The New Zealand priority criteria project. Part 1: Overview

David C Hadorn, Andrew C Holmes

Abstract

New Zealand restructured its health system in 1992 with the aim of achieving greater levels of assessment and accountability in the publicly funded health sector. A committee was established specifically to advise the minister of health on the kinds, and relative priorities, of health services that should be publicly funded. One of its projects has been to develop standardised sets of criteria to assess the extent of benefit expected from elective surgical procedures. These have been developed with the help of professional advisory groups using a modified Delphi technique to reach consensus. So far the committee has developed criteria for cataract surgery, coronary artery bypass grafting, hip and knee replacement, cholecystectomy, and tympanostomy tubes for otitis media with effusion. These criteria incorporate both clinical and social factors. Use of priority criteria to ensure consistency and transparency regarding patients' priority for surgery is required for access to a dedicated NZ$130m (£57m; US$90m) pool of money, created to help eliminate surgical waiting lists and move to booking systems. The criteria will also be used in surgical outcome studies, currently in the planning phase.

Introduction

In this article we describe a national project, sponsored jointly by New Zealand's National Advisory Committee on Health and Disability and the four regional health authorities, to develop standardised priority assessment criteria for elective surgical procedures. Under the auspices of this project, criteria were developed for cataract extraction, coronary artery bypass graft surgery, hip and knee replacement, cholecystectomy, and tympanostomy tubes for otitis media with effusion. These criteria are used (*a*) to assess patients' relative priority for surgery, (*b*) to ensure consistency and transparency in the provision of surgical services across New Zealand, and (*c*) to provide a basis for describing the kinds of patients who will or will not receive surgery under various possible levels of funding.

New Zealand health reforms

As part of a sweeping overhaul of its economy and social structure, New Zealand implemented major reforms of its healthcare system in 1992 (see box).[1] These reforms can be viewed as a response to the imperatives described by Relman in his 1988 editorial in the *New England Journal of Medicine* announcing the arrival of the era of assessment and accountability in health care.[2] Relman called for a "revolution" in how health care is provided and paid for, endorsing a proposal put forth by Elwood in the same journal just a few months earlier.[3] Elwood described the problem like this:

> Too often, payers, physicians, and health care executives do not share common insights into the life of the patient. We acknowledge that our common interest is the patient, but we represent that interest from such divergent, even conflicting, viewpoints that everyone loses perspective. As a result, the health care system has become an organism guided by misguided choices; it is unstable, confused, and desperately in need of a central nervous system that can help it cope with the complexities of modern medicine.

The New Zealand health reforms represent an effort to provide such a central nervous system. Elwood proposed that the healthcare system should routinely collect detailed clinical information concerning (*a*) the quantity and kinds of services provided, (*b*) the numbers and kinds of patients receiving those services, and (*c*) the outcomes experienced by those patients. Recognition of the need for such assessment data and for better channels of communication constituted a major rationale for the restructuring. At the same time, the contract mechanism was seen as a useful method for ensuring provider accountability.

New Zealand health reforms

- Fourteen area health boards were replaced with four regional health authorities, which purchase publicly funded health and disability services. The National Advisory Committee on Health and Disability was created to advise the minister of health on the kinds of services to be purchased with public funds—and their priority.
- The Ministry of Health (formerly Department of Health) is responsible for macro policymaking and funding. Inpatient services are provided predominantly by crown health enterprises (hospitals and affiliated institutions), which are managed as businesses and are state owned.
- A complete split exists between funding, purchasing, and provision of services.
- Since this paper was prepared for publication the New Zealand health reforms have themselves been drastically reformed. Future papers in the *BMJ* will describe these changes.

See editorial by Dixon

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This article plus substantial backing material is available on the BMJ web site.

National health committee

A major component of the legislation under which the healthcare system was restructured was the creation of a National Advisory Committee on Core Health and Disability Support Services, since renamed the National Advisory Committee on Health and Disability—and known as the national health committee. This committee is charged with providing independent advice to the minister of health (independent, in particular, of the Ministry of Health) concerning the "kinds, and relative priorities, of public health services, personal health services, and disability services that should, in the committee's opinion, be publicly funded."[4]

Early in its tenure the national health committee came under considerable pressure to develop a relatively simple list of services depicting what was in or out of the "core" of services that would be publicly funded. From the outset, however, the committee has taken a different approach. It has preferred to define eligibility for services in terms of clinical practice guidelines or explicit assessment criteria which depict the circumstances under which patients are likely to derive substantial health benefit from those services, bearing in mind competing claims on resources. Thus, for example, patients could reasonably expect to receive coronary bypass graft surgery at the taxpayer's expense if (and only if) their clinical circumstances were commensurate with a likelihood of substantial benefit from that procedure.

The waiting list problem

Long waiting lists for elective surgery have been a nagging issue that long predated the formation of the ministry, regional health authorities, and the national health committee. Based on one of its early commissioned reports,[5] the national health committee recommended that surgical services should move away from a system of waiting lists and toward a system of specific booking times, so that patients would know (within reasonable limits) when they would receive their operation. In addition, the committee called for greater transparency and consistency in the process used to decide priority for elective surgery.[6]

The minister, the ministry, and the regional health authorities accepted the national health committee's advice, including the replacement of waiting lists with booking systems. As a step toward realising this goal, the regional health authorities and national health committee cosponsored a national project to put in place the tools needed to assess the extent of patients' overall priority or urgency for surgery. These priority criteria would reflect primarily the benefit expected from surgery. Priority would generally be given to patients with the greatest likely benefit.

Thus, the ethical framework under which the project was conducted was largely utilitarian in nature, with the principal goal being to achieve the maximum possible health gain with the available funds. The national health committee had formally embraced the philosophy of maximising expected benefit in one of its early reports.[6]

Project methods

- A summary of the relevant literature was prepared by project staff.
- Professional advisory groups were constituted for each procedure, consisting of two or three specialists and surgeons from each of the four regions and two general practitioners.
- A two stage Delphi process preceding each professional advisory group meeting was open to all relevant specialists and surgeons in New Zealand (about 20-30 clinicians participated for each procedure, not counting members of the professional advisory groups).
- Criteria were selected and initial weights agreed at meetings of the professional advisory groups. The draft criteria were pilot tested and their weights recalibrated based on the results.

The national priority criteria project

A six member project steering group was constituted, consisting of representatives of the national health committee (DCH and ACH) and the surgical services managers of the four regional health authorities. Ministry of Health officials were briefed regularly but were not members of the steering group. The stated objective of the project was:

To develop national criteria for assessing the priority which should be given to patients for medical and surgical procedures.... The national priority criteria will serve the following purposes:
(1) To ensure that the process used to define priority is fair and consistent across New Zealand.
(2) To permit the assessment and comparison of need, case mix, and severity.
(3) To assist the regional health authorities in developing new booking strategies, including target booking times for patients with defined levels of priority.
(4) To permit comparison of waiting times across regional health authorities.
(5) To ensure that social values are integrated into the decision making process in an appropriate and transparent manner.
(6) To provide the framework for the national health committee to define maximum acceptable waiting times for patients with defined levels of priority, as well as core levels of each service.
(7) To make possible national studies on the health outcomes experienced by patients who do or do not receive the services.

The box above summarises the approach taken to develop the criteria.

Progress to date

Five sets of standardised assessment criteria were developed for elective surgical procedures under the auspices of the project. Numerical scores were assigned to each of the multiple levels of severity on each criterion; relevant scores on each criterion were added together to form a total score. These multiple factor, additive systems are known as linear models. Such models are well known to outperform unaided clinical judgment on a wide variety of diagnostic and predictive tasks.[7-9]

The procedures covered are (in order of development):

(1) Cataract extraction
(2) Coronary artery bypass graft surgery
(3) Hip and knee replacement
(4) Cholecystectomy

Table 1 Priority criteria for cataract surgery (maximum score 100)

Clinical features							Score
Visual acuity	**6/9 or better**	**6/12**	**6/18**	**6/24**	**6/36**	**6/60**	**Count fingers/hand movements**
6/9 or better	0	1	2	3	4	5	6
6/12		7	8	9	10	11	12
6/18			14	15	16	17	18
6/24				21	22	23	24
6/36					28	29	30
6/60						35	36
Count fingers/hand movements							40
Glare							
None							0
Mild-moderate							5
Severe							10
Ocular comorbidity (eg age related macular degeneration, chronic simple glaucoma)							
None							0
Mild-moderate							5
Severe							10
Ability to work, care for dependants, or work independently							
Not threatened or not applicable							0
Not threatened but more difficult							2
Threatened but not immediately							6
Immediately threatened							15
Extent of impairment in visual function (eg reading, recognising faces, seeing steps or kerbs, watching TV, driving, and reading traffic signs)							
None							0
Mild							5
Moderate							10
Severe							20
Other substantial disability (eg hearing loss, uses wheelchair)							
No							0
Yes							5
Total score							

Table 2 Priority criteria for major joint replacement (maximum score 100)

Clinical features	Score
Pain (40%)	
Degree (patient must be on maximum medical therapy at time of rating):	
None	0
Mild: slight or occasional pain; patient has not altered patterns of activity or work	4
Mild-moderate: moderate or frequent pain; patient has not altered patterns of activity or work	6
Moderate: patient is active but has had to modify or give up some activities because of pain	9
Moderate-severe: fairly severe pain with substantially limited activities	14
Severe: major pain and serious limitation	20
Occurrence:	
None or with first steps only	0
Only after long walks (30 minutes)	4
With all walking, mostly day pain	10
Significant, regular night pain	20
Functional activity (20%)	
Time walked:	
Unlimited	0
31-60 minutes (eg longer shopping trips to mall)	2
11-30 minutes (eg gardening, grocery shopping)	4
2-10 minutes (eg trip to letter box)	6
<2 minutes or indoors only (more or less house bound)	8
Unable to walk	10
Other functional limitations (eg putting on shoes, managing stairs, sitting to standing, sexual activity, recreation or hobbies, walking aids needed):	
None	0
Mild	2
Moderate	4
Severe	10
Movement and deformity (20%)	
Pain on examination (overall results are both active and passive range of motion):	
None	0
Mild	2
Moderate	5
Severe	10
Other abnormal findings (limited to orthopaedic problems eg reduced range of motion, deformity, limp, instability, progressive *x* ray findings):	
None	0
Mild	2
Moderate	5
Severe	10
Other factors (20%)	
Multiple joint disease:	
No, single joint	0
Yes, each affected joint mild: moderate in severity	4
Yes, severe involvement (eg severe rheumatoid arthritis)	10
Ability to work, give care to dependants, live independently (difficulty must be related to affected joint):	
Not threatened or difficult	0
Not threatened but more difficult	4
Threatened but not immediately	6
Immediately threatened	10
Total score	

(5) Tympanostomy tubes for otitis media with effusion

Table 1 shows the criteria for cataract extraction and table 2 those for hip and knee replacement. All criteria were subject to a pilot study to assess the extent of correspondence between the total priority score and global clinical judgments of urgency. A description of the development of the criteria for coronary artery bypass grafting together with their pilot study are described in part 2 of this article. Additional information on the pilot studies is available on the *BMJ*'s Internet web site (www.bmj.com).

Social factors considered in setting priorities

As well as clinical criteria, several social factors were discussed during the course of this project and, to some extent, incorporated within the priority criteria. The most important of these were (*a*) age, (*b*) work status, (*c*) whether patients were caring for dependants or threatened with the loss of their own independence, and (*d*) time spent on the waiting list.

Age

There was substantial disagreement among project participants about the appropriate role of patients' age in assessing the expected benefit from surgery. From a practical perspective, many participants considered age to be a roughly reliable guide to the overall extent of comorbidity experienced by patients, which in turn affects the extent of benefit that can be expected from surgery. However, others were concerned that, even if this is true on average, use of age as a factor in deciding priority for surgery could result in denying services to many elderly patients who would benefit as much as (or more than) younger patients. In the end, age was incorporated in just one set of criteria: those for coronary artery bypass graft surgery. The rationale for

its inclusion here was that this type of surgery has direct implications for life expectancy as well as quality of life, whereas the other surgical procedures directly affect only quality of life. The professional advisory group on coronary artery bypass grafting believed that life prolongation becomes progressively less important for elderly patients compared with the importance of quality of life. Accordingly, the group developed a formula to adjust downward, beginning at age 70, the weights assigned to variables associated with improvements in life expectancy (see *BMJ* web site for details.)

Threat to independence, care of dependants, ability to work

During the process of identifying the factors currently used by clinicians to make judgments of expected benefit project participants acknowledged that clinicians take into account whether (and to what extent) patients' clinical conditions threaten their ability to work, care for dependants, and live independently. Substantial discussion was held on this topic at each professional advisory group meeting, with clinicians generally agreeing that these factors should be represented as priority criteria. Nevertheless, a certain degree of misgiving was usually noted about incorporating these social factors. To address this issue, the national health committee sponsored two public hearings, one on each major island, specifically devoted to discussing the appropriateness of including these factors in the assessment of urgency and priority for elective surgery. A stratified random sample of the public in each community and patients with the relevant conditions were recruited to provide their perspectives. Clinicians from the local area and members of the professional advisory groups also attended. Although no definitive resolution was achieved, the results of the hearings were regarded by observers from the national health committee and regional health authorities as supporting the inclusion of these factors provided they are given relatively little weight compared to clinical factors.

Time spent on waiting list

The length of time spent waiting for the procedure also proved a contentious and difficult issue. Many clinicians favoured inclusion of such a factor on grounds that the "simple act of waiting" should warrant some consideration. However, this concern was balanced by the fact that, if waiting time were incorporated, the inevitable result would be that in many cases less impaired patients would be operated on before more impaired patients. In the end, "time spent waiting" was excluded from the criteria, mainly because the principal tenet of the criteria is that they reflect the degree of clinical (and social) likely benefit associated with the clinical condition, not time spent waiting.

Minister of health's announcement

On 8 May 1996 the minister of health, Jenny Shipley, announced the creation of a new NZ$130m (£57m; US$90m) fund with the express purpose of reducing waiting times and clearing waiting lists. Access to the funds is contingent on the use of explicit clinical priority criteria, such as, but not limited to, those developed during this project.

Professional and public response is generally positive

Response to the new waiting list initiative has been generally positive. In particular, the response from doctors has been largely one of relief that thousands of patients on waiting lists will now be provided with surgery who would not have received it without these new funds. News coverage has also been generally favourable. The capital's *Dominion* described the move as another "welcome step toward reducing waiting lists for non-urgent surgery in a responsible way, instead of resorting to the bad old practice of throwing money at a problem and hoping for the best....The new system is designed to ensure that people with the biggest need and greatest potential benefit will have their surgery first, that the same rules apply throughout New Zealand. . . . All this is light years ahead of rationing surgery by making people wait indefinitely for it, and with marked regional variations."[10]

In part 2 of this article we describe in more detail our experience developing, testing, and implementing the priority criteria for coronary artery bypass graft surgery.

We thank the many clinicians who participated in this project without whose support this project could not have been completed successfully.

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Conflict of interest: None.

1 Ashton T. From evolution to revolution: restructuring the New Zealand health system. *Health Care Analysis* 1993;1:57-62.
2 Relman AS. Assessment and accountability: the third revolution in medical care. *N Engl J Med* 1988;319:1220-2.
3 Elwood PM. Outcomes management: a technology of patient experience. *N Engl J Med* 1988;318:1549-56.
4 Health and Disability Act 1993, as amended 1995; Sec 8, par 2, p5.
5 Fraser G, Alley P, Morris R. *Waiting lists and waiting times: their nature and management.* Wellington: National Advisory Committee on Core Health and Disability Support Services, 1993.
6 National Advisory Committee on Core Health and Disability Support Services. *Second annual report.* Wellington: National Advisory Committee on Core Health and Disability Support Services, 1993.
7 Dawes RM, Corrigan B. Linear models in decision making. *Psychol Bull* 1974;81:95-106.
8 Meehl PK. *Clinical versus statistical prediction: a theoretical analysis and a review of the evidence.* Minneapolis: University of Minnesota Press, 1954.
9 Tversky A, Kahneman D. *Judgment under uncertainty: heuristics and biases.* Cambridge: Cambridge University Press, 1982.
10 Editorial. *Dominion.* 1996; 10 May:8.

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Corrections

Insulin resistance

Two editorial and two author's errors occurred in this article by Andrew Krentz (30 November, pp 1385-9). In box 4, Reaven's syndrome and Associated metabolic abnormalities should have been subheadings. In the section on Reaven's syndrome the last sentence of the first paragraph should have read "Other cardiovascular risk factors have been identified which are also components of the insulin resistance syndrome" and not syndrome X, and in the second sentence of the third paragraph diminished adrenomedullary activity should have read dyslipidaemia associated with hypertension. In the summary box and the section on acquired forms of insulin resistance α receptors should be α_1 receptors.

Grand Rounds—Hammersmith Hospital: A case of laboratory acquired brucellosis

A proofreading error led to authorship of this paper being attributed to the wrong person on the front cover (2 November, pp 1130-2). The author is Peter R Arlett (not S D Taylor-Robinson, who is the series editor).

The New Zealand priority criteria project. Part 2: Coronary artery bypass graft surgery

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Abstract

Priority criteria developed during a national project were used to conduct an audit of all 662 patients on waiting lists for coronary artery bypass surgery in New Zealand during spring 1996. Based on the observed distribution of priority scores, the cost of providing surgery to all patients down to various levels of priority was estimated. Descriptions incorporating life expectancy and quality of life implications of surgery were developed of the kinds of patients who would or would not receive surgery at each of several possible funding levels. Cardiologists and cardiac surgeons agreed that a threshold of 25 points was a reasonable clinical goal but to work with a threshold of 35, which can be sustained with current levels of funding. All agree that the gap between these clinically preferred and currently afforded thresholds is a subject for wider societal dialogue and decision. The ability to measure the size of the gap between clinical desirability and financial sustainability provides a new transparency to the problem of healthcare resource allocation.

Introduction

This paper discusses several issues arising from the priority criteria project in the context of the criteria developed for coronary artery bypass surgery. We describe the process of developing criteria, including the results of a pilot test, and discuss how the results of a clinical audit of all patients on New Zealand's waiting lists for coronary artery bypass grafting were used to estimate the cost of providing surgery to patients down to each of several possible clinical thresholds. A new government initiative to clear waiting lists is described which requires use of explicit criteria such as those developed in this project. We discuss how cardiologists and cardiac surgeons agreed to accept a specific numerical threshold as indicative of reasonable levels of service provision. Finally, we describe how the criteria were used to identify and describe the kinds of patients who would or would not receive coronary artery bypass surgery at defined levels of public funding.

Background

Development of the criteria for coronary artery bypass grafting as part of the priority criteria project followed similar work reported by clinicians at Greenlane Hospital in Auckland,[1] which itself had been motivated by earlier work on waiting lists sponsored by the National Health Committee on Health and Disability.[2 3] The results of the Greenlane study, which used a method based on the rating system developed by Naylor and coworkers,[4] had called into question the extent to which quantitative measures could capture clinicians' overall judgments of priority and likely benefit. Nevertheless, the Greenlane investigators, all of whom were also members of our professional advisory group on coronary artery bypass grafting, agreed it was important to continue the effort to develop such criteria.

Clinicians' reactions to the project

In general clinicians in New Zealand were very interested in the project and willing to participate despite tight timetables and nominal reimbursement. Almost all clinicians who were nominated by regional health authorities agreed to serve as professional advisory group members, and 20-30 additional clinicians from around the country took time to provide often extensive responses to requests for comments on each procedure. As described in part 1, all relevant specialists and surgeons were invited to provide comments as part of a modified Delphi process.

As might be expected, clinicians had mixed views on the project. The most commonly expressed concern was that the government or the regional health authorities would use the criteria to specify arbitrary numerical cut off points below which surgery would not be funded. In the minds of many clinicians the real problem was that the level of funding for surgical services was inadequate. Developing a priority system in the context of such scarcity would be like "rearranging the deck chairs on the Titanic," as one commentator put it. Similarly, a member of the professional advisory group for coronary artery bypass grafting wrote, "If the available surgical resource is inadequate, it is not possible to produce a workable numerical system of prioritisation for patients in need of coronary artery surgery."

Despite these concerns physicians and surgeons from around New Zealand cooperated with this project to a very substantial extent. Two principal reasons for this cooperation were identified. Firstly, clinicians almost universally acknowledged that decisions about urgency and priority were made inconsistently. Often, the "squeaky wheel would get the grease," and more deserving but uncomplaining patients would be disadvantaged. One cardiologist put it like this:

> Manipulation by referring doctors, friends in high places, MP letters, or just persistent nagging, and just slight exaggeration of symptoms, is rampant, and the poor benign patient simply sits on the list and is leap frogged. I support any system which will provide fair, humane, and prognostic order of surgery.

The second major reason for clinicians' cooperation in this project was their wish to develop an objective measure of symptoms and functional status that policymakers could understand. Participating clinicians viewed the development of standardised assessment criteria as having the potential to provide additional, more comprehensible, and possibly dramatic information concerning the extent of "unmet need."

See editorial by Dixon

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This article plus substantial backing material is available on the BMJ web site.

Development of criteria for coronary artery bypass grafting

The priority criteria for coronary artery bypass grafting were developed by a professional advisory group consisting of seven cardiologists, four cardiac surgeons, one physician, and two general practitioners. These individuals were nominated by the four regional health authorities and by the Royal New Zealand College of General Practitioners. Selection of the criteria followed an iterative modified Delphi consensus process, including consideration of written comments received from an additional 25 cardiologists and surgeons from around New Zealand (see part 1).

As described in part 1, the priority criteria represent the clinical factors—for example, the extent of coronary artery obstruction—that have been shown, or are considered, to be associated with the degree of benefit obtained from the procedure. Numerical scores (or weights) are assigned to each of multiple levels of severity on each criterion; relevant scores on each criterion are then added together to form a total score. This score is considered indicative of the overall degree of benefit expected from surgery (see table 1).

In selecting priority criteria for coronary artery bypass grafting the professional advisory group was able to rely to a much greater extent on published outcome studies than were the advisory groups for the other procedures (cataract surgery, hip and knee replacement, cholecystectomy, and grommets for glue ear). For example, a table listing the various possible degrees of coronary artery obstruction was adopted without significant change from a then newly published analysis of 10 years' experience with coronary artery bypass grafting by Duke University investigators.[5] The initial weights assigned to these degrees of obstruction were taken directly from this published report, although recalibrated to accommodate the 100 point maximum adopted for each set of criteria.

Weights were assigned to the remaining factors based on additional information in this report and from a meta-analysis of outcomes of coronary artery bypass grafting published during this process.[6] It was agreed that these initial weights would be revised as appropriate based on the results of a pilot study. As described in part 1, both a "social factor" and an age adjustment factor were incorporated into the clinical criteria to reflect both common clinical practice and the balance of social values, as gleaned by the national health committee via public meetings and consultation.

Table 1 Priority criteria for coronary artery bypass surgery (maximum score 100)

Clinical features	Score
Degree of coronary artery obstruction (% diameter occluded)	
No coronary artery disease (≥50%)	0
1 Vessel disease (50-74%)	8
>1 Vessel disease (50-74%)	9
1 Vessel disease (75%)	9
1 Vessel disease (≥90%)	14
2 Vessel disease (50-89%)	15
2 Vessel disease (both ≥90%)	15
1 Vessel disease (≥90%) proximal left anterior descending artery	19
2 Vessel disease (≥90%) left anterior descending artery	19
2 Vessel disease (≥90%) proximal left anterior descending artery	19
3 Vessel disease	19
3 Vessel disease (≥90%) in at least one	19
3 Vessel disease (75%) proximal left anterior descending artery	19
3 Vessel disease (≥ 90%) proximal left anterior descending artery	27
Left main (50%)	27
Left main (75%)	32
Left main (≥90%)	36
Angina (Canadian Cardiovascular Society criteria: class of angina after appropriate treatment)	
Class I: angina on strenuous exertion	1
Class II: angina on walking or climbing stairs rapidly	2
Class III: angina on walking one or two level blocks	8
Class IV A: unstable angina, rest pain	18
Class IV B: unstable angina on oral treatment, in hospital. Symptoms improved on treatment but angina with minimal provocation	22
Class IV C: in hospital on intravenous heparin or glyceryl trinitrate	26
Exercise stress test (Bruce protocol*)	
Negative	0
Mildly positive	8
Positive	12
Very positive	22
Ability to work, care for dependants, or live independently	
Not threatened but more difficult	1
Threatened but not immediately	5
Immediately threatened	16

*Very positive: ≥2 mm ST depression ± angina in stage I, fall in blood pressure >15 mm Hg in stages I-II, ventricular tachycardia or fibrillation in stages I-II, or unsafe to perform test; Positive: any of the above criteria but patient not on optimal treatment or inability to progress beyond stage II for other reasons; Mildly positive: test stopped at stage III; Negative: none of the above or test stopped at stage IV.

Pilot study

A formal pilot study was conducted of each set of criteria. Details of the methods and results of these studies are available on the *BMJ*'s worldwide web site (www.bmj.com). We briefly describe the coronary artery bypass grafting criteria pilot study here.

A total of 260 patients were assessed during the study. Of these, 133 patients were evaluated at Greenlane Hospital (Auckland), 119 at Dunedin Hospital, and eight at Waikato Hospital (Hamilton). Although patients were enrolled more or less consecutively during the study period, the sample should be considered a convenience sample.

Total priority scores were calculated for each patient by adding the weights assigned to various factors at the appropriate levels. In addition, physicians were asked to estimate what a "reasonable waiting time" (in days) would be for each patient, considering an "adequately, not infinitely funded service" and "keeping in mind competing claims for resources both within and outside the health sector." Reasonable waiting time, which was considered indicative of likely benefit, was used as the outcome (dependent) variable in our analyses. Alternative dependent variables could have been used, such as clinicians' global assessment of expected benefit on a scale of 0-100. It is unclear whether the results of our analysis would have differed substantially had an alternative dependent variable been used.

Regression analysis was used to determine the set of criteria weights resulting in the highest degree of correlation between priority scores and clinicians' judgments of reasonable waiting times. Slight modifications were then made in a few weights based on clinical judgment. The final criteria and weights

Table 2 The estimated cost of providing surgery on a steady state basis to patients at or above each of various possible clinical thresholds, highlighting the level of current funding (threshold 35 points)

No of operations per week	No of operations per year	Priority threshold	Estimated cost (NZ$)*
17	884	44	14 500 000
18	936	42	15 400 000
19	988	40	16 300 000
20	1040	39	17 200 000
21	1092	37	18 100 000
22	1144	35	19 000 000
23	1196	34	19 900 000
24	1248	32	20 700 000
25	1300	31	21 600 000
26	1352	29	22 500 000
27	1404	27	23 400 000
28	1456	25	24 300 000
29	1508	21	25 200 000
30	1560	7	26 000 000

*Based on unit costs of NZ$17 000 per elective operation, NZ$22 000 per acute operation (10 per week). 1NZ$=£0.44, $0.70.

(table 1) correlated quite closely with estimates of reasonable waiting time, with a statistical test of correspondence (coefficient of variation, or r^2) of 0.62 (perfect correlation would score 1.0, no correlation would score 0).

Based on the results of the pilot test we calculated the approximate cost of providing surgery to patients who present for coronary artery bypass grafting in New Zealand on a steady state basis—that is, assuming that a separate (and separately funded) initiative were used to clear the waiting lists (as discussed below). Table 2 shows the estimated cost of providing surgery to patients at or above each of various possible clinical thresholds. On current funding levels we estimate that coronary artery bypass grafting can be provided to patients scoring 35 points or higher.

Audit of waiting lists for coronary artery bypass grafting

Following development, testing, and revision of the criteria for coronary artery bypass grafting a clinical audit was conducted of all patients on New Zealand's waiting lists for coronary artery bypass grafting using the revised criteria. A single, experienced, independent nurse reviewer examined the clinical records of all 662 patients on the four regional waiting lists and abstracted from those records the data required for calculating priority scores. Standardised abstraction forms and coding protocols were developed to provide additional assurance of comparability across centres.

The observed distribution of priority scores for patients on waiting lists for coronary artery bypass grafting in New Zealand was roughly normal (fig 1).

Based on this distribution, we calculated the cost of providing coronary artery bypass grafting surgery to all patients on current public waiting lists at or above specified thresholds of clinical priority (table 3). These estimates were derived using various assumptions concerning the unit cost of coronary artery bypass grafting and the proportion of patients on lists who would no longer benefit from surgery.

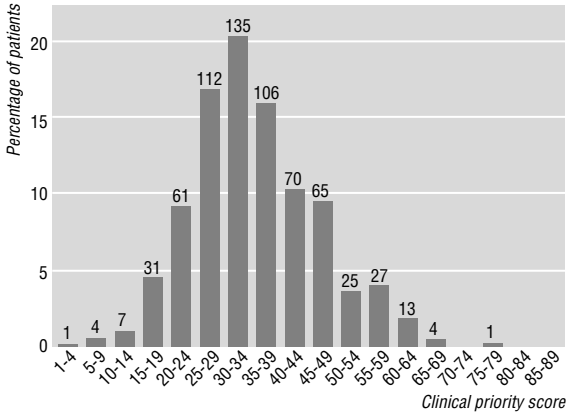

Fig 1 Distribution of priority scores for coronary artery bypass grafting among 662 patients waiting for the operation in New Zealand. Numbers of patients are given above each bar

Describing kinds of patients

The priority criteria used in this project lend themselves to the purpose of providing a "common insight into the life of the patient."[7] In the case of coronary artery bypass grafting, patients were described by reference to five point bands on the scale of clinical priority. Within each band, patients were ordered on each variable and the median values of each variable identified. The collection of median values on all four variables was used to describe the "average patient" within each five point band. Table 4 depicts the results of this process.

For purposes of communicating more directly to politicians, policymakers, and the public a greater degree of descriptive richness was considered necessary. For this reason, the range of priority scores was divided into three levels and the median values of patients within each level identified. Descriptions based on these values were constructed using the operational definitions of angina (table 1) together with estimates of the likely implications of coronary artery bypass grafting surgery on life expectancy. These estimates were based on an examination of a recent meta-analysis.[6] The resulting descriptions are presented in the box. These descriptions were deemed by

Table 3 Summary of costs for performing coronary artery bypass grafting on 662 patients on New Zealand's waiting lists

Priority score threshold	Proportion operated on	No of patients operated on	Cost (NZ$)*
65	0.02	12	200 000
60	0.04	25	430 000
55	0.08	56	950 000
50	0.14	94	1 600 000
45	0.24	157	2 700 000
40	0.36	237	4 000 000
35	0.51	337	5 700 000
30	0.69	454	7 700 000
25	0.87	574	9 800 000
20	0.95	626	10 600 000
15	0.99	655	11 100 000
10	1.00	660	11 200 000
5	1.00	661	11 200 000
0	1.00	662	11 300 000

*Based on a unit cost of NZ$17 000 per operation. 1 NZ$=£0.44, $0.70.

Table 4 Median levels of each clinical variable within each 5 point priority score band for coronary artery bypass grafting April 1996

Priority score	No	Coronary artery disease	Angina	Exercise stress test	Ability	Age
10-14	6	1 Vessel disease (75%)	Class II	Negative	Not threatened	67.5
15-19	29	2 Vessel disease (50-94%)	Class II	Negative	Not threatened	66.9
20-24	54	3 Vessel disease	Class II	Mildly positive	Not threatened	64.6
25-29	126	3 Vessel disease	Class II	Mildly positive	Not threatened	63.2
30-34	123	3 Vessel disease (≥95%) in at least 1	Class II	Positive	Not threatened	62.8
35-39	112	3 Vessel disease (≥95%) in at least 1	Class III	Positive	Threatened but not immediately	62.0
40-44	89	3 Vessel disease (75%) proximal left anterior descending artery	Class II	Positive	Threatened but not immediately	59.9
45-49	68	3 Vessel disease (75%) proximal left anterior descending artery	Class III	Positive	Immediately threatened	63.2
50-54	42	3 Vessel disease (75%) proximal left anterior descending artery	Class III	Very positive	Immediately threatened	59.6
55-59	35	3 Vessel disease (≥95%) proximal left anterior descending artery	Class III	Very positive	Immediately threatened	60.4
60-64	15	3 Vessel disease (≥95%) proximal left anterior descending artery	Class III	Very positive	Immediately threatened	64.8
65-69	8	3 Vessel disease (75%) proximal left anterior descending artery	Class IV A	Very positive	Immediately threatened	59.6

most observers to be valid and effective descriptions of patient severity with which to communicate to the public and policymakers.

Specification of clinically desirable threshold

As described in part 1, on 8 May 1996 the minister of health announced the creation of a NZ$130m fund to be used for clearing surgical waiting lists and replacing them with booking systems. On that same day the minister also launched a meeting attended by cardiologists, cardiac surgeons, and representatives of the Ministry of Health, national health committee, and regional health authorities.

The results of the audit just described were presented at that meeting. The clinicians accepted the results of the audit and, after discussion, agreed that a clinical threshold of 25 points before considering coronary artery bypass grafting was reasonable given the degree of benefit expected and competing claims on resources. Whether public funding would be sufficient to operate on all patients above this threshold was recognised by all participants to be a separate, societal question. Indeed, at the meeting the minister agreed to be held accountable for any gap between what is clinically desirable and what is financially sustainable, reasoning that appropriate funding levels must take into account competing claims on resources—adjudication of which is ultimately up to society to resolve through democratic processes.

As noted earlier, preliminary estimates indicate that current funding levels will permit surgery to be offered to patients scoring at or above 35 points. As such, there is an apparent 10 point gap between what is clinically preferred and what can be afforded. We believe that the ability to quantify this gap, even if imperfectly, represents a major advantage of the general approach described in this article.

The acceptance by clinicians of a quantitative threshold for surgery, based on priority criteria, represents a key development in the transition within New Zealand from waiting lists to booking systems. Such explicit acceptance by clinicians of the inevitability of limits is vital to the success of any attempt to distribute healthcare dollars more equitably. On balance, we believe the experiences described in this article are an important step towards the goal of a fair, transparent, and evidence based allocation policy.

Descriptions of average patient at each of three levels of priority score

- Patients with a score of 55 or more have considerably reduced quality of life due to chest pain and breathlessness on almost any physical activity and a reduction in life expectancy of perhaps 1-2 years in the absence of surgery.
- Patients with scores of 35-54 experience much reduced quality of life, mainly through pain on exertion, such as walking one or two blocks, as well as moderately (8-12 months) reduced life expectancy in the absence of surgery.
- Patients with scores of 25-34 points experience intermittent pain or breathlessness when undertaking such activities as walking or climbing stairs rapidly and experience a modest reduction in life expectancy (4-8 months) in the absence of surgery.

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1 Agnew TM, Whitlock RML, Neutze JM, Kerr AR. Waiting lists for coronary artery bypass surgery: can they be better organised? *N Z Med J* 1994;107:211-5.
2 National Advisory Committee on Core Health and Disability Support Services. *Second annual report.* Wellington: National Advisory Committee on Core Health and Disability Support Services, 1993.
3 Fraser G, Alley P, Morris R. *Waiting lists and waiting times: their nature and management.* Wellington: National Advisory Committee on Core Health and Disability Support Services, 1993.
4 Naylor CD, Baigre RS, Goldman BS, Basinski A. Assessment of priority for coronary revascularisation procedures. *Lancet* 1990;335:1070-3.
5 Mark DB, Nelson CL, Califf RM, Harrell FE, Lee KL, Jones RH, *et al.* Continuing evolution of therapy for coronary artery disease. *Circulation* 1994;89:2015-25.
6 Yusuf S, Zucker D, Peduzzi P, Fisher LD, Takaro T, Kennedy JW, *et al.* Effect of coronary artery bypass graft surgery on survival: overview of 10-year results from randomised trials by the Coronary Artery Bypass Graft Surgery Trialists Collaboration. *Lancet* 1994;344:563-70.
7 Elwood PM. Outcomes management: a technology of patient experience. *N Engl J Med* 1988;318:1549-56.

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Funding the NHS
Can the NHS cope in future?

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Abstract

Four potential pressures are likely to determine whether the NHS will be able to cope in future: the change in population structure, changes in level of morbidity, introduction of new technologies, and increasing expectations of patients and NHS providers. New technology and changes in expectations are likely to have the biggest effect and are also the most difficult to quantify. Nevertheless, these pressures are to some extent amenable to control. If the growth in funding continues as it has in the past there is no convincing evidence that the NHS will not continue to cope.

This is the second in a series of articles discussing how the NHS is funded

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Introduction

Last week we concluded that none of the approaches to funding discussed provided a satisfactory answer to the question of how much should be spent on the NHS and that the level of spending had to be based on broad political judgment. Such judgments, and indeed the ability of the NHS to respond to change in future, depend on three main things: the nature and extent of the pressures on the NHS; the level of resources available; and the efficiency with which they are used. In this article we examine these three areas at a national level, and in the next article we look at them from a local point of view.

The four main pressures on the funding and efficiency of the NHS over the next 20 years will be demography, morbidity, new technologies, and changing expectations. We examine each of these in turn.

Demography

The main demographic trend projected for the next 20 years by the government actuary's department is an increase in the numbers of elderly people, particularly the very old. As table 1 shows, elderly people, along with newborn babies, received by far the largest expenditure per capita in the hospital and community health services sector in 1993-4. In the family health services sector (general practice) elderly people also received higher expenditure per capita, although the difference was smaller.

To estimate how much extra spending is likely to be required to cope with demographic change in future we took total NHS per capita expenditures by age groups in 1993-4 for hospital and community services and general practice separately and applied these to population projections obtained from the Office for National Statistics. The method is described in more detail in appendix 1.

The results suggest that simply to cope with demographic change the NHS will require an extra 8.25% growth in real expenditure (expenditure adjusted to allow for general inflation) between 1994 and 2014, slightly less than the estimated growth of 10.3% from 1974 to 1994. Because relative costs for elderly people and newborn babies are much greater in hospital and community services than in general practice most of this extra growth will be required in hospital if current patterns of care continue.

Table 1 Per capita expenditure (£) by age group for hospital and general practice, 1993-4

Age	Hospital and community services[1]	General practice*
Births	1762.2	217.5
0-4	374.0	156.7
5-15	184.7	128.7
16-44	241.2	146.7
45-64	355.5	
65-74	702.5	248.8
75-84	1279.5	353.4
≥85	2260.2	

*Estimates prepared by the NHS executive (personal correspondence).

Morbidity

The only information describing changes in morbidity within the population as a whole comes from surveys of self reported health. Data from the general household survey show that there was a modest increase in self reported morbidity between 1979 and 1992 in the population as a whole and in specific age groups.[2]

It is unclear whether in future elderly people will experience "extended" or "compressed" levels of morbidity as their lifespan increases.[3-5] A recent comprehensive review suggests that there will be more light to moderate disabilities but fewer severe disabilities as a result of increasing life expectancy.[6]

We conclude that despite the fact that the incidence of some diseases seems to be rising (for example, asthma) and others (such as tuberculosis) are reemerging, there is no evidence which would suggest any significant escalation of demand for NHS care based on changes in population levels of morbidity. However, largely unforeseen events such as a major outbreak of infectious disease which is resistant to antibiotics or changes in lifestyle may worsen rather than improve health. There could also be a shift in morbidity towards illnesses that are expensive to treat.

Technological change

Many consider that technological advance is the greatest source of pressure on expenditure facing any healthcare system.[7,8] New technologies typically create pressure to increase spending because, although they may allow cheaper treatment per case, they also offer new opportunities for treatments or raise the quality or outcome of treatment and thus increase the number of people who may benefit. This means that overall health expenditures may increase, as has been shown for

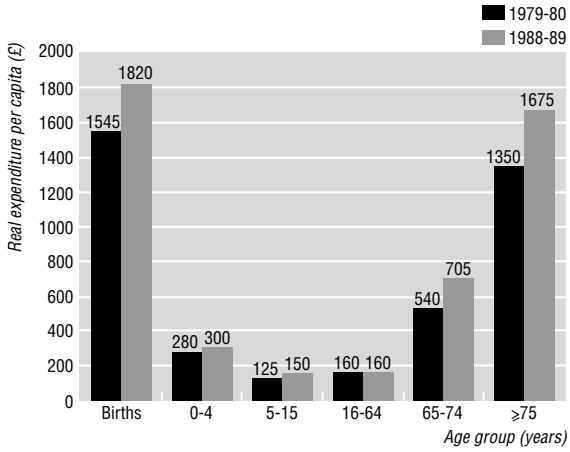

Fig 1 Growth in per capita expenditure by age 1981-8. Data from Department of Health

laparoscopic cholecystectomy.[9] The apparent increase in per capita expenditures in newborn babies and elderly people in the hospital and community health services sector (fig 1) may well be explained by increasing use of new technologies in these groups which have allowed interventions that were previously impossible or unsafe.

It is hard to find examples where new technologies have reduced spending in the health system as a whole rather than on individual patients. This is because there is relatively little research on the overall effects of introducing new technologies on health systems—for example, into whether they generate more demand, in which patients, and on the knock-on effects on use or costs of other services.[10] At best such effects have been discussed but not quantified.[11 12]

There is therefore no sure way of forecasting the effect of new technologies on NHS expenditure. But in the face of bullish forecasts of what technology may offer in the future [13] as well as evidence of the increasing number of technologies available each year,[10] the opportunities for introducing new technologies are likely to grow.[14]

Unlike demography, however, the introduction and use of technology is to some extent amenable to control. Processes such as health technology assessment and product licensing are designed to allow into common use only those innovations which can be shown to be cost effective.[15 16] The scope for such control depends partly on the acceptability to the public and healthcare professionals of the consequences, such as lower access to beneficial technologies compared with other countries (as observed in the past [17 18]), and the political will to encourage effective control.

Expectations

When people attempt to explain why the NHS appears to be under pressure they often argue that both the general public and health professionals expect the NHS to do more for patients. This is partly a result of changes in technology and partly a reflection of broad changes in the rest of society such as the growth in consumerism, which is both reflected in and fuelled by the citizen's charter.

In fact the NHS has managed to do more: activity has increased for every year in the past 20 years, and indeed since the formation of the NHS in 1948. The proportion of patients consulting their general practitioner grew from 66% in 1971-72 to 78% in 1991-92.[19] Total NHS hospital activity increased from 7 million finished consultant episodes in 1990-91 to 10.5 million in 1994-95.[20] Furthermore such figures do not take into account improvements in the quality of clinical care (such as better outcomes) or in the process of care (such as better physical conditions in hospitals and general practice surgeries, better information for patients, or shorter waiting times).

There is no direct way of showing that these changes have succeeded in meeting expectations of what the NHS should be doing. But if the NHS was falling short it might be expected to show itself in two ways: by people turning in greater numbers to the private sector and in their stated opinions as measured in public opinion polls.

The proportion of the population with private health insurance has slowly risen during recent years, although it has been fairly static since 1990 at around 11-12%.[21] Similarly, the use of care directly paid for by private individuals, such as complementary therapies and over the counter drugs, is also rising.[22 23] However, these trends are likely to be influenced more by factors such as government policy to change the status of drugs, the state of the economy, social status, and personal preference than NHS performance.[24-26] This may change in the future, particularly if the perception of the adequacy of care in the NHS falls greatly—for example, if waiting times were to increase significantly or services were increasingly excluded from the NHS menu.

The results of opinion surveys are likely to be influenced by several complex factors, not least of which is the way that the questions are phrased.[27] Drawing conclusions from different surveys is therefore difficult. Data from the British social attitudes survey, which has used the same questions over a long period, show fluctuations in the proportion of people reporting satisfaction with NHS care. For example, 54% were satisfied in 1983, 37% in 1989, 44% in 1993, and 37% in 1995.[28] Those reporting recent experience of using hospital care are more satisfied than those who have not (72% as opposed to 56%) and satisfaction with general practitioners remains consistently high at 80%.[29] On this basis it is hard to argue that people are becoming less satisfied with the performance of the NHS.

But the evidence of lower rates of satisfaction among members of the public who have not recently used the NHS does suggest another pressure on the NHS: the public may be losing confidence in the ability of the NHS to provide for them. This may be magnified by the media—for example, the paradox of news of the application of new technologies in the NHS run alongside stories of hospitals running out of funds. Addressing this form of dissatisfaction is a major challenge for the NHS and will require new methods.

Are funding levels enough to absorb pressures?

It is impossible to forecast the NHS's future resources reliably given the inherent uncertainties attached to

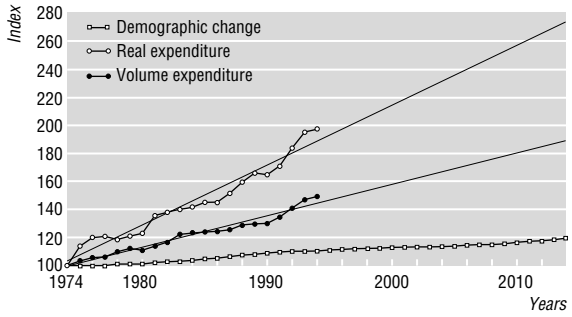

Fig 2 Growth in net government NHS expenditure (excluding capital expenditure) and demographic change, England, 1974-2014 (base year 1974=100)

both future economic performance and political decisions about the level and allocation of public spending. But it seems reasonable to assume both that the economy will continue to grow at the rates achieved in the past[30] and that the NHS will, as in the past, share in that growth. On that basis, projected growth easily exceeds that required to cope with demographic change for the NHS as a whole (fig 2) and within that for both hospital and community services (fig 3) and family health services (fig 4). The methods used to estimate expenditure are given in appendix 1. We have examined only data for England because of ease of access.

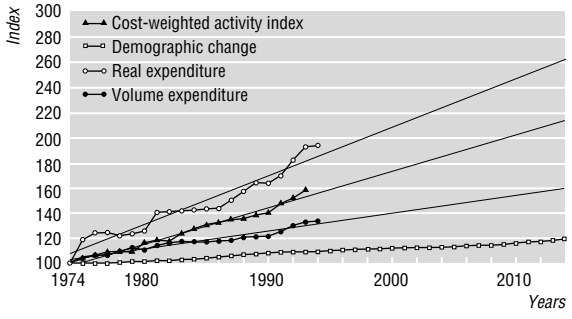

Fig 3 Growth in net government hospital and community health services expenditure (excluding capital expenditure), demographic change, and productivity, England 1974-2014 (base year 1974=100 except for cost-weighted activity index 1975=100)

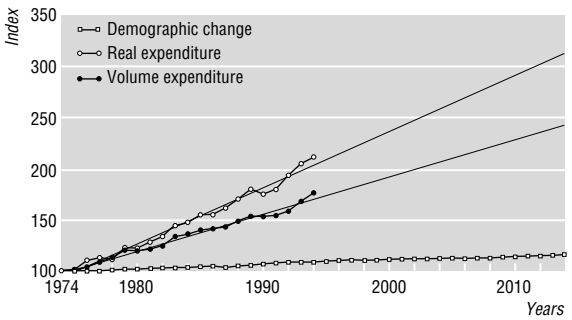

Fig 4 Growth in net government family health services expenditure (excluding capital expenditure) and demographic change, England 1974-2014 (base year 1974=100)

The ability of the NHS to deliver more care is influenced not only by its funding but also by what those funds can buy.[31] In general prices of goods and services in the healthcare sector have risen faster than inflation in the economy as a whole, largely reflecting increases in pay to NHS staff. This is illustrated in figures 3 and 4 as the difference between the rate of growth of real expenditure (which is expenditure adjusted to allow for general inflation of prices) and volume expenditure (adjusted to allow for the additional inflation of goods and services in the health sector). As shown in the figures, the rate of growth of volume expenditure is much less than the rate of growth of real expenditure, but even so it exceeds the requirement for dealing with demographic change. These figures rest on several assumptions, which are described further in appendix 2.

Efficiency

Only considering the growth of volume expenditure on the NHS ignores the amount of outputs that the NHS is able to produce with those resources. If efficiency increases more treatments can be bought for the same resources. One method of measuring efficiency is using the cost-weighted activity index (CWAI), which essentially measures the amount of hospital activity relative to expenditure.[32] There is no equivalent measure for general practice. Figure 3 shows that the cost-weighted activity index for hospital and community services has increased steadily since 1975. The accuracy of the index and whether the improvements achieved in the past are sustainable have been questioned.[33-35] In view of this, and because we judge that there is insufficient evidence to justify bolder assumptions, we assume that the trend since 1975 will continue. If so, the ability of the NHS to provide care will grow faster than the increase in volume expenditure in figure 3 suggests, leaving a more substantial margin to deal with pressures other than those arising from demography. However, both figures 3 and 4, and the calculations outlined in the earlier section on demography, suggest that the share of growth absorbed in this way would be slightly smaller than that absorbed in the previous 20 years, leaving more to cope with the other sources of pressure than has previously been available.

Conclusion

Pressures arising from changes in demography and population morbidity are likely to have a modest impact in future. The availability of new technologies and accompanying changes in provider and public expectations are likely to have a more substantial effect, although quantifying this is currently impossible. In future we can expect similar growth in real and volume expenditure to that seen in the past, and as the NHS becomes more efficient, it will be able to provide more health care than the growth in volume expenditure alone would suggest.

Whether this expected growth will be enough to absorb the cost of introducing new technologies or the related rise in provider and public expectations is difficult to predict. In addition, in the absence of any convincing evidence to the contrary we conclude that

the NHS will be able to continue to absorb these pressures in future. Other people, including the government in its recent white paper have reached a similar conclusion.[36 37] The burden of proof rests with those who wish to assert the opposite.

1 Health Select Committee. *Minutes of evidence: public expenditure/resource allocation.* London: HMSO, 1995:16. (561-I, 22 June.)
2 Dunnell K. Population review 2: are we healthier? *Population Trends* 1995;82:12-8.
3 Gruenberg EM. Failures of success. *Milbank Quarterly/Health and Society* 1977;55:3-24.
4 Fries JF. Aging, natural death and the compression of morbidity. *N Engl J Med* 1980;31:407-28.
5 Robine JM, Blanchet M, Dowd J. *Health expectancy: first workshop of the international healthy life expectancy network.* London: HMSO, 1992.
6 Bone M, Bebbington AC, Jagger C, Morgan K, Nicholas G. *Health expectancy and its uses.* London: HMSO, 1995.
7 Abel-Smith B. The escalation of costs: how did we get there? In: Health care reform: the will to change. Paris: OECD, 1996.
8 Aaron H. Thinking about health care finance: some propositions. In: Health care reform: the will to change. Paris: OECD, 1996.
9 Legoretta AP, Silber JH, Costantino GN, Kobylinski RW, Zatz SL. Increased cholecystectomy rate after the introduction of laparoscopic cholecystectomy. *JAMA* 1993;270:1429-32.
10 Geljins AC, Rosenberg N. Making choices about medical technology. In: *Conference on fundamental questions about the future of health care, April 18-19 1996.* Amsterdam: Scientific Council for Government Policy, 1996.
11 Parliamentary Office of Science and Technology. *Factors affecting pressures on health care resources.* London: HMSO, 1994.
12 House of Commons Health Committee. *Priority setting in the NHS: purchasing.* Vol 1. London: HMSO, 1995.
13 Schwartz WB. In the pipeline: a work of valuable technology? *Health Affairs* 1996 Summer:71-9.
14 Healthcare 2000. *UK health and healthcare services. Challenges and policy options.* London: Healthcare 2000, 1995.
15 Bloor K, Maynard A, Freemantle N. Lessons from international experience in controlling pharmaceutical expenditure III: regulating industry. *BMJ* 1996;313:33-5.
16 Sheldon TA, Faulkener A. Vetting new technologies. *BMJ* 1996;313:508.
17 Aaron HJ, Schwartz WB. *The painful prescription: rationing hospital care.* Washington, DC: Brookings Institute, 1984.
18 Stocking B, ed. *Factors affecting the diffusion of three kinds of innovative medical technologies in European Community countries and Sweden.* London: King's Fund, 1989.
19 McCormick A, Charlton J, Fleming D. Who sees their general practitioner and for what reason? *Health Trends* 1995;27(2):34-5.
20 Department of Health. *Ordinary and daycase admissions for England 1993-95.* London: HMSO, 1995.
21 Laing W. *Laing's review of private healthcare 1994.* London: Laing and Buisson, 1995.
22 Complementary therapy is booming worldwide. *BMJ* 1996;313:131-3.
23 Bradley C, Blenkinsopp A. The future of self medication. *BMJ* 1996;312:835-7.
24 Calnan M, Cant S, Gabe J. *Going private: Why people pay for their health care.* Buckingham: Open University Press, 1993.
25 Besley T, Hall J, Preston I. *Private health insurance and the state of the NHS.* London: Institute for Fiscal Studies, 1996.
26 Dixon J, Mays N. Unhealthy. *Economist* 1996 Feb 17-23:8.
27 Judge K, Solomon M. Public opinion and the National Health Service: patterns and perspectives in consumer satisfaction. *Journal of Social Policy* 1993;22:299-327.
28 Bosanquet N, Zarzecka A. Attitudes to health services 1983 to 1993. In: Harrison A, ed. *Health care UK 1994/95.* London: King's Fund Policy Unit, 1995.
29 Jowell R, Curtice J, Park A, Brook L, Thompson K, eds. *British social attitudes: the 13th report.* Aldershot: Dartmonth Publishing, 1996:230-31.
30 Elliott L. Britain's economic outlook could hardly be any brighter, says OECD. *Guardian* 1996 May 31:2.
31 Baumol WJ. *Health care as a handicraft industry. Office for Health Economics annual lecture 1995.* London: OHE, 1995.
32 Department of Health. *The Government's expenditure plans 1996-97 to 1998-99.* London: HMSO, 1996:47-50.
33 Cutler P. Trends in the structure, productivity, effectiveness and unit costs of the hospital and community health services workforce in England: 1979-1991. *Health Economics* 1993;2:65-75.
34 Bloor K, Maynard A. *Expenditure on the NHS during and after the Thatcher years: its growth and utilisation.* University of York: Centre for Health Economics, 1993. (Discussion paper 113.)
35 Adams CBT. OxDONS syndrome: the inevitable disease of the NHS. *BMJ* 1995;311:1559-61.
36 Department of Health. *The National Health Service: a service with ambitions.* London: HMSO, 1996.
37 Wordsworth S, Donaldson C, Scott A. *Future challenges for UK health and health care: a threat to the NHS?* London: Institute for Public Policy Research, 1996.

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Appendix 1

To estimate how much extra spending will be required to cope with demographic change in future

Past current and predicted population figures for England for the age categories 0-4 years, 5-15 years, 16-44 years, 45-64 years, 65-74 years, 75-84 years, and 85 years and over were obtained from the Office of Population Censuses and Surveys and the government actuary's department. Total real NHS expenditure (cash expenditure adjusted to allow for general inflation) per capita by age groups (the same age groups as the population projections) in England for 1993-4 was obtained from the minutes of evidence to the House of Commons Select Committee on Health. These expenditures in each age group were multiplied by the numbers of the population in each age group for every year between 1974 and 2014. 1974 was set as 100 (the base year) and the rate of growth of expenditure is presented as a percentage growth relative to 1974.

The resulting figures rest on the assumptions (*a*) that the population figures are correct and (*b*) that the distribution of per capita expenditures is the same as the distribution in 1993-4. All population figures are compiled with some degree of uncertainty. Figures suggest that over time the distribution of per capita expenditures by age is changing—growth seems to be relatively faster for infants and elderly people (fig 1) and this may continue in the future. However, because the change in population numbers in these age groups is proportionately low relative to the rest of the population, the effect on overall NHS expenditure is low.

Appendix 2

Asumptions underlying estimated growth in NHS expenditure

The projections of growth in expenditure were made simply on the basis of the past trend over the previous 20 years (1974-94) extrapolated on a linear basis. A number of assumptions lie behind these projections. Firstly, increases in real expenditure on the NHS are in part dependent on the growth in tax revenues, which in turn is partly dependent on growth in the economy as a whole. The projection therefore assumes that the economy will continue to grow, on average, at roughly the same rate over the next 20 years as it has done over the past 20. This seems reasonable in the light of the recent Organisation for Economic Cooperation and Development report on the state of Britain's economy.[30]

Secondly, increases in volume expenditure in the future will partly depend on the relative rate of increase of prices in health care compared with those in the wider economy. Again, our projections assume that this rate of change will remain constant, which will depend in particular on whether increases in wages can be contained as well in the future as in the past. This may not be so easy given the development of local pay determination. But increases in volume expenditure, in tandem with increasing relative prices of healthcare inputs, also are likely to entail an increasing share of gross domestic product. This may also be contentious given the current stance of the Labour and Conservative parties towards increasing taxes.