Hence these projects are not just a local issue. They indicate the likely configuration of hospital services in England and Scotland if current policies continue.

## Summary points

- The private finance initiative (PFI) is intended to attract private finance for public sector projects, such as roads and hospitals
- Several hospital schemes under the initiative are at an advanced stage of planning and include bed reductions of 25-30% in acute specialties
- Because of private sector involvement and "commercial confidentiality" information on schemes and their planning assumptions is often not publicly available
- Where data are available they suggest that the assumptions in these plans about clinical activity, throughput, and beds are out of line with recent trends and with health authorities' own projections
- As a result of the private finance initiative an important part of health care "planning"—of clinical services—is now being done not by health authorities but by the private consortia that are making the bids, with no involvement of clinicians or public health professionals

## How PFI contracts are negotiated

Managing any type of private deal is complex and expensive. For example, Bromley Hospitals Trust has spent £3 million on planning and procurement. The costs to the private sector have been estimated to be seven times higher than those of conventional tendering for public works. Total tender costs for all bidders can reach nearly 3% of the total project costs.[4]

Large hospital developments begin with the preparation of an outline business case. The guidelines state that this "should normally assume that private finance will be sought."[5] Once the outline case is approved by the NHS regional executive, the trust issues an invitation to negotiate and an "output specification,"[5 6] which states, not the number of beds needed, but the expected level of clinical activity.[5] The consortia responding to the invitation suggest the number of beds (and non-clinical services) appropriate for that level of activity.[7]

If a scheme involves leasing the trust must commission a public sector equivalent, giving the costs of meeting the same service requirements under a publicly funded development.[8] It can use this case to assess the private sector responses, but it is not obliged to publish the public sector equivalent (although the guidelines recommend making it available to the private sector). In theory, comparison between the private bids and the public estimate is based on value for money, taking into account "the benefits of transferring risk and responsibility under a privately financed solution."[5] In practice, because of the shortage of NHS capital, the public option is rarely pursued. Once a preferred partner is chosen, a full business case is sent to the Department of Health and the Treasury. For reasons of commercial confidentiality the full case is not available for public scrutiny. Major departures from the outline case are thus concealed during the procurement process.

**Consultation**

When the trust has chosen a preferred partner it seeks the main purchasing health authority's approval for the development. It does not have to consult other purchasers such as fundholders or neighbouring health authorities. The main health authority has to consult the community health council[9] but does not have to disclose the content of the bids.

The code of practice on openness in the NHS requires trusts to provide information about the services provided, the standards achieved, cost-effectiveness of the service, and details of proposed changes in the way health services are delivered. They may withhold information where it is too costly to provide or where it might prejudice negotiations. It is important to put the code to the test.[10]

## What determines bed numbers under the PFI?

Under the private finance initiative the public sector does not buy assets, it buys services. The private sector is responsible for deciding how to supply these services and what investment is required to support these services.[11]

The most notable feature of the hospital schemes under negotiation is the major reduction in bed availability (table 1). The intended 26-30% decrease over the next five to seven years is out of line with national trends for England (fig1) and Scotland, where the average number of acute beds available fell by 20% and 25% respectively over 14 years to 1996. In Scotland the average number of beds in acute and supra-area specialties available daily fell from 19 969 in 1982 to 14 904 in 1996 (a 2.1% fall annually).[16] In England the average number of acute beds available daily fell by 24% from 144 000 in 1982 to 109 000 in 1993-4 (a 2.5% fall annually). This downward trend levelled out at 108 000 beds in 1994-5, with a slight rise of 0.3% in 1995-6.[12-15]

One reason why numbers of beds have not continued to decrease may be the rising trend in inpatient activity (fig 2). In England numbers of ordinary and day case episodes for all specialties rose by 4.8% per year from 1991-2 to 1995-6 and by 6.5% from 1994-5 to 1995-6. In Scotland ordinary and day case discharges rose on average by 3.5% per year between 1985-6 and 1995-6.

**Table 1** Reductions in bed availability in England under private finance initiative (PFI) schemes

| PFI trusts | Best available current bed Nos | Nos planned (including 5 day beds) | % Decreases |
|---|---|---|---|
| **England** | | | |
| Barnet General (Well House) Trust* | 646 | 411 | 36 |
| Bishop Auckland Hospital Trust | 565 | 454 | 20 |
| Bromley Hospitals Trust† | 619 | 507 | 18 |
| Calderdale Hospitals Trust ‡ | 832 | 508 | 39 |
| Carlisle Hospital Trust | 509 | 474 | 7 |
| Dartford and Gravesham Hospitals Trust* | 524 | 400 | 24 |
| Greenwich Healthcare Trust | 654 | 573 | 12 |
| Hereford Hospitals Trust | 414 | 250 | 40 |
| Norfolk and Norwich Acute Hospital Trust | 1 207 | 809 | 33 |
| North Durham Acute NHS Hospitals Trust | 750 | 450 | 40 |
| South Buckinghamshire Hospitals Trust | 806 | Refused | |
| Swindon and Marlborough Hospitals Trust* | 632 | 450 | 29 |
| Walsgrave and Coventry Hospitals Trust | 1 145 | 1083 | 5 |
| Worcester Royal Infirmary Trust* | 697 | 390 | 44 |
| Total** | 9 194 | 6759 | 26 |
| **Scotland** | | | |
| Lanarkshire Health Board[16]§ | | | |
| All acute | 1482 | 1256 | 15 |
| All geriatric assessment | 226 | 200 | 12 |
| Lothian Health Board[16]¶ | | | |
| All acute | 2234 | 1442 | 35 |
| All geriatric assessment | 661 | 415 | 37 |
| Total acute | 3716 | 2698 | 27 |
| Total geriatric assessment | 887 | 615 | 31 |

*Bed numbers taken from NHS Executive[3]. All others were supplied by the trusts themselves. †Includes 127 five day beds. ‡Includes 45 five day beds. §Projected figures for Lanarkshire were supplied by the health board and are based on Monklands, Law, and Hairmyres Hospitals. ¶Projected figures for Lothian were supplied by the hospital trusts. **The total percentage of bed losses was calculated by excluding hospitals where PFI projections were unavailable.
NB: Some of the percentage decreases will underestimate the true loss as data were unavailable for smaller hospitals due to close as part of the PFI agreement.

These long term increases in activity and the halt in the decline of acute bed numbers suggest little scope exists for further reductions in numbers of beds without threatening access to care and quality of care. This calls into question the way the management consultants advising trusts, the private consortia, and health authorities have determined the numbers of beds required.

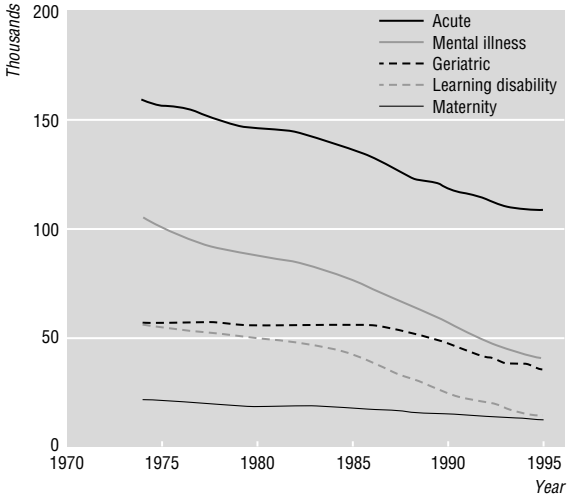


**Fig 1** Average number of beds available daily, England 1974 to 1995-6[12-15]

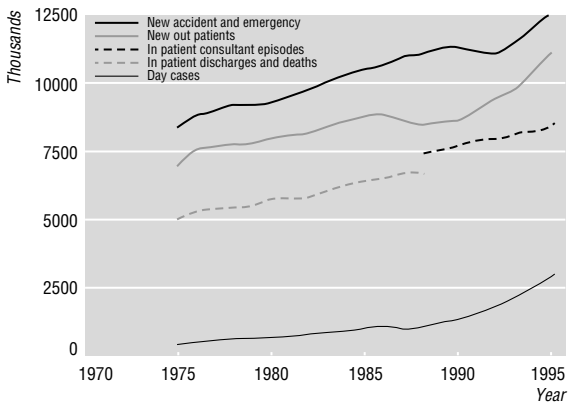


**Fig 2** NHS hospital activity, all specialties, England 1974 to 1995-6[12-15]

## Interpreting trends in bed availability

We first consider five key indicators used to forecast bed numbers or predict the impact of bed reductions: activity, throughput, bed occupancy, day case admissions, and length of stay. The most important is throughput since it is the final common path for all the others.

*Activity*—Inpatient activity in England is measured using finished consultant episodes—the time spent under the care of a particular consultant within one health care provider.[12] In Scotland it is still measured as numbers of discharges and deaths.[16 17] Table 2 shows the trends in activity for England and Scotland for ordinary inpatients and day cases from 1990-1 to 1995-6. The projections of activity assumed for the private schemes are then compared with national trends.

*Day case admissions*—Trusts claim that they can increase efficiency by increasing the percentage of day cases, but the percentage may eventually reach a natural ceiling. When numbers of emergency admissions continue to rise they will dilute the effect of increasing day cases. Unrealistic day case targets may be achieved only by reducing the number of complex cases requiring longer stays. Rigid targets for day cases could result in trusts "cream skimming," operating only on carefully selected low risk cases.

*Throughput*—In England throughput measures the number of inpatient episodes per bed per year. In Scotland it measures inpatient discharges per bed per year. Throughput data are important because they are a measure of how busy hospital and clinical services are and the pressure on staff and beds. Day cases are excluded from calculations of throughput. A better measure is to express throughput in terms of activity per available bed day. Table 3 shows current throughput nationally and for each of the three sites considered below and forecasts throughput for the year 2001 based on national and private finance initiative activity projections.

**Table 2** Comparisons of recent increases in levels of activity with those projected in PFI schemes

| | % Change in activity (finished consultant episodes) per year | | |
|---|---|---|---|
| | All | Ordinary inpatients | Day cases |
| England 1991-2 to 1995-6 (general and acute)[15] | 5.4 | 2.0 | 16.0 |
| Scotland (acute and supra-area) discharges and deaths 1990-1 to 1995-6[18] | 5.0 | 1.8 | 17.4 |
| **Projected in PFI schemes** | | | |
| Edinburgh - 2003* | 0.4 | –3.9 | 11.3 |
| Bromley - 2001* | 0.6 | NA | NA |
| Calderdale - 2001* | 1.6 | NA | NA |

*Trust projections.

**Table 3** Current and projected throughput for England, Scotland, and four PFI hospital developments

| | Throughput 1995-6, actual | 2001-3 projected in PFI plans | 2001-3 projected on basis of past trends‡ |
|---|---|---|---|
| **Scotland[18]** | | | |
| Acute | 49 | — | — |
| Geriatric assessment | 12 | — | — |
| All specialties | 24 | — | — |
| Lanarkshire Health Board (includes Law PFI)* | | | |
| Acute | 47 | 60 | 59 |
| Geriatric assessment | 12 | 17 | 16 |
| Lothian Health Board (includes Edinburgh Royal Infirmary and Western General Hospital schemes)* | | | |
| Acute | 55 | 69 | 94 |
| Geriatric assessment | 12 | 24 | 24 |
| **England[3]** | | | |
| Acute | 54 | — | — |
| Geriatric | 16 | — | — |
| All specialties | 38 | — | — |
| General and acute | 45 | | |
| Bromley NHS Trust (general and acute)† | Not provided | 84 | 93 |
| Calderdale NHS Trust (general and acute)† | Not provided | 95 | 96 |

*1995-6 data from *Scottish Health Statistics*.[18] Projected figures supplied by the health board.
†Throughput data and five year trends derived from Department of Health.[15]
‡Trend projections for Scotland are based on 1986-96 growth trends in acute and geriatric assessment categories.

*Bed occupancy*—Bed occupancy is the average number of beds occupied in a given period and gives an indication of spare capacity. As the NHS provides an emergency service, its hospitals should be designed to cope with peaks in admissions such as those seen during influenza epidemics. Bed occupancy rates for England are no longer collected. In Scotland average annual acute bed occupancy has remained constant at about 81% since the 1980s, though occupancy is higher in specialties such as general and geriatric medicine. In recent years bed occupancy in many hospitals in the UK approached or exceeded 100% in the acute sector at times of peak demand. When bed occupancy in a specialty exceeds 100% it is borrowing beds from other specialties, adding extra beds to wards, or leaving patients on trolleys. One result of bed borrowing is that occupancy for the lending specialties, such as surgery, may look lower than it is. For this reason the percentage of available bed days is a better measure of occupancy. It should measure the peak-trough variation in response to emergency admissions. Bed borrowing leads to inefficiency. Firstly, elective work is cancelled and staff and theatres lie idle. Secondly, the overstretched specialties have patients on outlying wards, making it more difficult for the clinicians to provide adequate care.

*Length of stay*—Average length of stay is calculated as the number of occupied bed days divided by the number of ordinary admissions (excluding day cases).

In England average length of stay in geriatric departments has fallen sharply from 35.7 days in 1991-2 to 19.8 days in 1995-6, probably reflecting the removal of long stay patients to other accommodation. From 1988-9 to 1994-5 length of stay in England for acute and surgical specialties fell by 17% to 5.2 days and 4.6 days respectively. In Scotland from 1988-9 to 1995-6 it fell by 24% and 21% respectively, to 5.5 days and 5.3 days. Despite the pressure on clinicians to discharge patients early, it will be difficult to reduce lengths of stay much further.

## The three schemes

The data available publicly are incomplete either because the trusts have not carried out the necessary analyses or because the business plans have not been made public during the consultation process. In all the schemes the documentation of bed numbers is subject to constant revision. We could not determine whether the populations served would be provided with a comprehensive range of services.

### Lothian

Within Lothian Health Board are two private projects in Edinburgh and a public one in Livingstone. The bed numbers and activity projections for the schemes were revised in October and November 1996. We were unable to obtain details of private beds and five day beds.

*Royal Infirmary Edinburgh Trust* currently provides 1292 acute beds at the Royal Infirmary, Edinburgh City Hospital, the Simpson Memorial Maternity Pavilion, and the Princess Margaret Rose Hospital. Under the proposed private scheme there will be 37% fewer beds at 814. The plan is to rebuild the Royal Infirmary on a greenfield site outside the city at a cost which had risen to £180m by August 1996 and to sell the smaller hospital sites. The preferred consortium, announced in October 1996, is Consort, comprising BICC PLC, the Royal Bank of Scotland, and the Morrison Construction Group, with facilities management by Initial Healthcare and Haden FM.

*Western General Hospitals NHS Trust* provides 549 acute beds and 34 day beds at the Western General and 313 beds at the Eastern General. The plan is to refurbish existing buildings and build new wards and theatres at the Western General and close the Eastern General site. Bed numbers will fall to 801. The preferred consortium is the Miller Consortium, comprising Miller Construction, the Royal Bank of Scotland, Property Facilities Management, and Scottish Hydroelectric.

The public and private schemes in Lothian take no account of the impact of the closure of smaller hospitals. When these are included the overall bed reductions for acute beds and geriatric assessment beds will be 35% and 37% respectively. The trusts' November 1996 projections for the schemes assume that inpatient discharges from acute specialties will fall by 28% (to 1979 levels) and geriatric assessment inpatient discharges will rise by 31%. In contrast, if they followed 10 year Scottish trend data for inpatient discharges (1985-6 to 1995-6) acute and geriatric assessment discharges would rise by 10% and 30% respectively by the year 2002-3.

*Throughput*—In 1995-6 throughput was 55 patients per bed per year for acute specialties in Lothian (table 3), equivalent to the English national average and higher than the Scottish national average. The Lothian 1992 hospital plan projected acute throughput of 61 patients. The trusts' November 1996 projections for activity in the Edinburgh Royal Infirmary, Western General Hospital, and St Johns Hospital predict throughput rising to 69 patients. When activity for the whole of Lothian is projected against 10 year Scottish trend data in inpatient discharges from 1986-96 acute throughput will rise to 94 patients. The question is: will Lothian Health Board providers be able to cope with this high throughput and what will be the impact on quality and level of service to Edinburgh residents? What evidence is there that the system currently has spare capacity?

*Bed occupancy*—The trusts' predictions for the bed numbers are based on a bed occupancy of 85%-95% for most specialties in 2003. Both the Edinburgh Royal Infirmary and the Western General Hospital already had bed occupancies of 81% to 99% for every medical specialty in 1995-6. Over the winter they had to cancel elective admissions, borrow beds, and reopen wards. Bed days are unlikely to be saved by increasing bed occupancy.

*Day cases*—Lothian Health Board providers have exceeded national targets for the proportion of day cases in general surgery and medicine. Data from the Scottish Home and Health Department show that even if all the surgical procedures identified by the Audit Commission as suitable for day case surgery were converted to day case admissions this would save about 4.7% of current bed days in all acute specialties.

*Lengths of stay* for general medicine in Edinburgh Royal Infirmary and the Western General Hospital are in line with or shorter than national trends.[18] The private plans assume reductions of 40% to 50% for general medicine and surgery over the next seven years to 2.9 and 3.2 days respectively. The revised November plans concede slightly longer lengths of stay for general surgery but this was achieved only by reducing projected inpatient discharges by 14%. GPs and hospital consultants have expressed concerns about the ability of the service to cope.

### Calderdale

Calderdale Healthcare NHS Trust provides acute beds at Halifax General Hospital, the Royal Halifax Infirmary, and the Northowram Hospital (largely psychiatric and geriatric care). The new scheme (with Catalyst Healthcare, a consortium of Bovis, the British Linen Bank, and RCO Support) will centralise acute services at the Halifax General. The other sites will be sold. The bed numbers proposed have been revised downwards twice from 635 beds plus 47 rehabilitation beds to 535 beds (table 4). Of these 50 will be mental health beds in a new unit and 50 rehabilitation beds for elderly people. Numbers of acute beds will fall by 42%.

*Throughput*—The predictions for beds assume that inpatient and day case activity would rise by less than 1% per year from 1996 until 2000. Since Calderdale did not provide current throughput data we have used data for England for 1995-6 to estimate the impact of these predictions for activity on throughput and concluded that acute throughput will rise to 95. Local data reflect national trend data over the past five years

**Table 4** Calderdale: number of beds by specialty

| Specialty | Actual: June 1996 | Projected: June 1996 plans | Projected: November 1996 plans |
|---|---|---|---|
| Orthopaedics | 67 | 44 | 100 |
| General surgery | 112 | 64 | |
| Urology | | | |
| Ophthalmology | 26 | 9 | 45 |
| Ear, nose, and throat | | | |
| Gynaecology | 41 | 20 | |
| Paediatrics | 45 | 27 | 73 |
| Maternity | 72 | 48 | |
| Special care baby unit | 18 | 14 | 32 |
| Intensive care | 4 | 6 | |
| Elderly | 218 | 190 | 255 |
| General medicine | 117 | 117 | |
| Mental illness | 209 | 96 | 48 |
| Total | 929 | 635* | 553† |
| Private beds | Not available | | 20 |

*Includes 47 rehabilitation beds. †Includes 45 five day beds.

in ordinary activity in England and suggest that throughput in acute specialties will rise to 96.

*Bed occupancy*—Calderdale hospitals currently exceed 95% bed occupancy with 832 available staffed beds. This winter the trust had to cancel elective surgery and reopen a closed ward. The chief executive is reported to have confirmed that when there are 42% fewer acute beds the hospital expects to cancel elective surgery.

*Day cases and lengths of stay*—Calderdale has already reached national targets for day cases and average length of stay for all acute specialties.

**Bromley**

Plans to centralise all acute services provided at Bromley, Beckenham, Orpington, and Farnborough hospitals were first proposed in 1993. Under the proposed private scheme the Bromley site, 28 acres at Orpington, and 4 acres at Farnborough will be sold. The new hospital will be built at Farnborough and will have 507 beds, only 380 of them seven day beds compared with 619 staffed beds available currently. The consortium, United Healthcare, includes Taylor Woodrow and Initial. The health authority has stated that if the trust cannot proceed with or afford current plans it will consider further reductions in bed numbers.

*Throughput*—Projections based on the 1991 census suggest that the population is likely to remain stable, but Bromley Hospitals Trust predicts that inpatient activity will fall by 3% between 1996-7 and 2001. Numbers of accident and emergency admissions are projected to remain constant until the year 2001. Since neither the health authority nor the trust would provide the data required to calculate throughput, our estimates are based on national data on acute throughput and five year activity trend data. Based on the private finance initiative projections of reduced activity throughput in acute specialties will rise from 54 to 84; based on national trend data in activity it will rise to 93 by 2001 (this assumes the five day beds will not be available for emergency admissions).

*Bed occupancy*—Bromley reported 82% occupancy for 1995-6 for all specialties, rising to 105% in geriatric medicine and averaging 85% to 91% across several acute specialties. This winter the trust cancelled elective surgery, borrowed beds, and reopened wards. Thus bed occupancy—currently with 18% more beds than proposed in the scheme— is already at the level of 87% projected for the year 2001.

*Day cases*—The trust expects to increase the proportion of day cases by 13%, though the current figure is well above the national average.

## Discussion

Our analyses are limited because of the difficulty we had in obtaining business plans, planning documents, and accurate bed numbers from all the trusts concerned. We have shown, however, that beds and activity projections under the assumptions of the private finance initiative are out of line with national and local trends. Throughput on each site will have to increase dramatically over the next five years to cope with the proposed reductions in beds and increased activity. Nationally throughput in general and acute specialties in England has risen by only 20% over the five years up to 1996, and the recent increase in numbers of acute beds at a time of continuing increasing activity indicates a system at saturation point. The planning assumptions therefore seem to follow financial imperatives rather than clinical need.

In all three cases key data are either missing or unavailable publicly or analyses have not been carried out. There appears to be an absence of strategic planning underpinning the reconfiguration of hospital beds and services: there is also a dislocation of planning at community and district level with the removal of the link between the planning of hospital bed numbers and clinical services. As the Lothian case shows, the failure of the private plans to consider the impact of the closure of smaller hospitals and reductions in beds serves only to underestimate the total number of bed reductions. Similarly, the Bromley case illustrates how the failure to consider the number of five day beds may underestimate the severity of bed losses. When bed numbers are adjusted for five day beds in Bromley the reduction in seven day beds is 38% rather than 18%.

In the face of current needs and trends in activity, bed reductions on this scale will compromise the ability of the NHS to provide a comprehensive range of health services to all sections of the population. It will also have difficulty providing an emergency service in winter months and during epidemics. The government has set great store on increasing activity as a performance measure of more patients treated and shorter waiting times.[19] The bed reductions proposed here will reduce the level of activity.

Rather than being "a tremendous opportunity for the modernisation of the NHS," the private finance initiative is likely to lead to a shrunken NHS that will not be able to provide a comprehensive range of health services to all sections of the community.

Private finance initiatives are funded from the NHS revenue budget. If NHS funding does not increase in real terms over the next five years the scheme will take a progressively higher proportion of the clinical services revenue, leaving less for patient care.

Health authorities are not making adequate provision to meet needs. There is no evidence of input from primary care, social services, or public health let alone

from hospital specialists. These schemes involve the sale of public assets and commitment of public funds for many years to come, so the information should be publicly available. It is essential that we know what flexibility there is to increase the numbers of beds and levels of clinical services to cope with peaks in emergency admissions.

We expect our clinicians to evaluate new drugs and treatments before they are made widely available to patients. If our politicians aim "to promote efficiency and to improve services" they should evaluate radical changes in the configuration of health services before these changes are implemented throughout the NHS.

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# Life expectancy, economic inequality, homicide, and reproductive timing in Chicago neighbourhoods

Margo Wilson, Martin Daly

## Summary

In comparisons among Chicago neighbourhoods, homicide rates in 1988-93 varied more than 100-fold, while male life expectancy at birth ranged from 54 to 77 years, even with effects of homicide mortality removed. This "cause deleted" life expectancy was highly correlated with homicide rates; a measure of economic inequality added significant additional prediction, whereas median household income did not. Deaths from internal causes (diseases) show similar age patterns, despite different absolute levels, in the best and worst neighbourhoods, whereas deaths from external causes (homicide, accident, suicide) do not. As life expectancy declines across neighbourhoods, women reproduce earlier; by age 30, however, neighbourhood no longer affects age specific fertility. These results support the hypothesis that life expectancy itself may be a psychologically salient determinant of risk taking and the timing of life transitions.

## Introduction

Psychologists, economists, and criminologists have found that young adults, poor people, and criminal offenders all tend to discount the future relatively steeply.[1-6] Such tendencies have been called "impulsivity" and "short time horizons" or, more pejoratively, impatience, myopia, lack of self control, and incapacity to delay gratification. Behind the use of such terms lies a presumption that steep discounting is dysfunctional and that the appropriate weighting of present rewards against future investments is independent of life stage and socioeconomic circumstance.

There is an alternative view: adjustment of discount rates in relation to age and other variables is just what we should expect of an evolved psyche functioning normally.[5-11] Steep discounting may be a "rational" response to information that indicates an uncertain or low probability of surviving to reap delayed benefits, for example, and "reckless" risk taking can be optimal when the expected profits from safer courses of action are negligible.[7 8 12 13]

### Hypothesis 1

Criminal violence can be considered an outcome of steep future discounting[6] and escalation of risk in social competition.[10] This is especially true of homicide in urban parts of the United States, where a large majority of cases involve competition for status or resources among unrelated men[7 9] and even marital homicides result from sexual proprietariness in the shadow of male-male competition.[14 15] This line of reasoning suggests that criminal violence will vary in relation to local indicators of life expectancy, hence our first hypothesis: homicide rates will vary as a function of local life expectancy.

### Hypothesis 2

Sensitivity to inequality is an expected feature of a psyche that adjusts risk acceptance as we envision, because those at the bottom may be especially motivated to escalate their tactics of social competition when it is clear that some "winners" are doing very well and when the expected payoffs from low risk tactics are

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**Table 1** Effects of life expectancy ("cause deleted" with respect to death from homicide), income, and income inequality on homicide rates of neighbourhoods in Chicago 1988-93: bivariate correlations

| | Homicide rate | Life expectancy for males | Life expectancy for females | Median household income* | Robin Hood index |
|---|---|---|---|---|---|
| Homicide rate | — | | | | |
| Life expectancy for males | –0.88 | — | | | |
| Life expectancy for females | –0.83 | 0.92 | — | | |
| Median household income | –0.67 | 0.73 | 0.59 | — | |
| Robin Hood index | 0.75 | –0.75 | –0.66 | –0.86 | — |

*Effects of household size partialled out.

**Table 2** Effects of life expectancy ("cause deleted" with respect to death from homicide), income, and income inequality on homicide rates of neighbourhoods in Chicago 1988-93: results of stepwise multiple regression predicting homicide rate of neighbourhoods from the other four variables in table 1

| | β | *t* | P value |
|---|---|---|---|
| **Variables in final equation** | | | |
| Life expectancy of males | –0.74 | –9.25 | <0.0001 |
| Robin Hood index | 0.19 | 2.34 | 0.02 |
| **Variables not in final equation** | | | |
| Life expectancy of females | –0.19 | –1.43 | 0.16 |
| Median household income | 0.12 | 1.11 | 0.27 |

poor.[12] This expectation accords with arguments that mortality is exacerbated by inequality itself, over and above the compromising effects of simply being poor on nutrition, access to medical care, safety, and other health promoting opportunities.[16 17] Recent papers in the *BMJ* have presented evidence that economic inequality predicts mortality in general, and moreover that it is most strongly related to "external" mortality of the sort affected by behavioural risk taking, especially homicide.[18 19] Accordingly, our second hypothesis is that economic inequality will account for additional variance in homicidal violence besides that accounted for by local life expectancy.

Previous demonstrations of the effects of inequality on homicide have focused primarily on comparisons between nations, American states, or cities.[18-21] The arguments presented above suggest that the relevant processes of social comparison might operate more locally, with the lives and deaths of people known personally being especially salient to one's mental model of life prospects. We have therefore compared neighbourhoods within a large city. This may also be a good level at which to detect the relations of interest because variables such as latitude, weather, urbanness, laws, history, and prevailing political practices complicate comparisons among larger jurisdictions.

### Hypothesis 3

Finally, if low life expectancy is indeed psychologically salient in the ways we envision, it will inspire short time horizons in other domains of behavioural decision making as well. Life expectancy cues might thus affect inclinations to invest in the future through education, preventive health measures, and savings, as well as decisions about the timing of major transitions and life events. Geronimus's studies of young mothers support these ideas: although early reproduction among urban poor people is commonly viewed as an instance of social pathology and failure to exercise choice, she has shown that teenage pregnancy is often an active decision, motivated in large part by expectations about a life course more compressed in time than that of more affluent people.[22 23] Her interviewees in urban ghettoes in the United States expressly wished to become mothers and grandmothers while still young and competent because they anticipated problems of early "weathering" and poor health. Thus, our third hypothesis is that reproduction will occur earlier in the lifespan as one moves from neighbourhoods with high life expectancy to those with low life expectancy.

### Data sources

There are 77 "community areas" with relatively stable boundaries in the American city of Chicago. We used demographic data for 1988-93 for these 77 neighbourhoods (vital statistics obtained from the Illinois Department of Public Health) and population data from the 1990 census. Following Schoen's method,[24] we used these data to compute male and female life expectancies at birth for each neighbourhood, "cause deleted" in that effects of homicide mortality were removed. We also computed sex and age specific mortality for different causes of death and age specific birth rates. We used counts of the number of households in each of 25 income intervals, derived from 1990 United States Census population and housing summary tape file 3A, to compute the Robin Hood index of income inequality (the maximum deviation of the Lorenz curve of cumulative share of total income from the straight line that would represent zero income variance[19]) for each neighbourhood.

## Life expectancy and homicide

Neighbourhood specific, cause deleted male life expectancy at birth (range 54.3 to 77.4 years) and homicide rates (range 1.3 to 156 per 100 000 per year) are highly correlated, confirming our first hypothesis (fig 1; $r = -0.88$, $P < 0.0001$).

Table 1 shows the bivariate correlations among homicide rates, cause deleted life expectancies, median

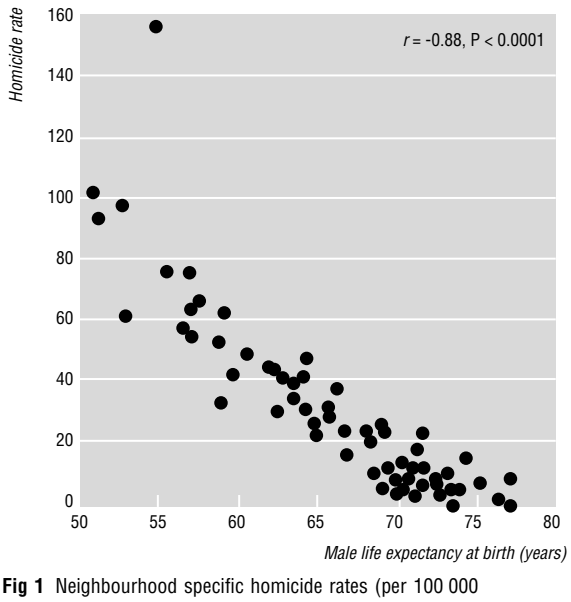


**Fig 1** Neighbourhood specific homicide rates (per 100 000 population per year) in relation to male life expectancy at birth (with effects of homicide mortality removed) for 77 community areas of Chicago, 1988-93

household income (adjusted to remove effects of mean household size, which was correlated with median household income across the 77 neighbourhoods at $r = -0.32$), and a measure of income inequality. All pairs of measures were highly correlated (all P values $< 0.0001$), but male life expectancy was more strongly related to both economic measures and to the homicide rate than was female life expectancy, and male life expectancy predicted the homicide rate better than either economic measure. Stepwise multiple regression indicated that economic inequality adds significantly to the prediction of homicide rate that is afforded by life expectancy, supporting our second hypothesis. The adjusted median household income is apparently of less relevance than inequality, a result that is consistent with previous findings from comparisons among larger politico-geographic units,[18-21] but since the two economic measures are so highly correlated, this conclusion must be tentative.

### Mortality patterns in best and worst neighbourhoods

Figure 2 shows age specific and sex specific death rates, distinguishing death by homicide and other "external" causes (accidents and suicides) from death by "internal" causes (all other causes—that is, by disease, broadly construed). The figure includes data only for the 10 neighbourhoods with the shortest life expectancies (panels on right) and the 10 with the longest (panels on left). Neighbourhoods with low life expectancy have higher levels of all sorts of mortality in virtually all age-sex categories; however, although the pattern of risk of death from internal causes across the lifespan is similar in the best and worst neighbourhoods, age related patterns of external mortality are quite different. These patterns support the idea that differential rates of external mortality are largely a result of differentials in risk acceptance and future discounting, especially in young adults. (Although perpetrating a homicide, rather than becoming a victim, might be thought to reflect risk acceptance and future discounting, the age-sex patterns for perpetrators and victims are similar,[9] largely because homicides in Chicago arise primarily from competitive interactions between male victims and killers who are drawn from the same demographic groups.)

**Table 3** Age specific birth rates (per 1000 women per year) in 10 neighbourhoods with longest life expectancy, 10 with shortest life expectancy, and 10 nearest median life expectancy in Chicago, 1988-93

| Age of mother (years) | Birth rate in neighbourhoods | | |
|---|---|---|---|
| | Shortest life expectancy | Median life expectancy | Longest life expectancy |
| 10-14 | 9 | 2 | 1 |
| 15-19 | 190 | 86 | 45 |
| 20-24 | 224 | 128 | 90 |
| 25-29 | 129 | 103 | 103 |
| 30-34 | 83 | 84 | 89 |
| 35-39 | 39 | 43 | 42 |
| 40-44 | 9 | 10 | 7 |

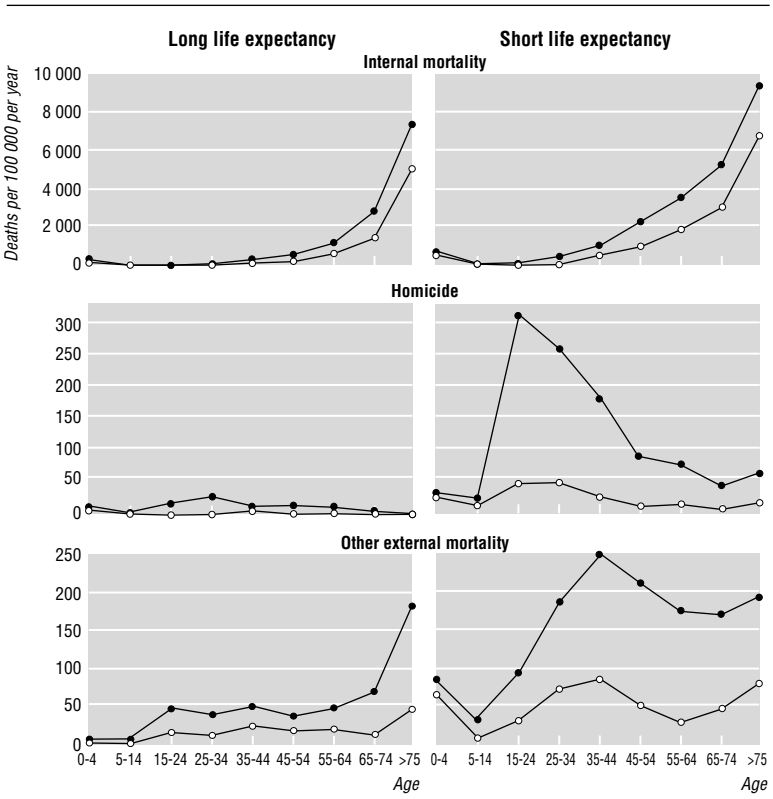


**Fig 2** Age specific death rates per 100 000 population per year, according to sex (male ●; female ○) and cause of death for the 10 neighbourhoods with longest life expectancy (left panels) and the 10 with the shortest life expectancy (right panels), Chicago, 1988-93

## Life expectancy and age specific birth rates

Table 2 shows age specific birth rates for the 10 neighbourhoods with the highest life expectancies, the 10 with the lowest, and the 10 nearest the median. Teenage birth rates are dramatically different, but the differentials decline rapidly and have vanished by age 30. The median age of women giving birth (the "generation time") was 22.6 years in the neighbourhoods with low life expectancy, compared with 25.4 years in the intermediate neighbourhoods and 27.3 years in the neighbourhoods with long life expectancy. These differences are consistent with our third hypothesis and support Geronimus's suggestion[22 23] that the relatively high birth rates in young women in the worst neighbourhoods often reflect a distinct family planning schedule rather than a mere absence of family planning.

## Effect of life expectancy

Life expectancy reflects not only affluence but such additional considerations as local pathogen loads, health care, and risk of violent death, and it may thus provide a more encompassing quality of life index than economic measures alone. More than just providing a useful epidemiological index, however, an "expectation" of future lifespan may be psychologically salient in its own right, although it need not be a conscious expectation. The data presented here indicate that people behave as if they have adjusted their rates of future discounting and risk acceptance thresholds in relation to local life expectancy, and that they do so in the non-violent domain of reproductive decision making as well as in the potentially violent domain of social competition.

How could such a statistical abstraction as life expectancy be a cause of anything? One possibility is that the human psyche produces what is in effect a semi-statistical apprehension of the distribution of local lifespans, based on the fates of other relevant people.[10] If a young man's grandfathers were both dead before he was born, for example, and some of his primary school classmates had already died, discounting the future could be a normal, adaptive reaction. Moreover, if much of this mortality seems to represent "bad luck" incurred more or less independently of the decedents' choices of action, then accepting more risks in the pursuit of immediate advantage would also make sense.

These inference processes are unlikely to be transparent to introspection, but they may be revealed in expressed attitudes and expectations. Ethnographic studies of urban poor people in American cities contain many articulate statements about the perceived risk of early death, the unpredictability of future resources, and the futility of long term planning.[25-28] One interesting question for psychological research is how the relevant mental models and subjective values develop and are adjusted over the lifespan.[29 30] Another is whether media representations, even fictitious ones, can affect such development in the same way as information about known relatives and neighbours. These questions may best be addressed from an evolutionary psychological perspective, which credits the mind with functional "design" for solving important problems of living in society and making decisions under uncertainty.[10 29 31 32] Such an approach has already shed considerable light on detailed aspects of sex differences and age effects.[5 9]

**Feedback effects**

The regression analysis in table 1 and our emphasis on life expectancy as a predictive variable must not be taken to imply that economic inequality plays only a secondary role. Considerable evidence indicates that such inequality is itself a major determinant of life expectancy variation,[17] so the more basic (and remediable) causes of violence and other manifestations of steep future discounting are socioeconomic and structural. How our proposal differs from some other accounts is in suggesting that inequality has its effects not only by virtue of non-adaptive or maladaptive stress effects but also by inspiring a "rational" escalation of costly tactics of social competition.[7-10 33] This consideration complicates causal analysis, because it implies that the distribution of age specific mortality is more than an outcome variable, having feedback effects on its own causal factors and hence on itself. We excluded deaths due to homicide from the analyses in table 1 to eliminate spurious autocorrelational effects, but it is likely that local levels of homicidal violence affect expectations of future life, discount rates, and hence further violence.[8]

The number of likely feedback loops among the phenomena of interest is daunting. If many people react to a local socioecological milieu by discounting the future and lowering their thresholds for risk and violence, the behavioural consequences are likely to worsen the very problems that provoke them, as well as contributing to fear, distrust, and perhaps even economic inequality itself. Living where any resources that one accumulates are apt to be expropriated will also exacerbate these tendencies. Wilkinson has proposed that the behavioural and health effects of unequal resource distributions reflect breakdowns in social and community relations, a proposition that we do not dispute. But exactly how the correlated phenomena of poverty, inequality, injustice, and exogenous threats to life and wellbeing affect the perceptions, motives, and actions of individuals remains to be elucidated. The causal links are several and multidirectional, but we cannot let that deter us from trying to disentangle them.

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