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A "Ready Reckoner" for staff costs in the NHS. Volume II. Methodology

Ann Netten, Jane Knight, Jane Dennett, Roger Cooley and Adam Slight

PSSRU discussion paper 1476/2
September 1998

The **PERSONAL SOCIAL SERVICES RESEARCH UNIT** undertakes social and health care research, supported mainly by the United Kingdom Department of Health, and focusing particularly on policy research and analysis of equity and efficiency in community care, long-term care and related areas — including services for elderly people, people with mental health problems and children in care. The PSSRU was established at the University of Kent at Canterbury in 1974, and from 1996 it has operated from three sites:

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Contents

Acknowledgements 4
Summary 5
Chapter 1 Background and overall approach 9
Chapter 2 Estimating the investment costs of training health service professionals 18
Chapter 3 Annuitising the human capital investment costs of health service professionals 33
Chapter 4 The software 54
Appendix A Health service professionals included in the Ready Reckoner 59
Appendix B Estimating multipliers for patient contact time 60
Appendix C User documentation 62

Acknowledgements

We have received a great deal of support, help and advice from a wide number of individuals during the course of the research. We would like to thank those who sat on the very active and helpful Advisory Group for the project: Jeremy Hurst, Hedley Hilton, Gabriel Serota, Nicky Cogan, Sue Read, Owen O'Donnell, Jennifer Beecham and Simon Old. The liaison officers throughout the project have been most helpful and supportive: Elizabeth Meerabeau, Susan Lonsdale and Claire Callender. We are grateful for advice and information from a wide number of individuals including Judy Presnell, Gill Bellord, David Kernick, John Ford, Jenny Griffiths, Sheilagh Richards, Marcia Beer, Sarah Robinson, Michael Goldacre, Myfanwy Lloyd Jones, Richard Reed, Sandy Goulding, Gill Clack, Keith Ryde, Pat Kentley, Philippa Peck, Roger Clayton, Jane Lawson and Andrew Fenyo. We are also very grateful to all those people in the trusts that provided helpful advice and information, and to those in the higher education institutions that responded to our frequent requests for information.

Summary

1. With nearly a million people (equivalent to 764,000 whole time equivalents) on the payroll, the NHS is one of the largest employers in the world. The workforce is not only large, it is also highly trained and very costly. Total expenditure on the NHS was £33,500 million in 1995-96 with sixty-eight per cent of Health Authority and NHS expenditure being on wages and salaries (Department of Health, 1998). The degree to which this workforce is employed in a cost-effective way clearly has important implications for what can be produced from such a large-scale operation.

2. Innovative ways of deploying the workforce can have a number of different objectives. These include improving patient care; improving work satisfaction; making best use of existing skills; developing further skills; reducing junior doctor hours; making best use of existing resources or coping with reduced resources. Whatever the short-term objectives there will also be long-term consequences if such innovations are taken up on a large scale in the NHS.

3. When evaluating these consequences it is essential that all the associated costs are appropriately identified so those involved in planning for the future can consider the full implications of innovative patterns of skill-mix. It is also essential that consistent approaches are used in cost estimation so that like is compared with like when alternative courses of action are under consideration.

4. The report describes the results of a research project which was funded by the Department of Health as part of the Human Resources and Effectiveness Initiative. The aim of the research was to develop an approach to estimating health service staff costs in a consistent and comprehensive way which is appropriate to use when evaluating the cost consequences of innovative uses of staff resources.

5. The project has developed a piece of software which can be used to reflect the particular circumstances of the health service professional under consideration. The first volume of the report summarises the default estimated national unit costs provided in this software, their constituent elements and the sources of information used. This second volume describes the methodology and basis of the estimates.

6. The approach is based on the method used in the *Unit Costs of Health and Social Care* series of volumes: a bottom-up approach which identifies each element of cost and the appropriate allocation of these to the unit cost of staff time.

7. Chapter 1 in this second volume describes the overall methodology and improvements that have been made in the approach. These include:

   - the flexibility to include information about unsocial hours in salary estimation;
   - separation of indirect and direct overhead costs;
   - separation of personal and treatment capital costs; and
   - the inclusion of training costs.

8. Health services are critically dependent on the skills of individual professionals. These skills can be described as human capital and are like physical capital in that they are not used up in the process of producing the service.

9. The costs of acquiring these skills are the costs of specific courses, ongoing professional development and the initial investment in qualifications. The software allows users to incorporate specific courses where appropriate. Ongoing training has been treated as an annual cost, the basis for estimation depending on the type of professional. But the major improvement in the estimation of unit costs of health service professionals is the inclusion of the costs of investment in acquiring qualifications.

10. The components of this investment are:

    - the costs of tuition;
    - costs or benefits from clinical placement activities; and
    - living expenses where no salary is paid during training; or
    - replacement costs where staff are taken away from their posts in order to train.

11. Chapter 2 in this second volume describes the estimation of these costs for the pre-registration training of a variety of nurses, doctors, and professionals allied to medicine. Inevitably when covering such disparate groups, it has not been possible to provide detailed estimates of underlying costs. For the most part it has been necessary to use information about funding as a proxy for costs.

12. Before discounting to reflect the distribution of these costs over time the investment costs of pre-registration training are estimated as £35,669 for nurses, £197,659 for doctors and £41,201 for physiotherapists.

13. Estimates have also been made of the costs of post-registration training of community nurses and doctors (SHOs, registrars, GPs and consultants) on a similar basis. A nurse is estimated to cost £12,120 in order to become qualified with a community qualification. Before discounting to reflect the distribution of costs over time consultants are estimated to cost £98,427 in post-registration training.

14. In order to allocate these investment costs to the unit costs of health service professionals it is necessary to allocate them over the period during which the skills will be used. Chapter 3 in this volume describes a methodology for estimating the expected working lives of health service professionals.

15. On the basis of analyses of the census and Labour Force Survey, the expected working life of nurses are estimated as between 19 and 22 years, and doctors between 26 years and 29 years. There was insufficient information to separately estimate the different professions allied to medicine. PAMs were estimated as working about 24 years in total.

16. A method was developed for allowing for the distribution of costs and returns on the investment (in terms of time spent working in related professional roles) over time.

17. In absolute terms the equivalent annual investment costs of training ranged from £4,520 for occupational therapists, through district nurses at £6,240, to £30,170 for consultants.

18. The impact on unit costs of staff of including investment costs was least on professions allied to medicine, although even for these groups costs rose by about a fifth. The lowest impact was for occupational therapists (16 per cent). The biggest impact among these professions was for speech and language therapists where unit costs are 19 per cent higher when investment costs of training are included.

19. For all types of nurse the impact was slightly higher, with unit costs rising by over 20 per cent when investment costs are included.

20. The most marked, and varied, impact was among doctors. Given the long-term investment required for consultants, it perhaps is not surprising that the costs including investment in training are 36 per cent higher than without this investment cost. But the most dramatic impact is on the costs of registrars. Because a high proportion of the investment required for a consultant is required for a registrar but pay is much lower the net effect of including investment costs is to increase unit costs by 60 per cent. If ongoing training costs are included costs rise by 66 per cent.

21. Clearly, the inclusion of investment costs of education and training has an important impact on the overall level of costs and the relative costs of health service professionals. This raises the question when these costs should be included and when they should be excluded from estimates of unit costs.

22. An important principle of economic cost estimation is that how costs are estimated depends on the reason the costs are being estimated. In turn this determines the perspective of the costing exercise: the costs to whom. For the most part these investment costs are borne by the wider NHS and individuals undertaking the training rather than trusts so those costing exercises that are concerned with narrowly defined costs to the provider organisation would not want to incorporate these investment costs.

23. The investment costs of education should always be included, however, when evaluating the cost-effectiveness of different approaches to using health service staff as it is important to include all the costs implicit in changing the professional mix. For the Human Resources and Effectiveness Initiative, it is clear that such costs should always be included in any cost-effectiveness evaluations. Evaluations of any techniques which change the way that staff are used (such as tele-medicine) should also include the investment cost of training. A reasonable rule of thumb when deciding whether investment costs of training should be included is to consider whether the issue under consideration has any potential implications in the long term for the workforce. If it has, then the investment required in training a skilled workforce should be incorporated.

24. The approach does allow us to make a reasonable estimate of the long-term investment costs of qualifying health service professionals. Clearly the levels of investment are such that including annuitised costs is essential if appropriate conclusions are to be drawn with respect to the cost-effectiveness of changing the patterns of use of professional expertise in the long term. The analysis also shows that the distribution of

returns on investment in education has an important effect on estimated equivalent annual cost. This has implications for the appropriate measurement of costs both when considering innovative staff use and workforce planning.

25. The principal objective of the project was to provide a basis for estimating unit costs appropriate for the Human Resources and Effectiveness Initiative. By the very nature of this Initiative, patterns of working and using staff are likely to be atypical. The development of a piece of software allows the default values to provide a basis which can be varied to reflect the specific circumstances of the health service professional when estimating unit costs. Chapter 4 in this volume describes the development of that software.

26. Clearly we do not yet know what the outcome of putting the software into practice will be. However, if it is successful and found to be practical there are a number of potential future developments. These include:

    - adapting the software so it can be made available on the internet;
    - providing more flexibility for users to vary long-term investment training assumptions;
    - including the facility to reflect variations in turnover;
    - including treatment costs;
    - including more health service professionals;
    - including social care professionals;
    - allowing team costs to be estimated;
    - including facility-based services; and
    - putting together costs of care packages.

27. Even in the absence of such developments the approach provides a sound basis for estimating costs for a wide variety of health service professionals. Information is provided about vital long-term investment costs which are not likely to be available to those concerned with specific evaluations. The flexibility provided by the software means there are a wide variety of potential applications of the approach including evaluations of specific uses of health service professionals, exploring the cost implications of different patterns of working and changing the skill-mix in different settings.

Chapter 1. Background and overall approach

1. Background

With nearly a million people (equivalent to 764,000 whole time equivalents) on the payroll, the NHS is one of the largest employers in the world. The workforce is not only large, it is also highly trained and very costly. Total expenditure on the NHS was £33,500 million in 1995-96 with sixty-eight per cent of Health Authority and NHS expenditure being on wages and salaries (Department of Health, 1998). The degree to which this workforce is employed in a cost-effective way clearly has important implications for what can be produced from such a large-scale operation.

In order to make best use of such a workforce there is considerable interest in the degree to which, with or without additional training, professionals can substitute for one another. This is demonstrated at all levels of the health care system: shown for example, by the increased use of practice nurses in primary health care and variations in practice introduced in hospitals in response to the "new deal" initiative to reduce the hours of junior doctors. Moreover, there is interest in the degree to which staff without professional qualifications can take over some of the tasks currently undertaken by nurses or professionals allied to medicine. The concern to make the best use of staff is demonstrated in the wide variety of innovative posts currently prevalent in the NHS. The extent of innovative use of staff is illustrated by a research project Exploring New Roles in Practice funded by the Department of Health and conducted by researchers from the University of Sheffield, University of Bristol and the King's Fund which recently identified 838 new roles for nurses and professions allied to medicine in 40 trusts (Read, 1998).

Such innovative roles have a number of different objectives. These include improving patient care; improving work satisfaction; making best use of existing skills; developing further skills; reducing junior doctor hours; making best use of existing resources or coping with reduced resources. Whatever the short-term objectives there will also be long-term consequences if such innovations are taken up on a large scale in the NHS.

When evaluating these consequences it is essential that all the associated costs are appropriately identified so those involved in planning for the future can consider the full implications of innovative patterns of skill-mix. It is also essential that consistent approaches are used to cost estimation so that like is compared with like when alternative courses of action are under consideration.

This is the second volume of a report which describes the results of a research project which was funded by the Department of Health as part of the Human Resources and Effectiveness Initiative. The aim of the research was to develop an approach to estimating health service staff costs in a consistent and comprehensive way which is appropriate to use when evaluating the cost consequences of innovative uses of staff resources. The first volume of the report summarises the default estimated national unit costs, their constituent elements and the sources of information used. The first chapter in the second volume describes the overall approach to the estimation of these default values, the second chapter the method adopted and estimates of investment costs required in order that the staff are sufficiently trained and skilled to deliver the care required, and the third chapter describes the annuitisation of those costs. The final chapter describes the development of a piece of software that provides default national estimates of the costs of a variety of health service

professionals and allows users to adapt the information to reflect the innovations under consideration.

2. Theoretical basis for estimating the cost of health service professionals

For the purposes of an economic evaluation, the cost of employing a health service professional requires that we identify the value of the resources needed in order that outputs (in this case care) can be delivered. Economic theory defines the cost of a resource as the benefit forgone (the opportunity lost) by losing its best alternative use. (Knapp, 1993a). This theoretical basis for costing is important because it implies that the cost estimated depends on the purpose of the costing exercise. So before estimating default values for the Ready Reckoner, we need to clarify the purpose and the consider implications of that purpose.

The over-arching purpose of the Human Resources and Effectiveness Initiative is the evaluation of innovative ways of delivering care and considering the implications for the type of NHS workforce that is required to deliver care in the future. Clearly, therefore, it is important to reflect the long-term resource implications. While the changes resulting from such innovations may have important implications for the future workforce, these changes will not be wholesale but operate at the margin as the balance of the required skill mix from different types of profession alters. Thus the cost estimated should reflect the resource implications at the margin. The aim, therefore, is to estimate as close an approximation as possible to the long-term marginal opportunity cost of each health care professional.

Opportunity cost in this instance is the value of the best alternative to tying resources up in each type of professional under consideration. The most important issue to identify in estimating appropriate opportunity costs is to clarify the perspective: the costs to whom. For the most part the concern here is the costs to the NHS but there will be knock-on effects for other sectors of society: for example, the costs of training fall in part on the higher education sector and to private individuals. As far as possible in estimating the defaults, the wider societal opportunity costs have been identified here on the basis that it is then possible to define relevant costs more narrowly for particular purposes.

In terms of estimation, ongoing opportunity cost is for the most part measured by the expenditure associated with identified activities. In the case of capital costs, however, opportunity cost is best estimated by the returns that would have been gained if an investment of equivalent value to that tied up in capital, such as a building, had been in annuities which had delivered returns over the same period that the building is expected to be used.

For costs to be *long-term*, resources that are fixed in the short and medium term need to be included. When applied to innovations in the health service workforce, it is important that the capital implications of employing each type of professional are included. Clearly this includes the cost of office space, where applicable, and treatment space where this is directly linked to the individual worker. It also includes the investment in human capital. For skilled care to be delivered, health service professionals have to be appropriately qualified and trained. While some of this training will be ongoing, much will take the form of investment in human capital. So, for example, if nurses are taking over doctors' roles, this implies a need for more nurses to be trained in the future. Thus unit costs need to include the long-term costs of qualifying for all the types of professional under consideration.

In order to reflect *marginal costs*, we need to ensure that assumptions about the value of resources reflect the effect of an additional (or in some cases one less) unit. In this instance we initially take a "unit" to be an additional whole time equivalent (wte) health service professional. The difference between long-term marginal cost and average cost is most apparent in the estimation of capital. Average cost is reflected in the current value of capital, be this physical plant or the training required to generate the current workforce. Marginal cost requires the estimation of the capital requirements of an additional health service professional. In terms of physical capital this would be new build costs of the space available rather than current valuations of existing capital stock. In terms of human capital this would reflect the costs of current training requirements rather than historical costs.

3. Cost estimation

There are two main approaches to estimating unit costs: top-down and bottom-up. The top-down approach identifies all relevant expenditure and divides it by units of activity. This is very helpful where units of activity are reliably measured and allocated to expenditure as changes in estimated unit costs can provide a useful management tool in monitoring changes in performance and indicating whether there may be increasing or decreasing levels of efficiency. Problems arise in ensuring consistency of definitions and ensuring that all relevant, and no irrelevant, expenditure is identified.

The bottom-up approach identifies the different resources tied up in the delivery of the service (in this case an individual health care worker) and assigns a value for each of these resources. The value of this approach is that it allows separate consideration of appropriate assumptions for each of the elements in order to most closely approximate long-term marginal cost. This is the approach adopted here.

When estimating costs it is important to ensure that they are comprehensive, identify important variations and enable like to be compared with like (Knapp, 1993b). In order to ensure they are comprehensive we consider below each of the main elements of cost and how it is best measured in this context. Potential sources of variation are identified, and the degree to which these can be reflected in current estimates or by users of the software is discussed. A consistent approach is adopted throughout to ensure that wherever default values are compared, like will be compared with like.

Costs have been estimated for a wide variety of health service professionals including a variety of nurses; doctors and a number of professions allied to medicine. A full list is given in Appendix A. The following sections identify for each of the main groups the approach used to derive the default values provided in the software including assumptions required and principal sources of information. More detailed information about individual types of professional are summarised in Volume I of this report.

During the course of the project a number of Trusts were consulted in order to check assumptions and provide background information about the costs of employing each type of health service professional. Three community trusts, three acute trusts and one mental health trust participated.

4. Cost elements

The resources tied up in delivering health care through a professional consist of their salary and associated oncosts; investment costs of training; direct and indirect overheads; and capital overheads. The issues associated with the estimation of the investment costs of training are discussed further in chapters 2 and 3. Here we consider each of the other elements in turn.

4.1 Salary costs

The objective is to estimate national unit costs. For each professional this will consist of basic pay at the appropriate grade, specific additional payments, an element of regional weighting and salary oncosts in the form of national insurance contributions and superannuation payments.

The bulk of salary costs consists of basic pay. Although individual pay bargaining was introduced in 1995 most trusts still paid nurses and PAMs at levels very closely associated with nationally determined rates. Current policy is to move back towards national pay rates so for the purposes of the Ready Reckoner basic pay is estimated as the salary levels agreed by such bodies as the Nursing and Midwifery Staff Negotiating Council, Professions Allied to Medicine and Related Grades of Staff (PTA) Council and the Review Body on Doctors' and Dentists' Remuneration.

Although ideally we would include a weighted average salary that reflected the proportion of people employed on each grade, such information is no longer available. For the most part, therefore, basic pay is represented by the mid-point on the relevant grade. Trusts were consulted about appropriate grades. The basis for estimating the remuneration of general practitioners is very different and is reported in detail on page 84 in Volume I of this report.

Additional payments are specifically linked to the individual professional. As far as possible, estimates reflect the proportion of the profession receiving the payment nationally. One important exception is additional duty hours (ADH) of junior doctors. In order to reflect average pay from this source, the number of additional duty hours worked was taken from a study conducted for the Review Body on Doctors' and Dentists' Remuneration in 1994.

For relevant professionals the costs of unsocial hours have been included by estimating the expected number of unsocial hours that will need to be worked in order to provide an adequate level of coverage over the period during which care is provided by the service.

In order to reflect true national costs we need to allow for the proportion of the workforce that receive special regional payments: i.e. London weighting. Overall salary costs were inflated to reflect the proportion of salary costs that is attributable to such payments. This is just under two per cent for nurses and professions allied to medicine (Nursing and Midwifery Annual Report, 1997; NHS Executive, 1998). The impact on doctors salaries was so low (regional payments consisting of 0.1 per cent of earnings) that no allowance was made.

Employers contributions to national insurance reflect current rules and the assumption has been made throughout that the NHS contributes four per cent of salary costs for superannuation.

4.2 Overheads

We distinguish between two types of overhead: direct and indirect. Direct overheads are those resources required to deliver the service and which are related directly to the level of service activity. These would include, for example, clerical support, direct supervision, and uniforms. We also include ongoing training required in order to keep staff up-to-date. Indirect overheads are support services required in order for services to carry out their main functions. These include human resources, finance and estates.

Generally, information about the level of overheads required for any one type of health service professional is very difficult to establish with any accuracy. Information used in *Unit Costs of Health and Social Care 1997* is based on returns to the Department of Health for 1989/90 so referred to a period before the introduction of the NHS reforms. Ideally we would include more up-to-date national information reflecting current structures, but no national level information is available.

It was not within the remit of the current study to investigate overhead costs in great detail but the opportunity was taken to consult with participating trusts about overhead assumptions. Two trusts - one community and one acute - were able to provide detailed information in a form that allowed the estimation of overheads at the level of the individual health service professional.

Using the 1989/90 returns, the estimated level of overheads, both direct and indirect, for community-based services was 17 per cent on salary costs. Information provided by the acute trust indicated that indirect overheads had been allocated per whole-time equivalent rather than related to salary costs. The type of support services included in indirect overheads are more likely to be related to the number of whole-time equivalent posts than to salary levels. The estimated cost of indirect overheads for this acute trust was £2,000 per wte (at 1997/8 prices). The information was supplied in a rather different form by the community trust where it appeared that indirect overheads were about ten per cent of salary costs. For the type of professional concerned (professionals allied to medicine and community nurses) average salary costs are in the order of £20,000 so indirect overheads would be approximately £2,000.

For community services, the direct overhead costs, excluding travel and equipment, were approximately five per cent on salary costs for physiotherapists, occupational therapists and speech and language therapists. The direct overheads associated with community nurses were greater due to higher direct management costs. Because of the variation in the nursing workforce, it was less clear how these should be allocated across different grades. Consultation with the trusts suggested that a reasonable estimated level of direct overheads for qualified community nurses was ten per cent of salary and for unqualified nurses five per cent of salary.

For all PAMs and for district nurses the average cost of ongoing training, which is included in the estimate of direct overheads, was two per cent of salary costs in the community trust. Information from another trust suggested much lower costs at £106 per nurse. In practice many PAMs and nurses incur private costs of training but at present it is not possible to include these. In order to reflect good practice, it has been assumed in the Ready Reckoner that all nurses and PAMs, wherever they are employed, incur training expenses at two per cent of salary costs. The estimation of the costs of training doctors are described in Chapter 2.

For consultants it is possible to make an estimate of the direct overhead costs required in terms of clerical and secretarial report (see pages 72, 75 & 78 in Volume I for details). For other hospital-based staff it is difficult to separate out the direct overheads which are associated with the employment as opposed to delivery of patient care. For this reason only indirect overheads and ongoing training costs have been included for hospital-based doctors, nurses and PAMs.

For GPs the direct overheads are the costs of running the practice. These have been derived from an analysis of national expenditure by health authorities on primary care and a sample of tax returns which is taken each year to guide the Review Body on Doctors' and Dentists' Remuneration. The analysis has deducted those items not associated with the provision of primary care by the GP (such as trainees and locum costs which generate separate outputs) or which are best estimated separately (such as capital and prescription costs). Page 84 in Volume I describes the adjustments made.

Indirect overheads for GPs are the costs to the health authority of administering primary care. These overheads were estimated on the basis of recent work by Griffiths (forthcoming) which identified nine principal and over 90 sub-functions in 77 health authorities. Two of the principal functions are relevant for most purposes when costing GPs: family health service (FHS) administration and primary care strategy and development. FHS administration covers:

- administration of FHS lists;
- making financial payments to practitioners;
- patient registration, medical records and so on.

Strategy and development includes:

- primary care strategy and development; and
- practice premises, staff, IT and personnel development.

A further function, supporting primary care led purchasing, includes support for such activities as locality commissioning; fundholding and employment of GPs. This has been shown to make a major contribution to service and management development in primary care through the development of other services (e.g. mental health, maternity and outpatients). Where the process of purchasing of primary care based services are relevant to the investigation, it is relevant to include this overhead in estimates of GP unit costs.

For some analyses the overall input of primary care services is proxied by the GP contact. For these purposes the costs of practice nurses should be included as a direct overhead on GP input. Where the contacts with practice nurses are counted separately or the focus of interest is the changing roles of GPs and practice nurses, the costs of practice nurses should be counted separately. This requires the deduction from GP costs of both salary and overhead costs associated with the practice nurse. In the absence of detailed information about the support needs of practice nurses the same level of overheads as district nurses are assumed. The distribution of indirect overheads of practice nurses between the health authority and individual practice will vary. For the purposes of the Ready Reckoner, the assumption is that they will all fall to the practice.

Necessarily the estimates of overhead cost are very approximate and will vary considerably between different trusts and practices. One important source of variation will be differences in the levels of turnover. There is information in the February 1997 Audit Commission Bulletin, *Finders, Keepers*, which would allow some adjustment for rates of turnover. It was not possible at this stage to include this in the software but it may be possible to include this in future developments as an annual percentage rate of turnover for each profession which will allow the costs of recruitment, induction, additional training and temporary cover to be included in unit costs.

Nevertheless, the default estimates of overheads shown in Volume I of this report are based on the evidence currently available and there is scope within the software to adjust levels of indirect and direct overheads to reflect better sources of information or local circumstances.

4.3 Capital

As far as possible the estimates provided throughout reflect the costs of the health service professional input and do not include any other costs associated with treatment. In the case of capital overheads we have identified two types of capital requirement:

- that associated with the employment of the individual staff member; and
- that associated with the treatment by that health service professional.

For the majority of health service professionals it has been possible to provide separate estimates of both. It is not practical to identify capital costs associated with treatment for hospital-based doctors and nurses, however.

The capital estimates in each case are based on information about new-build supplied by the Building Cost Information Service. This provides information about the square metre costs for a wide range of types of facility. The estimated unit cost is adjusted to reflect additional costs not included in the base estimate such as architect fees, utilities (such as connecting with drainage) and VAT. The number of square metres required are based on NHS Executive guidance for costs estimates (NHS Estates, 1995, Departmental Cost Allowance Guides (Concise 4) Database) with an additional allowance for circulation space. Where appropriate, assumptions have been made about the number of professionals sharing the facility.

4.4 Travel

Information about travel costs by professional and the number of different types of contact was provided by one of the community trusts. An analysis was conducted which varied assumptions about the number of contacts per visit that were likely in clinics and on hospital sites. This indicated that the average cost per visit lay between £1.03 and £1.05 for district nurses and health visitors. Previous work was based on an analysis of the expected average annual level of claims divided by the number of contacts per district nurse to give an average cost per visit at 1989/90 levels (Netten, 1992). When this is uprated to 1996/97 levels average travel costs per visit for community nurses were £1.03 per visit. Cost per visit has been assumed to be £1.03 at 1997/98 prices for health service professionals who are expected to spend a high proportion of their time visiting and are likely to be able to organise their visits to reduce travel costs.

It was less clear for professions allied to medicine, who conducted a much higher proportion of their contacts in hospital, what an appropriate range of assumptions might be. It is feasible that PAMs do incur higher travel costs than nurses but it was not felt that the data were sufficiently robust or generalisable to include actual values as defaults in the Ready Reckoner. However the range of values for these professions suggested that £2.00 per visit would be appropriate for those professions who would cover a wider area than community nurses.

When annual unit costs are estimated, this can be put together with information about the number of visits over a year to estimate total travel costs. When the unit costs to be estimated are per visit or per hour, then travel expenditure should be allocated on a per visit basis rather than per hour. Volume I of this report shows this for each professional, and the Ready Reckoner software facilitates this allocation. In addition to expenditure, it is important to allocate the costs of travel time appropriately. For this we need information about working patterns.

5. Working patterns

Data about working patterns are essential if we are to make realistic estimates of the cost of contact time with patients in the delivery of care. Innovative uses of staff are likely to impact upon patterns of working so it is important that the amount of time required for activities other than delivery of care is allowed for, or the full opportunity cost of care will not be reflected. This information can be very broad brush: for example, given total annual cost and total number of contacts made during a year we can derive the cost per contact. For many purposes, however, this is too crude as it does not allow variations in the duration of the contact which may be of considerable importance in understanding the impact of changes in skill-mix.

In order to cost a care hour information is required about the working year in terms of days annual leave, sick leave and the average number of hours worked each week. This information will allow the costing of a basic working hour. Beyond this, however, it is important to have an understanding of the level of administrative, travel, and other activity required in order that the professional can provide care in the form of face-to-face contact with patients. Appendix B shows the way in which proportions of time spent in each activity can be converted into multipliers which, when applied to the basic hourly cost, reflect the true cost of delivering care.

The different circumstances under which professionals work will be reflected in what it is appropriate to measure in terms of types of time. For the purposes here it is helpful to provide default values for the software but it should be noted that, particularly with the increase in innovative patterns of working, information used may not be generalisable or reflect the national picture. There are also constraints caused by lack of information, particularly for professions allied to medicine because of the variety of their working patterns. Information about the working patterns of the professions allied to medicine included in the Ready Reckoner was obtained from discussions with the trusts. One trust had conducted a time diary exercise with hospital nurses and kindly made the information about patient related work and patient contact available for inclusion in the Ready Reckoner.

For community nurses the distribution of time was based on work by Dunnell and Dobbs (1982). There is some concern that working practices may have changed as the survey

conducted by Dunnell and Dobbs was conducted in 1981. Unfortunately we do not have any more up-to-date information which can be used to allocate working time. The Ready Reckoner allows such assumptions to be changed. For example, if changing working practices meant that time spent travelling dropped from 24 per cent to 20 per cent of time, and time spent on visits in patients own homes rose from 38 per cent to 42 per cent, unit costs of time spent on home visits would fall from £53 per hour to £48 per hour. Assuming this was the result of each visit lasting 30 rather than the assumed 20 minutes the average cost of a home visit rises from £18 to £24.

For a number of health service professionals they will need to work unsocial hours and/or be on-call. The Ready Reckoner has the facility for inclusion of such patterns of working for all professionals where this might apply. Default values have only been provided for hospital-based nurses working on 24-hour wards.

6. Conclusion

The default values provided in the Ready Reckoner and in Volume I of this report have been estimated on the basis of providing as close as possible an estimate of the long-term marginal opportunity costs to society. Opportunity costs by definition are context specific so the degree to which the defaults provide an appropriate estimate of the opportunities lost can only be evaluated against particular circumstances. The bases for estimates provided have been drawn from national data, the literature and discussion with a small sample of trusts. The intention has been to reflect as accurately as possible the resources tied up in health service professional time. Necessarily there are problems in getting up-to-date, and in some cases, any, data. Nevertheless, the facility is in the software to amend these to reflect better information as it becomes available and/or local circumstances.

The principal purpose of the Ready Reckoner is to facilitate the estimation of the costs of health service professionals that can be used when innovative patterns of skill-mix are being evaluated. The flexibility provided in the software allows users to amend salary, overheads, and working patterns to reflect innovative ways of working. There are wider potential uses of approach. For example, the Ready Reckoner could be used to consider the cost implications of different options for human resource management. One element essential in any use where there are implications for the supply of different types of skill is the costs of training, in particular the investment costs required in order that professionals can deliver care. The estimation of these investment costs is the subject of the next chapter.

Chapter 2. Estimating the investment costs of training health service professionals

1. Introduction

It was identified in chapter 1 that for most purposes the most relevant economic cost is the long-term marginal cost. Health services are critically dependent on the skills of individual professionals. These skills can be described as *human capital* and are like physical capital in that they are not used up in the process of producing the service. Indeed, skills can and do develop through application.

When evaluating the cost-effectiveness of innovative approaches to using health service staff, it is important to include all the costs implicit in changing the professional mix. Although the acquisition of skills tends to be rewarded by higher wage rates, the long-term cost differential between skilled and unskilled labour is not reflected by differences in pay. At best pay, differentials may reflect the relative scarcity of particular skills. In the long term we should include the cost of training each type of staff, as at the margin, if nurses take over doctors' tasks, for example, more nurses and fewer doctors will need to be trained for such procedures. To incorporate the resource implications of maintaining a trained and skilled workforce into the costs of care delivery, therefore, we need to explicitly value the costs of training and education.

Medical and nursing education consists of:

- specific training which qualifies or provides a level of skill necessary for an individual to perform a particular task;
- ongoing updating of skills; and
- investment needed in order to obtain general professional qualifications (e.g. diploma or degree) or specified level of seniority (e.g. medical registrar).

An example of specific training would be a course designed for nurse practitioners to manage diabetic care. Clearly it is inappropriate to provide default estimates for specific training as circumstances will vary so widely. There is scope within the software, however, for users to include the costs of such specific training and to allow for the length of time over which it is expected the training would be used.

Ongoing updating of skills will require continual inputs so this has been assumed to be an overhead cost reflected in annual expenditure on training. Chapter 1 describes the basis for the estimation of default costs of ongoing training for nurses and professions allied to medicine. Ongoing training for doctors also contributes to long-term investment costs of senior doctors and consultants. As a result the estimation of the annual expected level of ongoing training costs for doctors is described below in the context of their post-registration investment costs.

Investment costs of training are far from straightforward to estimate. There are two ways of approaching the issue:

1. to estimate the total cost of education of all those who were trained to the particular level of competence and divide this by the number who are currently using this training by participating in the workforce (the top-down approach); or

2. estimate the cost of training an individual and then estimate the stream of returns in terms of whole-time equivalent years of return on this investment (the bottom-up approach).

There are complications attached to either approach, the most important of which in each case is adequate sources of data. The latter approach, which has been adopted here, is more consistent with the bottom-up approach used overall in the Ready Reckoner and allows variations in assumptions to be explored in a way that is most meaningful at the level of the individual health service professional. This chapter describes the estimation of the initial investment and chapter 3 describes how these costs are annuitised to reflect the returns over time.

The basis for estimating the costs of investment could be either:

- what it costs to train the current workforce; or

- what it would cost in order to deliver a marginal unit (one wte staff) given current training requirements and costs.

We use the latter approach here as the concern is with the future implications of changing patterns of skill-mix. Although we cannot predict how costs will change in the future, this approach does take into consideration the cost implications of current policies.

When estimating costs we need to ensure that we have been comprehensive, ensure we identify important sources of variation, and that estimates allow the comparison of like with like (Knapp, 1993b). For costs to be comprehensive we have to ensure that all the relevant costs have been identified. The components of the cost of training health service professionals are:

- the costs of tuition;

- infrastructure costs (such as libraries);

- costs or benefits from clinical placement activities; and

- lost production costs during the period of training.

Each of these are considered below. Ideally we would also include the investment cost of training the trainers, both those providing tuition and those providing support on clinical placements (such as ENB 998 Teaching and Assessing in Clinical Practice for Nurses). The resources required to estimate and appropriately allocate such costs to the level of individual students are disproportionate to the effect that they would have on the estimated unit cost of health professional time.

In order to ensure that like is compared with like, assumptions are made on the same basis, as far as possible for each type of health service professional. To reflect real underlying variation in resource use we have linked information specific to the professional group wherever this is available. This has been most difficult for professions allied to medicine

where there is greater diversity but fewer people practising so sources of information are more limited.

First we discuss the estimation of pre-registration education costs for each professional group. This is followed by a description of the estimation of post-registration nursing and medical education costs.

2. Pre-registration costs

For pre-registration courses we need to consider the costs of tuition, the net cost or value of clinical placement, and living expenses over the duration of the course.

2.1 Tuition expenses

Ideally underlying costs of the tuition of health service professionals would be estimated on the basis of resource inputs required for each course. The potential for this type of approach was explored but proved impractical within the remits of the current study. To establish the cost of any one course would require an in-depth analysis of information which was very sensitive in the climate of purchasers and providers of education prevailing at the time of the study. The objective in this study was to provide reasonable estimates for a wide variety of health service professionals. It is legitimate, and in this instance considerably more practical, to use the price paid by the NHS or Local Education Authority as this represents the cost to the purchaser of training. This price includes that paid for those students who do not complete the course so it needs to be adjusted for each type of health service professional to reflect the expected wastage rate.

Nurses

Tuition costs for nurse training are funded through the non-medical education and training levy (NMET). Information about costs per whole time equivalent (wte) nurse were estimated using the Financial Workforce Information Returns supplied to the NHS Executive from the Regional Offices. Data were available about total expenditure on nurses and midwives. In order to estimate tuition costs of nurses this needed to be adjusted to deduct expenditure on bursaries; to reflect the relative costs of nurse and midwifery training; and to reflect expected wastage rates.

Annual bursaries for nurses were estimated as £4,887. Following deduction of bursaries, the annual cost of tuition is £6,740. Wastage rates for nurses were reported as four per cent in the common foundation programme and five per cent in the adult branch programme during 1996/7 (ENB Annual Report, 1996-7). Allowing for this, the cost of tuition of a pre-registered nurse is £7,010 for nurses on the common foundation programme and £7,077 for those on the adult branch programme per year or £21,130 for a three-year course.

Doctors

In the traditional five-year medical undergraduate course the first two years are spent in academic studies and the last three years are predominantly spent on clinical placement. Although there is a move to integrate clinical and pre-clinical education over the whole course, for the most part this arrangement still prevails. There are no obvious cost implications of the changed arrangements: the same costs would simply be distributed differently over the period of the course.

Medical undergraduate tuition is financed by the HEFCE who negotiate block contracts with HE institutions for a specified number of students. Additional funds are received on a fee per student basis from students' local education authorities. These correspond to Band 2 fees during the pre-clinical first two years of training and increase to Band 3 level during the final three years in the clinical section of training.

A questionnaire was sent to all 20 medical schools in England asking for the numbers of medical students, total levels of funding and wastage rates. Data were available from eight higher education institutions for the financial year 1995/6. Tuition costs for each institution were estimated on the basis of total funding from all sources that was associated with tuition of medical undergraduates divided by total number of wte students and adjusted for wastage at each institution. The average costs for London and non-London institutions was estimated and a weighted average taken reflecting the proportion of medical students based in London (Higher Education Statistics Agency, 1997). On this basis annual tuition costs ranged from £1,939 to £8,563 for pre-clinical training and from £9,156 to £11,496 for clinical medicine. Wastage rates ranged from zero per cent to nine per cent.

PAMs

Tuition costs for professions allied to medicine have been obtained from two sources. For physiotherapists, OTs and radiographers most courses are funded through the non-medical education and training levy, NMET. For these groups tuition costs were estimated on the same basis as nurses, using the Financial Workforce Information Returns adjusted to reflect bursary payments and inflated to reflect wastage at the rate reported by each Regional Office.

Tuition of speech and language therapists and dietitians is funded through the Higher Education Funding Council. A questionnaire was sent to every institution that appeared to be offering these pre-registration courses. In practice many of these 21 institutions were offering related courses rather than registerable qualifications. Only eight institutions provided details of expenditure and numbers of students in each year of the course and numbers of discontinuations by year of the course. These were used to estimate annual costs of tuition for each course.

The number of years that students take to complete their pre-registration qualifications varies within a number of the professions. The most common pattern was taken when estimating total training costs. Annual and total course costs are reported in table 2.3 for each type of professional.

2.2 Clinical placement

Clinical placements would be expected to result in:

- costs to the higher education establishment organising and supervising the placement;
- costs to the service provider of supervising and supporting the placement; and
- benefits to the service provider of patient care provided that would otherwise have been provided by paid staff.

Costs to the higher education establishment are included in the tuition fees for the course.

Clearly the impact on the service provider depends on the balance of cost and benefits. Ideally we measure these directly by establishing information both about the extent of placements and an appropriate valuation of the cost or benefit associated with time spent on these placements. Often this is not possible so we need to make some assumptions. One helpful indicator about whether there is a cost or benefit to the service provider is whether it is difficult to find placements. In some cases providers require a payment in order to be prepared to take students on placement. The higher the payment (or leverage) the higher the perceived cost to the service provider.

Nurses

For nurses information about the clinical settings and distribution of placements throughout pre-registration training was obtained from an institution offering nurse training. Patterns of clinical placement were also discussed with the project team at the School of Health and Related Research at Sheffield which undertook a study evaluating the costs of clinical placements for nurses and midwives (Lloyd-Jones & Akehurst, 1996). On this basis it was assumed that 225 hours were spent on the community and 188 hours spent in a hospital during the first year of training. During the second year, students are supernumerary for the 112 hours spent in the community and 525 hours spent on a hospital ward whereas in the third year, students undertake rostered service for 225 hours on the community and 1,050 hours in hospitals.

For the valuation of time spent on clinical placement, it was assumed that first-year students are of zero cost and zero benefit to the service provider. Lloyd-Jones & Akehurst (1996) measured the costs of extra allowances and training for clinical supervision and for time spent on guidance provided to students. Benefits were valued in terms of the pay that would have been needed to deliver the same level of nursing to patients. They found that second and third year ward-based nursing students were of benefit worth £3 to £4 per hour depending on stage of training, and students on community placements constituted a cost to the service provider of £0.48 per hour.

On this basis placements throughout the three-year course were estimated as resulting in a net benefit of between £6,000 and £7,000 to the service provider depending on the branch of the course followed. Students on the adult branch were estimated to be of £6,971 net benefit and those training in mental health nursing, a benefit of £6,611 to the service provider.

The finding that more senior students were seen as contributing to the service was validated in discussions with a higher education institution. This institution found that, once students were no longer supernumerary and were doing rostered service, trusts were very keen to provide placements.

Doctors

The costs of supporting undergraduate placements have proved difficult to identify. Trusts told us of studies based on time diary information which gained such poor response rates they were never completed. An exercise was conducted during 1995/6, initiated by the NHS Executive in order to link the SIFT allocation more closely to costs of supporting clinical placements (see HSG(95)60 for guidelines). Unfortunately none of the results were felt sufficiently robust to act as a benchmark or indicator of actual costs. A major reason for the difficulties is the problem of joint production. Because of its very nature activities associated with clinical education (such as ward rounds) are also associated with providing

patient care, and will on occasion be associated with post-graduate education and research. The same is true of facilities such as libraries. Moreover, costs are not always associated with additional activity which can be identified by a specific measure or a proxy. In a number of settings the opportunity cost is the treatment of patients. For example, in one trust that was visited during the study it had been estimated that when students were present in one department a third fewer patients are seen at outpatients clinics. The issue is further complicated by "knock-for-knock" arrangements whereby clinical input by HE staff is assumed to equate to a certain level of educational input by clinical staff.

In the absence of information about costs we need to turn to proxy information about the level of compensation services require in order to take students on clinical placement. Trusts receive financial support for clinical placements during the final three years through the service increment for teaching (SIFT). SIFT is paid to support teaching: to provide additional facilities for medical education and to help meet excess service costs experienced by the trust as a result of having students in a particular setting. This was initially SIFTR, which included an allowance for research in trusts. The national level of SIFTR was based on an analysis of the excess treatment costs associated with the numbers of students on placement in teaching hospitals. This was carried out using a formula developed by the Resource Allocation Working Group (RAWP), following the reorganisation of the NHS in 1974 which removed the higher resources allocated to teaching hospitals, especially those in London, compared with other hospitals, (Bevan, 1997). RAWP (DHSS, 1976) found substantial variation, up to six fold at the extremes, in the excess costs per student so based the SIFT rate on the median excess costs per student. Seventy-five per cent of the median excess was agreed for teaching. The additional 25 per cent of the median excess was allocated to research, creating SIFT*R*.

With the introduction of changes in the funding of research in Trusts resulting from the implementation of recommendations from the Culyer Report (Culyer, 1995), 25 per cent of SIFTR was incorporated into a separate research levy. The remaining 75 per cent became SIFT, financed by a national levy withheld from all health authorities and fundholding GPs. Accompanying changes in the system of distributing the funds also took place. Medical schools are now given a planning budget by the regional office based on numbers of students and with which to negotiate placements with trusts and GPs. The regional office then contracts with these service providers and allocates funds accordingly.

SIFT is divided into two components.

- A 20 per cent portion comprising the clinical placement budget used to offset inflated service costs which depend directly on the presence of students. This is paid on a per capita basis according to numbers of students.

- The remaining 80 per cent constitutes the facilities budget and is intended to provide resources to support teaching. These include both tangible assets and human resources. This portion is not determined by student numbers and each institution is considered on an individual basis (NHSE, 1995).

Both components (inflated to 1997/98 levels) are included as an indication of the costs to Trusts of supporting each medical student during their three years of clinical placement.

After consulting with service providers and those involved in undergraduate medical education, no allowance was made for the service contribution of undergraduate doctors

during their clinical placement. This is supported by both the official position: such trainees are always supernumerary to any clinical department, and by the original basis for the estimation of SIFT, which identified excess treatment costs so would have taken into consideration any additional service contribution.

PAMs

Clinical placements on all PAMs courses have been assumed to be of zero cost and zero benefit. This is based on the findings of a group of studies undertaken by six Regional Health Authorities, reported in *'In the Balance? The costs and benefits of clinical placement in health care education'* (1993). These projects were carried out in response to an increasing reluctance on the part of service providers to participate in training by offering clinical placements and in some cases, providers demanded payment for placements. These were indications that there was a cost to service providers in offering placements and the studies aimed to quantify any costs or benefits and determine the balance between the two with a view to introducing a system of payments for placements, to ensure continuation of quality healthcare education.

Two research methods were used. Firstly, providers gave their perceptions of the costs and benefits to themselves of having students on placement and secondly, activity analysis measured the effect of student placements on the number of patients treated.

Studies found that the costs of placements tended to be short-term and easy to quantify in cash terms, for example, staff time in supervision, decreased patient throughput and costs of training supervisors. In contrast, the benefits identified were longer term and difficult to quantify in cash terms, for example, improved staff morale and job satisfaction, staff development, increased standards of care and enhanced status of the department. When placements were considered on balance, the benefits were seen as outweighing the costs. In terms of patient activity analysis, there was a net gain of staff time in physiotherapy and radiography, no effect in occupational therapy and a net loss of staff time in speech and language therapy. Moreover, these effects were small, in the case of physiotherapy, an average marginal gain of around £0.66 per day (Furness, T. 1993), and varied across specialties within each of the professions. In the light of these findings, it was decided that it was most appropriate for the 'Ready Reckoner' to assume no net cost or benefit as part of the investment costs of training resulting from clinical placements.

However, a short term cost that is incurred during clinical placements is the cost of supervisory payments for practitioners who take students. In the above studies, this was regarded the principal short-term cost, causing reluctance to provide placements. To allow for this an annual allowance of £1,035 is identified as an element of ongoing salary costs for all professionals other than speech and language therapists (where the payment does not apply).

2.3 Lost production costs

In order to get a comprehensive estimate of the cost of training we need to include all costs, whether or not they are associated with public expenditure. During the period that students are studying they incur living expenses including expenditure on books and stationery. To some extent these are subsidised by bursaries paid by the NHS but actual living expenses increasingly exceed the levels of grants, bursaries and student loans (Callender & Kempson, 1996).

For the purposes of the Ready Reckoner living expenses have been estimated for all professional groups on the basis of '*Student Finances: Income, expenditure and take-up of student loans*' (Callender & Kempson, 1996). Figures given for annual expenditure have been adjusted for doctors and nurses for those years that they work a full, rather than an academic year. On this basis the annual cost of living for nurses and clinical medical students who do not have a long summer vacation was estimated at £7,170 and for students of the professions allied to medicine and pre-clinical medical students the living expenses were estimated at £6,896 per year.

An alternative approach to estimating the cost to the student during the period of study is the estimation of what they could have earned during the period. This is a more accurate reflection of the lost production costs and is particularly relevant when the issue of concern is the returns on education and the decision of the individual to invest in their own future. Such estimates require assumptions about the expected wage rate for people with the qualifications necessary for the course, age, and unemployment rate. No estimates have been provided, but there is scope within the software for including such estimates if required.

3. Post-registration qualifications

There are no post-registration courses which are essential for a specific grade or type of profession allied to medicine. Moreover, there are inconsistencies and considerable variations in the provision of post registration education for PAMs. This was demonstrated by the eight projects within the PAMs Career Development Initiative undertaken in 1997 on behalf of the Regional Offices of the NHS Executive. It is not, therefore, possible or appropriate to include any courses as default estimates for any of the professions allied to medicine, although the facility is available in the software to include them.

For nurses and doctors, however, there are much more structured requirements for post-registration training.

3.1 Nursing

It is only appropriate to include post-registration training as an investment cost when a substantial level of training is a requirement for the staff fulfilling a specific role. In the case of nurses, the only post-registration course that has been included is community nurse training. Current pre-registration nurse training leads to a higher education diploma in nursing. Post-registration training is assumed to equate to the last year of a degree level qualification. Different options allow nurses to qualify for district nursing, community psychiatric nursing and community nursing for people with learning disabilities.

The course lasts for one year full-time or two years part-time and is assumed to consist of one day spent in college each week over thirty weeks. Tuition costs were collected from 14 educational institutions.

It was assumed that clinical placements were taking place in nurses' normal place of work. These placements would have a neutral effect on the service provider as the costs incurred would be offset by the increasing skills brought in as a result of the course.

Lost production or replacement costs are incurred by the service provider as patient care will not be provided by the nurse while they are training. On the basis that nurses spend one day per week away from the workplace these have been estimated as £7,620 over the year.

3.2 Doctors

The funding of continuing postgraduate medical education for junior doctors is a complex area and one in which the allocation of the funding stream does not reflect actual costs of training, which can not be clearly identified. This problem is compounded by the issue of joint products where the junior doctor is providing care at the same time as receiving supervised training.

Funding through the medical and dental education levy (MADEL) is allocated by the regional postgraduate deans' departments and is intended to cover the infrastructure costs of postgraduate centres, libraries and study leave, as well as clinical tutors. The consultation document *Funding PGMDE* (NHSE, 1996), highlighted the fact that funding through the postgraduate medical deans only meets the costs of the infrastructure supporting training of junior doctors, "...no explicit account is taken in the PGMDE funding stream of the 'hidden' and opportunity costs of training" (section 2.17, p.13).

These hidden and opportunity costs include the cost of the time spent by consultants in undertaking training activities, the cost of additional facilities and staff costs required because of the increased time required to carry out procedures while training juniors and the costs of increased patient care activity resulting from trainees providing care, such as higher out-patient and theatre return rates. From a funding perspective "not all of these can or should be quantified or taken into account in the calculation of 'excess costs' but at the moment we do not have the necessary information to know whether they are funded through MADEL or through patient services allocations." (NHSE, 1996). The situation is further complicated by the issue of joint products in the supervision of trainees by consultants when the training activity may also result in patient care, research or the training of undergraduate medical students.

The estimation of these hidden costs were not within the scope of the study. In addition to the practical difficulties of obtaining actual cost information, the issue is highly political, given the interests of the different parties involved. In the light of these difficulties, the estimated costs of postgraduate medical education have been restricted to using the funding provided for salary and infrastructure costs at a national level through MADEL.

Salary costs

In addition to the identifiable infrastructure costs of training, current funding arrangements for postgraduate medical and dental education incorporate a 50/50 split whereby the Trust employing doctors is required to pay 50 per cent of salary with the other 50 per cent met by MADEL funds. This arrangement is a proxy to reflect the fact that training of junior doctors largely takes place while they are delivering care in a clinical setting and because of the training component, junior doctors are not as productive as they would otherwise be. It acts as a subsidy for the costs to the Trusts of offering placements in a regulated training environment and provides leverage for the postgraduate deans to ensure adequate supervision and appropriate educational experiences. It also enables the regional postgraduate deans to exercise some control over the placements and training opportunities offered to junior doctors, in particular in specialist areas which have a lower service output.

Infrastructure costs

There is regional variation in the way in which funding is allocated and in terms of what elements are included and excluded from MADEL funds. This makes the use of regional

information problematic. Some regional postgraduate deanery's expenditure accounting is done by grade and specialty, but this system is not universal across regions. In view of these variations, 1996/7 national expenditure figures supplied by the Medical Education Unit of the NHS Executive have been used.

Three elements of MADEL infrastructure support have been distinguished: postgraduate centres and study leave; postgraduate deans' departments; and contributions by health departments to the Medical Royal Colleges' infrastructure in support of curriculum setting and inspection of posts for specialist training. Expenditure specifically for public health trainees was not included as we were concerned only with the training costs associated with doctors providing patient care. To a greater or lesser degree, facilities funded through MADEL are also used by GPs, dentists, career grade doctors and, in the case of libraries, other health professionals, as well as doctors in training.

In order to reflect the differential use of facilities, a weighting method was devised. Each grade of doctor was given a percentage weighting based on his/her assumed usage of each of the three elements funded through MADEL. This weighting was then used to adjust the total numbers of doctors in post on each of the grades as potential users1. Table 2.4 shows the central assumption concerning proportional usage of each service and the resulting annual cost of postgraduate education infrastructure for each type of medical professional.

The use of some facilities such as libraries by non-medical staff has not been taken into account here because the educational costs of these nurses and therapists has been estimated separately, using costs and funding sources specific to each of these professions.

Clearly the estimated costs depend on the assumptions about the proportional usage of the facilities. For example, if it is assumed that PRHOs make only 30 per cent use of the study centres and study leave, the annual cost of their training falls from £1,388 to £1,192, while that of SHOs and registrars increases to £2,451. If, however, the assumption remains that PRHOs make 70 per cent use of postgraduate centres and study leave, but that consultants make 20 per cent use of the facility, the cost of PRHO education infrastructure increases to £2,163 and that of SHOs and registrars from £2,399 to £2,835. The variation in estimates resulting from changed assumptions do not represent a very high proportion of the total annual cost of a doctor although it would be preferable to have more grounded assumptions.

The estimated annual costs of ongoing training for all types of doctor consists of the infrastructure support as shown above, the contribution to salary costs and other indirect costs which we have not been able to identify here. There is scope in the software to include information about indirect costs if the information is available.

The ongoing training costs at each level of seniority also constitute an investment cost for the subsequent levels of seniority as a senior house officer will need to have completed a year as a pre-registration house officer, a registrar will also need to have spent at least two years as a senior house officer and so on. The information above, therefore provides us with the basis for estimating the investment costs of training doctors up to and including

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[1] The numbers of doctors in post have been taken from Department of Health Statistical Bulletins: *Statistics for General Medical Practitioners in England 1986 - 96* (May 1997) and *Hospital, Public Health Medicine and Community Health Service Medical and Dental Staff in England, 1986 - 96* (July 1997).

consultants. For general practitioners, however, it is also necessary to estimate the cost of the vocational training year.

General practitioner training

The costs of the year spent as a GP registrar required before a doctor can become a general practitioner include:

- salary and on-costs less the value of patient care provided;
- expenses;
- costs to the trainer GP;
- capital costs of accommodation required in the practice; and
- infrastructure support.

The registrar's salary and on-costs are met by the General Medical Services (GMS) allocation at a level equivalent to that which the doctor had reached in the acute sector at the start of the year. It is assumed that the registrar has completed two years as a senior house officer so the salary is at the bottom of the registrar scale. Consistent with the approach used in relation to the training of other junior doctors, it is assumed that 50 per cent of salary costs are an appropriate estimate of the patient care provided. Thus, 50 per cent of the salary during the trainee year is taken to represent a cost of clinical placement.

The registrar is entitled to claim a range of expenses to cover inconvenience and additional expenses relative to those incurred by registrars working in the acute sector. These will vary with the circumstances of the registrar and the placement. For the purposes here, we include the subscription to the medical defence society (£2,000) and the annual car allowance (£3,928).

The trainer's grant of £5,140 per annum (1997/98) is assumed to cover most of the costs to the GP trainer. These will include both direct costs and the time the trainer is required to spend attending trainers' meetings and in preparation and discussing patients or consultation techniques with the registrar. But this allowance will not cover the capital cost implications of additional office space which is a requirement before a placement can be made with a GP. The capital cost associated with this additional space are estimated as £6,802 per annum on the basis of a consultation room and study area in a surgery.

It is assumed that the registrar would spend one day each week at the local postgraduate medical education centre and receive teaching by GP trainers and consultants, and attend special lectures. The infrastructure costs of supporting these activities is estimated as £1,548, based on the analysis of MADEL funding described above.

On this basis it the total cost of the GP trainee year is estimated as £30,183.

4. Conclusion

If we are to draw appropriate conclusions in exercises which require us to consider the cost implications of use of health service professionals, for example, the cost-effectiveness of

different types of skill-mix, it is essential that we include an estimate of the investment costs of training. Here we have focused on the costs of training additional health service professionals. This is the most appropriate approach when, at the margin the choice is whether to train an additional worker or not. The same estimates would not be appropriate when the alternative would be a contraction overall in the numbers in a particular profession being trained. In such circumstances a retraction model would be needed estimating the net opportunity cost of training fewer health service professionals. However, in the current climate, the number of nurses, doctors, and professions allied to medicine, who are being trained is increasing. In these circumstances using nurses to take over tasks previously undertaken by doctors (for example) would not mean fewer doctors needing to be trained but fewer additional doctors.

It is not possible to provide very detailed accurate costings about a wide range of health service professionals within the scope of the current study. It is possible, however, to provide initial estimates which can provide a reasonable valuation of the resource implications of current policies. Here we have provided an indication of the cost of the investment required. If we are to allocate this to health service professional time we need to estimate the equivalent annual cost. How we go about that is described in the next chapter.

Table 2.1 Pre-registration costs of training nurses

Year	*Tuition*	*Clinical placement*	*Living expenses*	*Total*
1	7,077	0	7,170	14,247
2	7,043	-1346	7,170	12,867
3	7,010	-5629	7,170	8,551
Total	21,130	-6975	21,510	35,665

Table 2.2 Pre-registration costs of training doctors

Year	*Tuition*	*Clinical placement*	*Living expenses*	*Total*
1	5,766	0	6,896	12,662
2	5,766	0	6,896	12,662
3	11,150	39,125	7,170	57,445
4	11,150	39,125	7,170	57,445
5	11,150	39,125	7,170	57,445
Total	44,982	117,375	35,302	197,659

Table 2.3 Pre-registration costs of training Professions Allied to Medicine

Profession	*Course length (years)*	*Total tuition*	*Total living expenses*	*Total**
Physiotherapists	3	20,513	20,688	41,201
Occupational therapists	3	19,052	20,688	39,740
Speech and Language therapists	4	14,996	27,584	42,580
Radiographers	3	28,384	20,688	49,072
Dietitians	4	15,317	27,584	42,901

* Assumes that there is no net cost or benefit resulting from clinical placements

Table 2.4 Infrastructure costs of supporting post-graduate medical education

Type of Medical Professional	*Assumed use of each educational facility (%)*			*Total annual cost per capita (£) 1996/7*
	Centres and study leave	*Deans' departments*	*Royal Colleges Medical Education*	
PRHO	70	100	0	£1,857
SHO	100	100	100	£2,399
Registrar	100	100	100	£2,399
Consultants	70	0	0	£1,191
Other doctors	20	0	0	£340
Hospital Training Grade Dentists	30	100	100	£1,208
Hospital Career Grade Dentists	10	30	0	£370
GP Trainees	50	100	100	£1,548
Practising GPs	10	70	0	£636
Total Expenditure	£73,446,000	£32,407,000	£806,000	£106,659,000

Table 2.5 Ongoing annual training costs of doctors

Type of doctor	*Proportion of salary contributed by MADEL (%)*	*Total Salary Contributed (£)*[2]	*Total Infrastructure cost (£) (MADEL)*	*Total*
Pre Reg House Officer	100	15,938	1,857	17,795
Senior House Officer	50	9,630	2,399	12,029
Registrar	50	10,765	2,399	13,164
GP	0	0	636	636
Consultant	0	0	1,191	1,191

[2] Salary rates are based on the December 1997 pay scales. The first point on each scale is assumed, with the exception of PRHOs where the mid-point between the two points is used.

Chapter 3. Annuitising the human capital investment costs of health service professionals

1. Introduction

The previous chapter described the estimation of the investment costs required in order to qualify a variety of health service professionals for their professional activities. In order to incorporate these costs into the unit costs of professional time, we need to annuitise the investment in a way that reflects the expected return over time.

For the purposes of annuitising the costs of education and training we need:

- to estimate the total return on the investment (the number of years a health service professional would use his/her training);
- to allow for the distribution of costs over time; and
- to allow for the distribution of the returns on the investment over time.

There is an implicit problem in providing any estimate of future streams of benefit from current training in that necessarily all we have to work on is historical information. Given that working patterns are changing this could be expected to provide a biased picture. However, if we can provide estimates for different groups we could weight the resulting estimate to reflect current or expected numbers of these groups being trained. Moreover, sensitivity analysis will allow us to explore the implications of expected changes in patterns of employment. Before any such analyses can be undertaken, we need a basis for annuitising the long-term costs of education and training. Despite concerns about supply of labour and wastage rates in the health service workforce, there is very limited information about the working lives of health service professionals.

Although there are some longitudinal data for doctors which are currently being analysed by Goldacre and colleagues (Lambert et al., 1996), all the data sources we can draw on directly are cross-sectional. This paper describes an approach we have developed for estimating expected working lives and annuitising the costs of education on the basis of cross-sectional data. We report on results for doctors, nurses and professions allied to medicine based on the two per cent sample of anonymised records from the 1991 census and the Labour Force Survey for the second quarter of 1995/6. Approaches to annuitising costs based on this information are described and the implications for annual estimated costs of pre-registration qualifications reported.

2. Estimating expected working lives

The approach for estimating expected working lives described here is similar to worklife tables produced to predict labour force participation and lost earnings capacity (see for example, Smith, 1982; Finch, 1983; Smith, 1985; Alter and Becker, 1983). These are synthetic estimates in that they summarise the behaviour of all age groups in the population during a given year rather than trace the history of any one group through its lifetime (Smith, 1982).

Working patterns are such that health service professionals, especially women, can be expected to leave and rejoin the workforce a number of times during their working lives. There is no attempt to develop an increment-decrement model including estimates of the rate of entering or leaving the health service labour force. The cross-sectional data are just assumed to identify the probability of participation in the labour force for a particular period at a particular age. All the literature on worklife models examined to date makes assumptions about or draws on data to estimate the total number of person years worked after a particular age. In the pragmatic approach adopted here the assumption is that workforce participation at a particular age is indicative of workforce participation during that year.

Information is available which allows us to adjust for the proportions of people working full or part-time at each age. Because different patterns of working lives would be expected, separate analyses are conducted for each type of health service professional and by gender.

2.1 Method

We have taken the period during which health service professionals could be using their qualification to be from the ages of 22 for nurses and professionals allied to medicine, and 24 for doctors, to 60 for women and 65 for men. We know for each of these ages what proportion of qualified professionals are working in their professional capacity and the proportion of a working week that the part-timers are working. The expected number of years worked is the length of time it is possible to work multiplied by the proportion of those qualified employed as a health service professional. The expected working life is the sum of these years over the entire potential working life:

$$E = \Sigma(p_{fti} + p_{pti} Y_{pti})$$

where:

E is the expected working life;

p_{fti} is the proportion of professionals in full-time work at age i;

p_{pti} is the proportion of nurses in part-time work at age i;

Y_{pti} is the expected part-time working year at age i.

The expected part-time working year is the proportion of the working year worked by those in part-time work:

$$Y_{pti} = hw_i/ftw_i$$

where:

hw_i is the average number of hours worked per week by part-timers aged i; and

ftw_i is the number of hours in a full-time working week.

Those people who have died during the period will not be observed so allowance needs to be made for expected mortality of qualified individuals. The expected working life thus becomes:

$$E = \Sigma(p_{fti} + p_{pti}Y_{pti})(1-m_i)$$

where:

m_i is the probability of dying between qualification and age i.

Using cross-sectional data, different cohorts are taken to indicate the probability of participating in the labour force at each age. The resulting estimate will not, therefore, distinguish age and cohort effects: the underlying assumption will be that the behaviour of current 22 year olds when they reach 50 will be the same as current 50 year olds. This is a standard demographic approach, which, it can be argued, uses the latest available data about patterns of behaviour (Bebbington et al., 1996). The results will be biased to the degree that current 50 year olds are more or less likely to be employed than current 22 year olds when they reach that age. Two current trends in working patterns would be expected to bias the results in the opposite way:

- as women increasingly work during the period that used to constitute a career break to have children (see Long and Jones, 1981), the current estimate could be expected to be an underestimate; but
- as people retire at earlier ages (see Bone et al., 1992), the current estimate could be an overestimate.

Smith (1985) maintains that in using worklife tables it is possible to develop group-specific estimates of expected working lives only if the group is closed to entry and exit. This is not true of qualified health service professionals in that some workers may become qualified at a later age and enter the group later than others. We assume that (other than errors in reporting) once qualified health service professionals remain so. In the census we only have information about "highest qualification", so people achieving a higher degree in another discipline will, in fact "exit". The Labour Force Survey, however, has information about three highest qualifications, so loss from such exits are likely to be minimal. The most likely form of exit from the perspective of health benefit to the UK population is through emigration. This is more problematic in that people may well return after a period of gaining experience abroad. As with mortality, such qualified health professionals are not observed and so need to be allowed for on a similar basis. Thus:

$$E = \Sigma(p_{fti} + p_{pti}Y_{pti})(1-(m_i + e_i))$$

Where:

e_i is the proportion of professionals have emigrated so absent at age i

In order to allow for the late entry problem, it is necessary to allow for the distribution of age on qualification. This is achieved by weighting the expected working year at each age to reflect the proportion of people qualified by that age. Thus:

$$E = \Sigma q_i[(p_{fti} + p_{pti}Y_{pti})(1-(m_i + e_i))]$$

Where:

q_i is the proportion of professionals qualified by age i

The weight q_i will be less than one for the younger age groups and reach one for the age by which it is assumed that all the relevant professionals are qualified. For doctors these have been based on the age distribution of house officers (most of whom would have just qualified). For nurses, information about age distribution of qualifying traditional learners in five-year age bands in 1991 was supplied by the King's College Nursing Research Unit. The English National Board for Nursing, Midwifery and Health Visiting (ENB) was able to provide a much broader breakdown of ages of Project 2000 students.

Another potential source of bias related to entry and exit is that all those who identified that they were in full-time work are assumed to work the whole year and all those who were not working are assumed not to work as health service professionals for that year. In practice, of course, some individuals working full time will leave during the year and others not working join the health service workforce. This potential source of bias is increased when, for most groups of health service professionals, it is necessary to use age bands rather than individual years as the basis for estimation. This is because the number of doctors, male nurses, and therapists is too low for any individual age to have much confidence in individual year estimates.

If age groups are used, the same equations apply, but the period which it is possible to work extends to include the whole age band (e.g. 5 years). Thus the expected working life becomes:

$$E = \Sigma q_i[(p_{fti}Y_{fti} + p_{pti}Y_{pti})(1-m_i)]$$

where:

Y_{fti} is the number of full-time working years in age group i; and

$Y_{pti} = (hw_i/ftw_i)Y_{fti}$

Predicted working life can be estimated separately for those groups known to show different working patterns and for whom there is sufficient information to allow an adjustment to be made on the basis of the composition of newly-qualified health service professionals or the existing health workforce. Issues such as dependants can be assumed to be reflected in the proportion of people working and number of hours worked. The only subdivision used within health professional types, therefore, is gender.

Although we should consider carefully what groups we might want to estimate separately, it is important not to have too many groups or the number of observations in each group will be too small to provide a robust estimate of the probability of working. This same issue applies to the age groups selected. Ideally, we want to maximise the number of age groups selected in order to most accurately reflect actual variations in participation in the workforce. But the shorter the period (or narrower the age range) the fewer the observations.

2.2 Results

Qualified health service professionals were defined as participating in the workforce if they were working full or part-time in "medical and other health services or veterinary services" (in the census) or "health and social work" (in the Labour Force Survey) regardless of whether or not they were working for the NHS. All time spent on either or both of primary and secondary employment in these categories was included. The few qualified professionals who have been classified as training or in education have been assumed to be undertaking further professional training and have been included as using their qualification.

About three per cent of qualified doctors, and one per cent of qualified nurses and professions allied to medicine were classified as full-time students.

Figures 3.1 to 3.4 are based on census data and illustrate the proportions of doctors and nurses in full and part-time employment by gender. The impact of family responsibilities is clearly demonstrated for women, who were less likely to be in full-time employment and more likely to be in part-time employment, particularly in their early 30s.

Lambert et al. (1997) found that about ten per cent of doctors qualifying in the UK emigrate. It is difficult to get accurate information about emigration and the proportion of emigrants that can be expected to return, so adjusting the estimate to reflect this issue may well result in further bias. If no adjustment is made, the estimated length of the expected working life will be a slight over-estimate. Once any adjustment is made, the direction of bias will depend on the numbers returning, which is unknown. In practice, therefore, no adjustment has been made for emigration.

Tables 3.1 to 3.4 summarise the evidence about employment patterns, mortality, age on qualification and the resulting estimated expected working life for doctors and nurses separately for males and females. These analyses suggest an expected working life of 30 years using census data and 31 years using LFS data for male doctors and 22 years for female doctors using both sources. When female doctors up to the age of 65 are included, the expected working life rises to 23 years. Using information about age of those qualifying from traditional training as registered general nurses (RGN) in 1991 to weight the data the estimated working life was 21 for male and 17 for female nurses using the census. The analysis based on the LFS resulted in higher estimates of 23 years for male and 20 years for female nurses.

One potential source of bias in estimates is that the degree to which individuals participate in the workforce is assumed to hold for the whole of the age band. Thus those who were employed at the time of the survey but leave within the period represented by the age band are assumed to be offset by those who were not in employment but start working during the period. The LFS does provide information about changes in employment during the previous year which show that those returning to work outnumber those leaving. Among nurses, five per cent who were nursing at the time of the survey were not nursing a year ago, and two per cent of nurses not working were working a year ago. There is a similar pattern among doctors. As more people are observed as working who would not have been working for the whole period, the expected direction of bias is upward.

Given the difference found between male and female expected working lives, estimates for each type of health service professional should reflect the gender distribution. Allowing for different sources of information (reflecting those qualified in the general population, the current workforce, and newly qualified people) has very little impact on the expected working lives. The difference between the estimates is never great but is most marked for doctors where the weighted average varied from 29 years using the LFS based on those in the current workforce to 26 years using the census based on the gender distribution of house officers. Using the census and gender distribution of the current workforce the estimated expected working life of a doctor is 27.5 years. Using the LFS and gender distribution of newly qualified doctors the estimate is 27 years. For nurses the expected working life using the census was 19 years. The estimate based on LFS data was 20 years.

Because of the problems of separately identifying professions allied to medicine it was only possible to use the LFS. Individuals recorded in the LFS as having a degree in studies allied to medicine/physiotherapy were identified as qualified professionals allied to medicine and those reported to be working full-time or part-time in the area of health and social work were regarded as using the qualification.

The numbers were very small so age bands had to be expanded to ten years. For each profession the estimate was adjusted to reflect the gender distribution of professionals in the current workforce (Department of Health, 1997). Variation in estimated working lives was not high, however. Overall PAMs were expected to work 24 years, the highest group being speech and language therapists with an estimated working life of 24.7 years and the lowest being radiologists who were expected to work 24.3 years.

3. Annuitising costs over expected working life

The annual opportunity cost of an investment in either physical or human capital should reflect the period over which the benefits are delivered. An important guideline when considering interventions that have long-term cost and outcome implications is that future costs and benefits should be discounted to the same point in time (Drummond, 1993). This discounting process reflects the lower value put on future costs and outcomes. So, having estimated the total number of years a health service professional is expected to work, the next issue is how to reflect the distribution of costs and returns on investment over time.

3.1 Allowing for distribution of costs over time

In order to allow for the distribution of the costs over time, the estimated costs of each year are multiplied by the appropriate discount factor which reflects the time preference rate and the number of years from the base year that the cost will be incurred. The time preference rate which reflects the degree to which benefits in the future are valued less than those delivered in the present has been set by HM Treasury at six per cent per annum. This is also the rate recommended when estimating the rate of return on investment in capital schemes in the public sector. This rate has been taken throughout the following discussion.

If the time preference rate is six per cent, the discount factor for any one year is:

$$v^n = \frac{1}{(1.06)^n}$$

where:

n is the number of years the cost is delayed after the base year.

In order to obtain a qualified district nurse, we can assume that we can invest immediately in the first year of pre-registration training but we will not incur the second and third year training costs until one and two years hence, respectively. A period of consolidation is required during which there will be a flow of value from this training but in order to have a nurse with a community nursing qualification we need a further year of training. If this takes places five years after qualification the costs should be discounted by eight years to reflect the delay necessary before the costs will be incurred.

The undiscounted cost of training a nurse, including tuition, clinical placement and living expenses has been estimated as £35,665 for pre-registration training and £12,120 for post-registration training (see chapter 2). Discounting these costs to the base year:

Discounted cost of basic training

$$= \text{Year 1 costs} + (\text{Year 2 costs})v + (\text{Year 3 costs})v^2$$

$$= £14{,}247 + (£12{,}867)0.94 + (£8{,}551)0.89$$

$$= £33{,}996$$

Discounted cost of community training

$$= (\text{Year costs})v^8$$

$$= (£12{,}120)0.63$$

$$= £7{,}604$$

This process allows for the distribution of the costs, but it is important also to allow for the distribution of the returns or benefits of the training. Just as the costs are adjusted downwards to reflect the preference for incurring costs in the future rather than the present, there is a need to reflect in the estimated costs the effect of delaying the future stream of benefits.

Before considering the implications for the investment costs of doctors and PAMs, it is helpful to complete the picture by annuitising these investment costs for nurses in a way that reflects the returns over time.

3.2 Allowing for distribution of benefits over time

If the cost of pre-registration training of a nurse is simply annuitised over the expected working life of 19 years estimated in section 2 above, in the resulting estimate (£3,629 p.a.) there is the implicit assumption that the returns on the investment occur immediately. The fact that initial returns will be delayed until after qualification (three years after training begins) and some returns will not be achieved until up to 47 years after qualification means that the investment is tied up for longer, so the costs should be higher.

If the returns were spread evenly over the 44 years post-qualification and we allow for initial returns being delayed until after qualification (three years after training begins) some returns will not be achieved until up to 47 years after starting training. Allowing for this if the returns were spread evenly over the 44 years post-qualification period, then the equivalent annual cost (EAC) of training is:

$$£33{,}996 = ((19/44)\ v^3\ a_{44}^{.06})EAC.$$

$$EAC = £33{,}996/\ ((19/44)v^3\ a_{44}^{.06}\ .) = £33{,}996/5.5774$$

$$= £6{,}095$$

where:

$$v = \frac{1}{(1.06)}$$

$$a_{44}^{.06} = (v + v^2 + v^3 \ldots\ldots + v^{44})$$

In practice we know that the distribution will not be uniform through time: people will be more likely to work as a nurse immediately after qualification than later in their lives. We can use the number of years worked in each age group as a starting point in estimating this distribution, assuming that the number of years worked by those aged 22-26 who are qualified nurses reflect the number of years worked in the first five years after qualification. The equation for each age group is very similar to that shown above for estimating the total number of years but excludes (at this stage) the adjustment to reflect age on qualification:

$$N_j = (p_{ftj} + p_{ptj}Y_{ptj})(1-(m_j + e_j))$$

where:

N_j is the expected working year in the jth period after qualification

By not allowing for age at qualification we are more accurately reflecting working patterns in each age group but, necessarily, we are over-estimating the expected working life. As the data are being used to represent working patterns in each period after qualification rather than the basis for estimating total number of years worked (as above) a different approach is needed when adjusting for age on qualification. In order to allow for the fact that those who qualify later can not work for as long a period as those that qualify at younger ages, the number of years worked during the older age groups which represent the longest periods after qualification need to be deflated. Thus, for example, if 70 per cent of female nurses are qualified by the age of 25, then we know that of nurses aged 60, 30 per cent of them could not have been working as nurses more than 35 years after qualification. Thus the equation for number of years worked in each period after qualification becomes:

$$N_j = q_i(p_{ftj} + p_{ptj}Y_{ptj})(1-(m_j + e_j))$$

where:

q_i is the proportion qualified by age i

where:

$$65-i = j$$

Because the adjustment for qualification has a more marked effect on younger age groups than older age groups the total of years worked estimated on this basis is still an overestimate, although in practice the effect is not marked (using census data male and female nurses together still are estimated as having a total working life of 19 years).

In order to present the information in a meaningful way the data about male and female nurses are combined for each period, reflecting the proportion of males working in the

workforce overall (see table 3.5 below). At the time of the census, women retired at 60 rather than 65. For the purposes here, where we are interested in future flows which will include women working to 65, female patterns of working in this age group are assumed to be the same as male.

This approach provides us with a basis on which to spread the expected working life over the period after qualification. In order to annuitise the cost of training, each period is treated separately when discounting. The bold figures below are based on the weighted average of years worked by male and female nurses in each age group, adjusted to allow for age on qualification. These are used to estimate the proportion of years worked in each period after qualification to adjust for the proportion of training "delivered" in each period. The weighted average is based on the proportion of male nurses currently qualifying (10 per cent), which is the same as the proportion of qualified nurses in the LFS. In the more dated census dataset the proportion was eight per cent; in the NHS workforce the proportion of nurses who are actually working who are male is just six per cent. All except for the final period after qualification are shown as five-year bands. The final period is just four years, reflecting the 57-60 year age group.

We now have all the information we need to estimate the annuitised costs of training a nurse:

- the cost of the training discounted to reflect the distribution of costs over time; and
- the distribution of expected returns on training.

Thus on this basis the EAC of the basic training of a district nurse is:

$$£33{,}996 = [\,(\mathbf{3.91}/5)\,v^{3}\,a_{5}^{.06} + (\mathbf{2.98}/5)\,v^{8}\,a_{5}^{.06} + (\mathbf{2.34}/5)\,v^{13}\,a_{5}^{.06} + (\mathbf{2.41}/5)\,v^{18}\,a_{5}^{.06} + (\mathbf{2.4}/5)\,v^{23}\,a_{5}^{.06} + (\mathbf{2.16}/5)\,v^{28}\,a_{5}^{.06} + (\mathbf{1.77}/5)\,v^{33}\,a_{5}^{.06} + (\mathbf{0.78}/4)\,v^{38}\,a_{4}^{.06} + (\mathbf{0.40}/5)\,v^{42}\,a_{5}^{.06}] \times EAC$$

$\rightarrow$ £33,996 = 7.18 x EAC

$\rightarrow$ EAC = £4,735

The cost of the additional year of community nurse training also reflects the delay in returns:

$$£7{,}604 = [\,(\mathbf{3.91}/5)\,v^{9}\,a_{5}^{.06} + (\mathbf{2.98}/5)\,v^{14}\,a_{5}^{.06} + (\mathbf{2.34}/5)\,v^{19}\,a_{5}^{.06} + (\mathbf{2.41}/5)\,v^{24}\,a_{5}^{.06} + (\mathbf{2.4}/5)\,v^{29}\,a_{5}^{.06} + (\mathbf{2.16}/5)\,v^{34}\,a_{5}^{.06} + (\mathbf{1.75}/4)\,v^{39}\,a_{5}^{.06} + (\mathbf{0.78}/5)\,v^{43}\,a_{4}^{.06}] \times EAC$$

$\rightarrow$ £7,604 = 5.04 x EAC

$\rightarrow$ EAC = £1,508

Allowing for the proportion of district nurses that have this qualification (91.5%) brings the estimated annual cost to £1,380.

3.3 Annuitising investment costs of doctors

The implication for doctors, where much of the training continues post-registration, is rather more involved but is based on the same principles. Each year after registration a substantial proportion of the salary (100% or 50% depending on the level of seniority) can be attributed to the investment costs of training for subsequent stages in the doctors career. This cost, together with additional expenditure representing infrastructure costs for maintaining post-graduate medical education, is taken as the total training cost for that year. For each grade of doctor the cost of training years previous to that grade are discounted on the basis of the number of years that each training year occurs after the first year of pre-registration training. The annuitisation process then assumes that the investment starts to be delivered after the stage in the doctor's career has been completed.

Thus for a consultant the total costs of investment would be:

A. Pre-registration investment

(Year 1 + (Year 2)v + (Year 3)v^2 + (Year 4)v^3 + (Year 5)v^4) annuitised over 27 years starting five years after initial investment

plus

B. Provisional registration House Officer investment

(100% salary + infrastructure costs) v^5 annuitised over 26 years starting six years after initial investment

plus

C. Senior House Officer investment

((50% first year salary + infrastructure costs) v^6 + (50% second year salary + infrastructure costs) v^7) annuitised over 24 years starting eight years after initial investment

plus

D. Registrar investment

((50% first year salary + infrastructure costs)v^8 + (50% second year salary + infrastructure costs) v^9 + (50% third year salary + infrastructure costs) v^{10} + (50% fourth year salary + infrastructure costs) v^{11}) annuitised over 20 years starting twelve years after initial investment.

Thus a registrar's costs training costs would include the annuitised investments prior to that grade (A through C) plus ongoing training costs in the form of 50 per cent salary and annual infrastructure costs.

Clearly, assumptions about length of time spent in each grade are key to the estimates made, particularly for consultants' investment costs. The assumption used for the default estimate,

reported in table 3.6, is that the average length of time a consultant spends as a registrar is four years. The annuitised investment of post-graduate education is £10,015 on this basis. As the number of years as a registrar increases, so do the costs of postgraduate education: from £5,362 if a single registrar year is assumed to £25,074 if ten years are spent as a registrar.

For GPs the investment costs of training are estimated on the same basis as consultants with a year as a trainee GP registrar replacing the four year period as a hospital-based registrar. On this basis the equivalent annual cost of postgraduate training of a GP is £28,997.

3.3 Annuitising investment costs of PAMs

The methodology applies equally to professions allied to medicine but information about the expected working lives of professions allied to medicine is not as complete or satisfactory as that for nurses and doctors. There are three main problems:

- fewer people employed in these professions in total;
- they are difficult to define satisfactorily; and
- it is likely that within the overall group patterns of working will very considerably depending on which profession is under consideration.

Nevertheless it is important that the investment costs of these professions are taken into consideration. The assumptions used in estimating expected working lives have been described above and the estimated cost of training described in chapter 2. Table 3.7 shows the annuitised costs of training each of the professions included in the Ready Reckoner using this information and the approach to discounting and annuitising costs used for doctors and nurses. Given the reservations about the sources of information it is likely that these estimates do not reflect the full variation between professions but this is the best information we have to date.

4. Effects of including investment costs of training on unit costs of health service professionals

In absolute terms the equivalent annual investment costs of training ranged from £4,520 for occupational therapists to £30,170 for consultants. Table 3.8 summarises the impact of these costs of education and training for some exemplar types of health service professional. Basic unit costs in this table include ongoing annual expenditure on training.

The impact on unit costs of staff was least on professions allied to medicine, although even for these groups costs rose by about a fifth. The lowest impact was for occupational therapists shown in table 3.7 at 16 per cent. The biggest impact among these professions was for speech and language therapists where unit costs are 19 per cent higher when investment costs of training are included. For all types of nurse the impact was slightly higher with unit costs rising by over 20 per cent when investment costs are included. The most marked, and varied, impact was among doctors. Given the long-term investment required for consultants it perhaps is not surprising that the costs including investment in training are 36 per cent higher than without this investment cost. But the most dramatic impact is on the costs of registrars. Because a high proportion of the investment required for a consultant is required

for a registrar but pay is much lower the net effect of including investment costs is to increase unit costs by 60 per cent.

Clearly the inclusion of investment costs of education and training has an important impact on the overall level of costs and the relative costs of health service professionals. This raises the question when these costs should be included and when they should be excluded from estimates of unit costs.

An important principle of economic cost estimation is that how costs are estimated depends on the reason the costs are being estimated. In turn this determines perspective of the costing exercise: the costs to whom. For the most part these investment costs are borne by the wider NHS and individuals undertaking the training rather than trusts so those costing exercises that are concerned with narrowly defined costs to the provider organisation would not want to incorporate these investment costs.

The investment costs of education should always be included, however, when evaluating the cost-effectiveness of different approaches to using health service staff as it is important to include all the costs implicit in changing the professional mix. For the Human Resources and Effectiveness Initiative it is clear that such costs should always be included in any cost-effectiveness evaluations. Evaluations of any techniques which change the way that staff are used (such as tele-medicine) should also include the investment cost of training. A reasonable rule of thumb when deciding whether investment costs of training should be included is to consider whether the issue under consideration has any potential implications in the long term for the workforce. If it has, then the investment required in training a skilled workforce should be incorporated.

5. Conclusion

There is a lack of information about the expected working lives of health service professionals. Given the importance of planning for and investing in an adequate workforce for the NHS, this is an important omission. All approaches to estimation have their disadvantages as future patterns of behaviour would not necessarily reflect the past patterns even if longitudinal data were available. The approach developed above was derived for a specific purpose, but given the lack of information in this field it may prove to have wider uses.

Necessarily the approach is limited by the data available. Cross-sectional data are taken to represent different aspects of working life patterns which in all cases combine cohort and age effects. The net effect of the bias resulting from this could only be established by comparing predicted results with actual patterns, but the historical picture could be investigated. Age and cohort effects could be disentangled by applying the approach to previous census data and labour force data to compare working patterns of health service professionals at specific ages (for example, 25, 35, 45, 55 and 60) over time.

The approach does allow us to make a reasonable estimate of the long-term investment costs of qualifying health service professionals. Clearly the levels of investment are such that including annuitised costs is essential if appropriate conclusions are to be drawn with respect to the cost-effectiveness of changing the patterns of use of professional expertise in the long term. The analysis also shows that the distribution of returns on investment in education has an important effect on estimated equivalent annual cost. This has implications

for the appropriate measurement of costs both when considering innovative staff use and workforce planning.

The principal objective of the project was to provide a basis for estimating cost estimates appropriate for the Human Resources and Effectiveness Initiative. By the very nature of this Initiative patterns of working and using staff are likely to be atypical. Moreover, throughout the discussion above, assumptions have had to be made where better information may be forthcoming in the future or where better information may be available about local costs. The approach presented here provides a sound basis for estimating costs and information about investment costs which are not likely to be available to those concerned with specific evaluations. The development of a piece of software allows the default values to provide a basis which can be varied to reflect the specific circumstances of the health service professional when estimating unit costs. The next chapter briefly describes the development of that software.

Table 3.1 Productive Working Lives of Male Doctors

Age Group	*No. Qualified*	*Proportion FT (%)*	*Proportion PT (%)*	*Average PT hours*	*P (dying)*	*% Qualified*	*Working Life (years)*
24-28	152	80.2	1.3	35	0.0097	91	3.66
29-33	239	73.6	2.5	19	0.0097	98	3.65
34-38	215	77.7	2.3	24	0.0168	100	3.88
39-43	194	80.9	5.7	24	0.0168	100	4.14
44-48	170	75.3	8.8	24	0.0406	100	3.87
49-53	128	82.0	4.7	9	0.0406	100	3.98
54-58	130	70.0	11.5	20	0.115	100	3.35
59-65	147	42.2	18.4	18.4	0.115	100	3.18
TOTAL	1375						29.71

Table 3.2. Productive Working Lives of Female Doctors

Age Group	*No. Qualified*	*Proportion FT (%)*	*Proportion PT (%)*	*Average PT hours*	*P (dying)*	*% Qualified*	*Working Life*
24-28	156	75.0	5.1	23	0.0045	94	3.65
29-33	173	54.9	19.7	17	0.0045	98	3.09
34-38	121	38.8	28.9	21	0.0105	99	2.66
39-43	77	41.6	32.5	17	0.0105	99	2.75
44-48	69	52.2	27.5	23	0.0274	100	3.31
49-53	49	46.9	30.6	25	0.0274	100	3.20
54-60	56	33.9	32.1	22	0.0695	100	3.36
TOTAL	701						22.02

Table 3.3 Productive Working Lives of Male Nurses

Age Group	*No Qualified*	*Proportion FT (%)*	*Proportion PT (%)*	*Average PT hours*	*P (dying)*	*% Qualified*	*Working Life (years)*
22-26	102	78.4	2.0	18	0.0042	38	1.50
27-31	159	74.8	0.6	12	0.0097	81	3.01
32-36	152	62.5	0	0	0.0097	92	2.85
37-41	149	65.8	0.7	20	0.0168	97	3.15
42-46	144	63.2	0.7	40	0.0168	98	3.08
47-51	101	52.5	2.0	27.5	0.0406	99	2.56
52-56	77	54.5	1.3	25	0.0406	100	2.66
57-60	55	32.7	1.8	20	0.115	100	1.19
61-65	57	22.8	1.8	19	0.115	100	1.05
TOTAL	996						21.05

Table 3.4 Productive Working Lives of Female Nurses

Age Group	*No Qualified*	*Proportion FT (%)*	*Proportion PT (%)*	*Average PT hours*	*P (dying)*	*% Qualified*	*Working Life(years)*
22-26	1412	71.8	11.3	21	0.0015	71	2.77
27-31	1991	46.2	24.1	19	0.0045	83	2.41
32-36	1736	31.5	32.5	19	0.0045	87	2.05
37-41	1355	33.7	29.9	20	0.0105	91	2.22
42-46	1440	38.9	24.4	20	0.0105	95	2.42
47-51	1127	38.2	21.3	21	0.0274	96	2.34
52-56	1015	31.3	19.6	21	0.0274	100	2.04
57-60	661	21.0	15.1	20	0.0695	100	1.08
TOTAL	10737						17.33

Table 3.5 Equivalent annual cost of training whole time equivalent staff

Years after qualification	*Nurses* *Years worked*	*Doctors* *Years worked*
0-5 years	3.91	3.96
6-10	2.98	3.44
11-15	2.34	3.30
16-20	2.41	3.48
21-25	2.40	3.60
26-30	2.16	3.61
31-35	1.75	3.03
36-39	0.78	3.05*
40-44	0.40	
Total working life	19 years	27 years
Investment cost of training	£35,669	£197,659
Discounted cost of training	£33,996	£169,467
Equivalent Annual Cost	£4,735	£21,215

Note: Working life estimates are based on the assumption that 10% of nurses and 52% of doctors are male, reflecting the pattern of newly qualified professionals in 1996.

* As doctors qualify later, the maximum number of years after qualification is 42 years

Table 3.6 Equivalent annual cost of training consultants

Grade	*No. of years*	*Initial investment (£)*	*Discounted investment costs (£)*	*Equivalent annual cost*
Pre Reg House Officer	1	17,795	13,298	1,682
Senior House Officer	2	24,706	16,911	2,421
Registrar	4	55,926	32,128	5,912
Total	7	98,427	62,337	10,015

Table 3.7 Equivalent annual cost of pre-registration costs of training Professions Allied to Medicine

Profession	*Investment costs of training (£)*	*Discounted costs of training (£)*	*Expected working life (years)*	*Equivalent annual cost(£)*
Physiotherapists	41,201	38,913	23.8	4,694
Occupational therapists	39,740	37,533	23.6	4,517
Speech and Language therapists	42,580	39,148	24.7	5,051
Radiographers	49,072	46,347	24.3	5,618
Dietitians	42,901	39,398	23.4	5,019

Table 3.8 Effect of including investment in qualifications on unit costs of health service professionals

Profession	*Annual unit cost excluding investment costs of training (£)*	*Annual unit cost including investment costs of training (£)*	*Percentage increase(%)*
Occupational therapist	28,835	33,354	16
Speech & Language therapist	26,311	31,359	19
District nurse	28,831	34,946	21
Staff nurse	20,249	24,984	23
GP	110,051	139,048	26
Consultant	83,393	113,562	36
Registrar	46,995	71,813	53

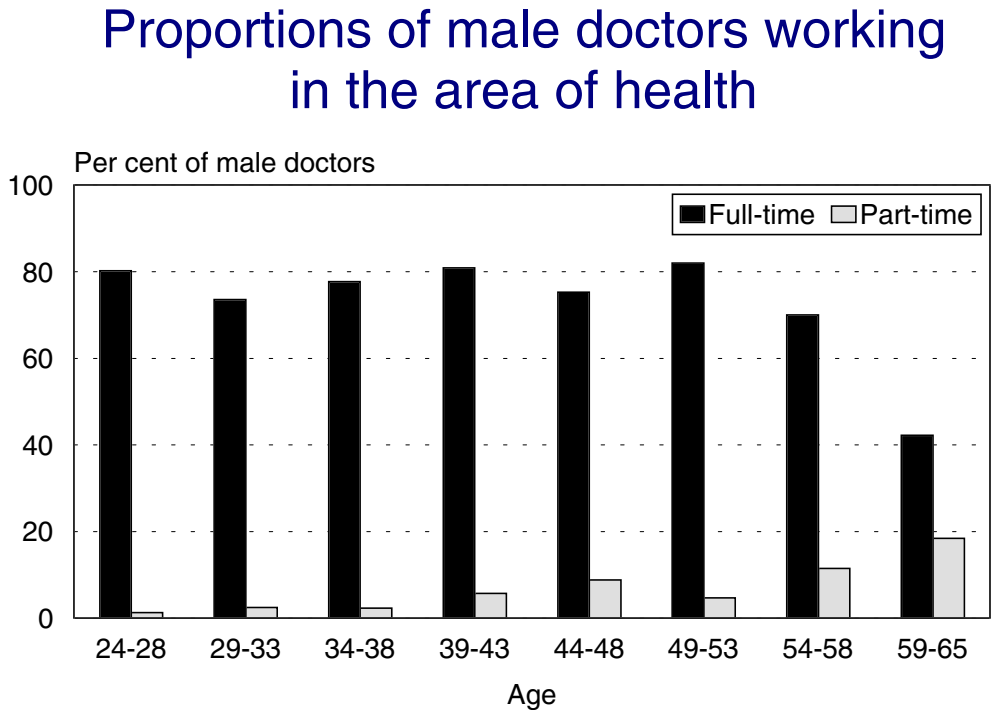


Figure 3.1

Figure 3.2

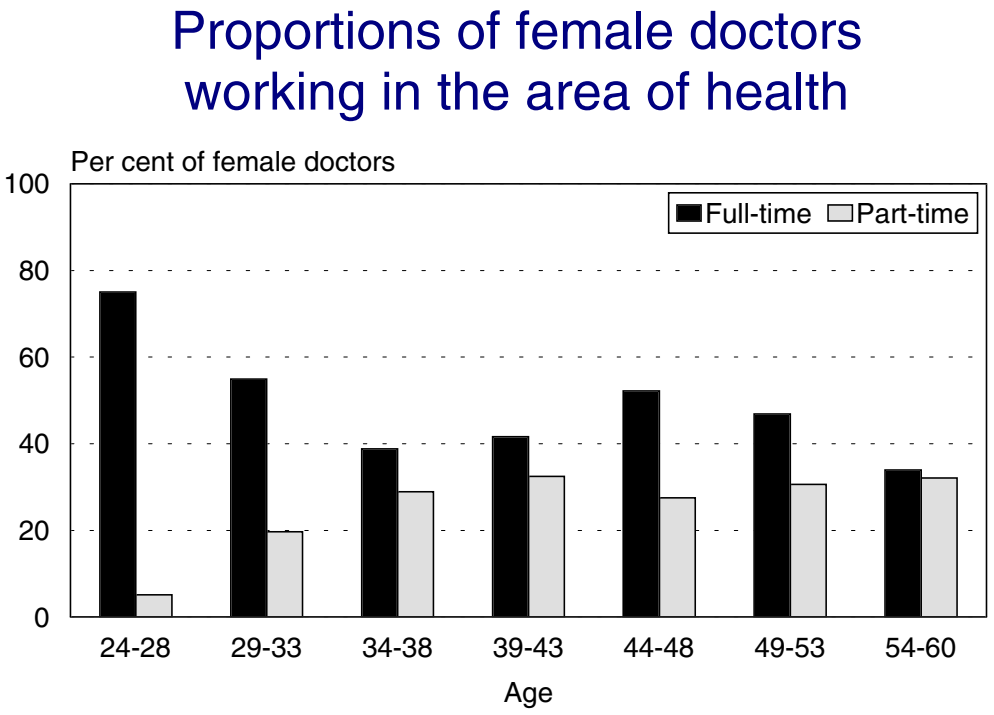


Figure 3.3

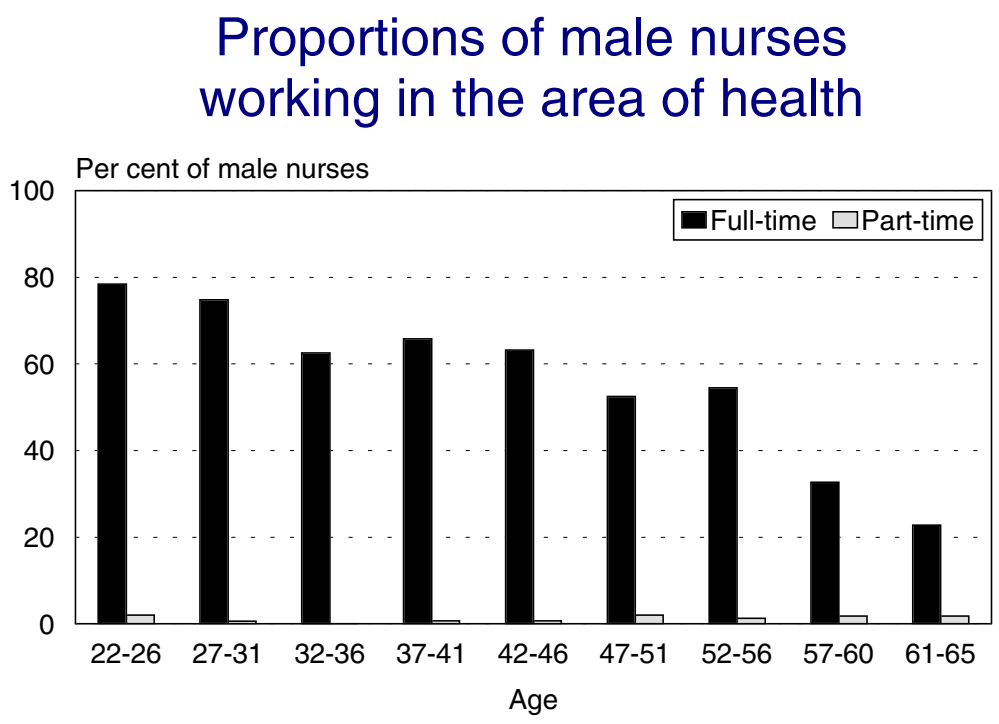
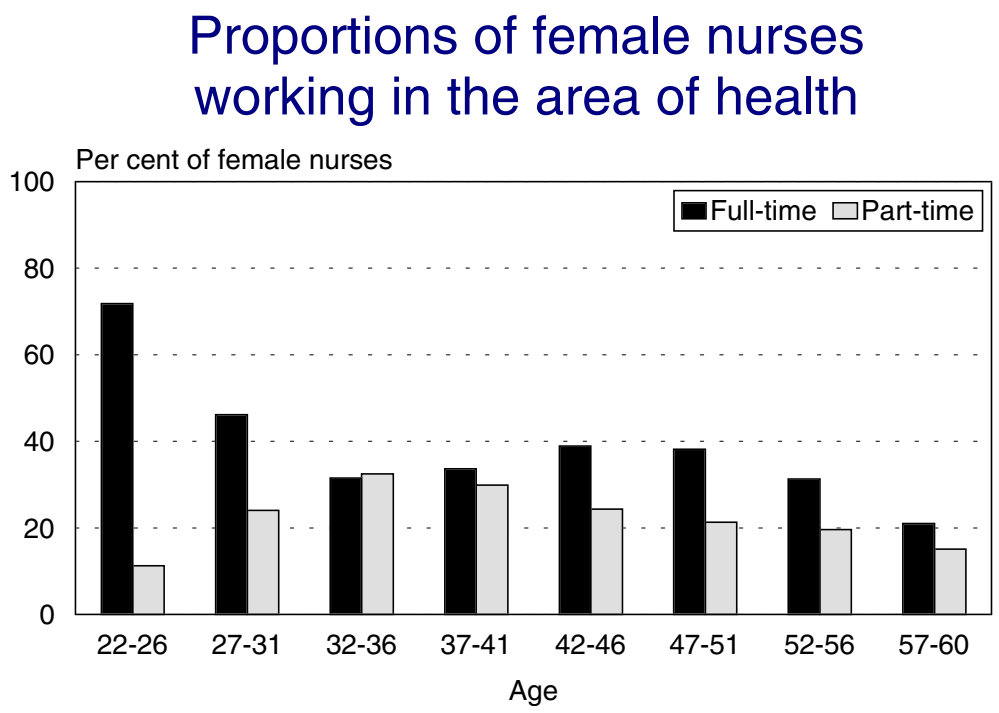


Figure 3.4



Chapter 4. The software

This chapter discusses the design of the Ready Reckoner software. It explains how assumptions about the nature of the users and their anticipated goals have determined structural elements of the design before describing implementation, evaluation and distribution.

1. Description of the software

The Ready Reckoner project is designed to help users construct models of labour. It is intended to be used to estimate the employment cost of particular kinds of National Health Service labour. It is not designed to calculate the costs of teams, still less the total cost of service provision. It can, however, be used to produce a range of unit costs.

Underlying the design of the software is the assumption that many potential users are not, at least initially, familiar with costing, and so must be given help in deciding which elements of cost should be included and which types of unit costs can be calculated. More sophisticated users may be primarily interested in the software as a source of up-to-date cost estimates.

Since the less experienced users are expected to need guidance as to which cost elements should be included in a calculation, a series of *Help* messages is incorporated in the model to address this need. However, all classes of users are likely to be interested in the sources of the estimates presented in the software; and one of the advantages of using a computer to provide these estimates is that such supporting material can be made available in a more convenient and speedier fashion than can be achieved in a paper publication.

The built-in cost estimate is, of course, based on current conditions in the Health Service. Users interested in organisational change, or users with access to some detailed cost data of their own, may wish to substitute their own figures for those built into the software. The software is designed to make it easy and safe to do this.

2. The Design

The cost calculations implemented by the program follow the form of a single rooted tree, in which the root is the name of a type of employment and the branches are various items of cost or determinants of unit costs. The branches can lead to other branches that provide the constituent cost elements of their parent branches. This sub-branching process can be repeated as far as it is necessary. As the user of the program selects a branch, a window or the part of a window appears, which displays the appropriate sub-branches or cost estimates.

To simplify the task of using the program, a consistent approach is taken to the layout of the information on the screen and to the variety of visual clues used. Where possible, the remoteness of a branch from the root corresponds to how far to the right of the screen information is placed. Wherever possible, information indicating the identity of a parent branch of some part of a calculation appears on the screen to help the users orientate themselves. Again, where possible, movement from a parent to a child branch is indicated by a suitable, (slow), visual effect. Use is also made of *pop-up* windows. Again, the position of the window on the VDU screen is intended to help to reinforce its relationship to other cost elements in the hierarchy of cost elements.

The general approach to screen design is reflected in the use of data validation checks, warnings, source citations and error messages. Question mark "?" help buttons and source "S" buttons are placed next to the data items to which they refer. Where possible, cross checks between values selected by a user are carried out with the relevant selections simultaneously visible on the screen. The colour scheme is chosen to help the user move through the various branches of a

calculation, but the user of the program does not have to depend upon colour vision to be able to use it effectively.

Users have the ability to overwrite the cost figures in the Ready Reckoner. Replacement figures are entered through the use of a dialog box, which is displayed in response to a mouse click on a button labelled “A”. When a replacement figure is used, it is indicated on the screen by the appearance of a prominent asterisk by its side. It is possible to revert to the default figures either for an individual cost element, or for all the costs within a particular type of labour, or for all types simultaneously. A facility is provided to allow users to annotate the screens of the software. Particularly, when overwriting a default value, the statement of the source of the default value is replaced by a message entered by the user. A message recording the change of value is automatically generated and the user is prompted to enter additional details of the change. This information is printed during an audit print. It is also available for inspection in just the same way as was the original source information.

With all interactive software there can be difficulties in keeping track of decisions that users take and which can affect results. To ease the problems associated with this, the Ready Reckoner can produce a report that records all the cost elements that have been included in a calculation. The asterisks that indicate that a default value has been changed on the screen also appear in the report. Users' annotations, entered in the current or previous usage, can also be printed. This printed material is meant to serve as an audit trail.

3. Software Selection

The Ready Reckoner software is written in an application development language called Toolbook, which provides a range of facilities similar to those provided by Visual Basic. In addition, using Toolbook, it is particularly easy to arrange a series of screen images in a manner that mimics the pages of a book. This feature is exploited to provide separate chapters for each employment type, and within each chapter, pages for each type of cost. Initial trials with the language produced a set demonstration screens. The results produced were encouraging, and it was decided to continue the project in the same language to avoid the delays that would accompany training the project’s programmer to use a different language.

4. The development process

The idealised account of the software development process assumes the prior existence of a specification stating exactly what the software is to calculate. In this project, there was no such specification. The research on costs continued throughout the life of the project, and this research provided the specification of the software. This meant that a prototyping approach had to be adopted. To some extent, this fitted in well with a chapter by chapter, (i.e. labour type by labour type), approach to the software; but it fitted less well when there were methodological changes to costing procedures. Such changes could entail the need to modify a range of pages in several different chapters. This problem was partially ameliorated by factoring out common elements in the costing of different labour types to provide a set of template screens that could be loaded with the cost data corresponding to particular types of labour. This complicated the software but made the process of continuous modification much easier to deal with. It also had the beneficial side effect of reducing the size of the software.

The problem of coping with changes in data values is an easier problem than coping with changes in the structure of calculations. Though it would have been possible to let the applied economic researchers directly modify values held in the Ready Reckoner, its complexity argued against this procedure. There would be too great a risk of making an accidental change to the system that could have indirect consequences. Instead, it was decided to load data values from free-standing spreadsheets. Data from these can be automatically loaded into the Ready

Reckoner, and the spreadsheets can be maintained without reference to the arrangement of data within the program.

5. Testing and evaluation

Testing the Ready Reckoner requires checking that the cost figures presented to the user are accurate, and it also involves checking that the various options afforded the user on every screen are consistent. The former proved less of a problem than the latter. Trivial calculations were easily checked by mental arithmetic, more complex ones were checked using a spreadsheet. In some cases the spreadsheet calculation was the same as that used on the Unit Cost programme, on others the calculations were prototyped on a spreadsheet before incorporation in the Ready Reckoner.

Checking the consistency of the information provided by the various pop-up screens and panel displays was much harder. It was time-consuming and required concentration. Though it was absolutely essential, it was not a popular task. The many different routes through the software make it very difficult for every single one to be checked. Thus it is essential to assume, as all commercial producers of software assume, that there will be some errors in the finally distributed version of the software.

Evaluation of the software was carried out by two distributions to volunteer groups. Twenty-five copies were distributed in November 1997 together with a *User Guide* and a questionnaire. Follow-up telephone calls helped to produce a very high response rate, and a range of useful comments. The feedback indicated that the basic design of the Ready Reckoner was satisfactory. The commonest problem encountered by users was that the screen was too large for users' VDUs. Although this could be surmounted by users increasing the resolution setting on their PCs, we responded by reducing the screen area occupied by the Ready Reckoner. Other changes associated with navigation from one screen to another were also made in response to this feedback. Some users also had problems with installing the software on their PCs.

The second trial distribution was to a smaller group of potential users with a special interest in the *professions allied to medicine*. This took place in February. The response from this trial distribution was encouraging, though some users still had difficulty installing the software.

Users also provided some feedback about the potential uses of the Ready Reckoner. As described in earlier chapters the principal objective was to provide a tool for those involved in the Human Resources and Effectiveness Research Initiative. It was anticipated, however, that others may find uses for the software. Trusts did express interest, particularly for using hte software in a personnel context, for estimating the costs of procedures and for planning purposes.

6. Distribution

Packaging and installing the software is carried out using a proprietary system called *Installshield Express,* which is a very popular and widely used; but it does require the user to have some familiarity with the PC file store.

An executable version of the Ready Reckoner must be distributed along with software called the Toolbook Reader as a single package. The Toolbook Reader can be distributed free of licence charge. Instructions for installing the Ready Reckoner are contained in the opening pages of the *User Guide* (see Appendix C).

7. Conclusion

Clearly we do not yet know what the outcome of putting the software into practice will be. However, if it is successful and found to be practical there are a number of potential future developments. These include:

- adapting the software so that it can be made available over the internet;
- providing more flexibility for users to vary long-term investment training assumptions;
- including the facility to reflect variations in turnover;
- including treatment costs;
- including more health service professionals;
- including social care professionals;
- allowing team costs to be estimated;
- including facility-based services; and
- putting together costs of care packages.

Even in the absence of such developments the approach provides a sound basis for estimating costs for a wide variety of health service professionals. Information is provided about vital long-term investment costs which are not likely to be available to those concerned with specific evaluations. The flexibility provided by the software means there are a wide variety of potential applications of the approach including evaluations of specific uses of health service professionals, exploring the cost implications of different patterns of working and changing the skill-mix in different settings.

Appendix A. Health service professionals included in the Ready Reckoner

1. District nurse
2. Community psychiatric nurse
3. Health visitor
4. Practice nurse
5. Community auxiliary nurse
6. Hospital staff nurse, day ward
7. Hospital nurse, manager, day ward
8. Hospital staff nurse, 24-hour ward
9. Hospital nurse, manager, 24-hour ward
10. Hospital auxiliary nurse
11. Community physiotherapist
12. Community occupational therapist
13. Community speech and language therapist
14. Hospital physiotherapist
15. Hospital dietitian
16. Hospital speech and language therapist
17. Hospital radiographer
18. Hospital occupational therapist
19. Therapy support worker
20. Pre-registration house officer
21. Senior house officer
22. Registrar
23. Consultant psychiatrist
24. Consultant surgeon
25. Consultant physician
26. General practitioner

Appendix B. Estimating multipliers for patient contact time

In order to allocate time spent away from patients or not on patient-related activity onto patient contact or related time we can use multipliers which are applied to the basic hourly cost. The aim is to ensure that these reflect the appropriate allocation of time so, for example, travel time is only allocated to visits and not to contacts in clinics. It is also important to ensure that time which generates separate outputs to patient care (for example, teaching) is not included as an overhead on patient care costs. We rarely, if ever, have a complete breakdown of time so we can be sure that all time is appropriately allocated. The assumption is made that all time relates directly or indirectly to patient care unless we have clear evidence otherwise. Thus, for example, study days, attendance at conferences, trade union activities and general administrative tasks are all assumed to be overheads on patient care.

The process by which multipliers are estimated in order to allocate time is illustrated below using district nurses' and consultants' time use information. These two examples illustrate the basic allocation of non-clinical time, the allocation of travel time to visits when information is available about the proportion of clinical time spent on visits, and the allocation of time which generates separate inputs, in this case teaching.

District Nurse time

Table A.1 shows the distribution of district nurse time based on tables 6.7 and 6.8 in Dunnell and Dobbs (1982).

Table B.1 Distribution of time of district nurses

Notation in equations	*Activity type*	*% of time*
F	All face to face contacts:	48
P	Patients' own home	38
C	Clinics etc	6
H	Hospitals	2
O	Other	2
N	Non-clinical activity	28
Tr	Travel	24

In order to establish loading: we need a multiple of face-to-face contact hours which reflect total hours worked (T). At its most basic this multiple (q) is such that:

$$qF = T$$
$$F+N = T$$

From table B.1 we have per cent of time use 48% face-to-face contact. So the proportions of time are:

$$F = .48$$
$$T = 1.00$$

so $N = 0.52$

To estimate the multiplier:

$$0.48 + 0.52 = 1$$
$$0.48q = 1$$
$$q = \frac{1}{.48} = 2.08$$

But we identified above that we want to allocate information above such that travel is allocated only to visiting time. To estimate clinic based contact time we need to remove travel time:

$$qF = T\text{-}Tr$$

$$q = \frac{T - Tr}{F} = \frac{.76}{.48} = 1.58$$

Thus when estimating the cost per hour of a District Nurse in clinics or other venues,
cost = 1.58 x basic hourly cost.

To add travel to home visit time we first need to identify all the time we need to allocate.

We want Np - proportion of time spent on non-clinical activity which is attributable to visiting patients in own home

Tr - time spent travelling

P - time spent on visiting patients at home

We have the values of Tr and P from table A.1. To estimate Np (the proportion of time spent on non-clinical activity which is attributable to visiting patients in own home) we assume the balance of non-clinical time reflects the balance of time spent in patients' homes and in clinics.

$$Np = \frac{P}{P + C + H + O} \text{ x } N = \frac{.38}{.48} \text{ x } .28 = .22$$

$$qP = Np + Tr + P$$
$$q = (Np + Tr + P)/P$$
$$= (.22 + .24 + .38)/.38$$
$$= 2.21$$

So the cost per hour of time spent in an individual's own home is 2.21 x basic hourly cost.

Consultants' time

In order to eliminate activities associated with outputs from teaching activities from our estimation of unit costs we deduct teaching time from total time.

Total time - teaching time = Treatment-associated time

When estimating patient related time (where no time is associated with travel:

$$\text{Multiplier} = \frac{\text{Treatment-associated time}}{\text{Patient-related time}}$$

In the case of surgery where ward rounds can be associated with time spent in surgery

$$\text{Multiplier} = \frac{\text{Treatment-associated time}}{\text{Operating theatre time}}$$

Appendix C. User documentation

Introduction to using the Ready Reckoner software

The 'Ready Reckoner' computer software has been developed as a framework to enable estimation of the costs of a range of health professionals. The range of health professionals includes a variety of grades of hospital doctor, general practitioners, other types of nurses, and professionals allied to medicine, such as radiographers and dietitians.

The 'Ready Reckoner' will allow you to estimate the total annual cost and a variety of unit costs, such as cost per year, cost per hour and cost per hour of patient contact. You can select the cost components you wish to include in the unit costs, and these may include salaries and related employment costs, investment and ongoing training costs, overheads and travel.

The software offers a range of built-in defaults for costs and working conditions based on national data where possible. It allows you to adapt the estimated costs to reflect local conditions and requirements by replacing these default values where the cost of specific elements or patterns of work are known to be different.

Installation

Please note that if you have installed a previous version of the Ready Reckoner, you need to uninstall it now by clicking the **Uninstall** icon.

To run the Ready Reckoner software you need:

An IBM-compatible PC

10 MB of free disk space

at least 4MB of random-access memory (RAM)

Microsoft Windows 3.1 or Windows 95 or Windows NT

To install the Ready Reckoner software:

Insert the disk labelled Ready Reckoner Setup into the 3.5 inch drive

For Windows 3.1

Choose **Run** from the Program Manager **File** menu

In the Command Line box type **A:\setup**

Click **OK** then follow the instructions that appear on the screen

[Alternatively, you can click on READYREC.EXE using File Manager.]

For Windows 95 and NT

Click on the **Start** button

Select the **Run** button

Enter **A:\setup**

Click **OK** then follow the instructions that appear on the screen.

Note that you should specify the directory to which the Ready Reckoner will be installed by clicking on the **BROWSE** button and selecting the drive and directory.

With a networked system, you may find it necessary to consult a network administrator. If you want several users to be able to work with the software at the same time, the file **READYREC.EXE** must be read only (the read only property attribute must be set).

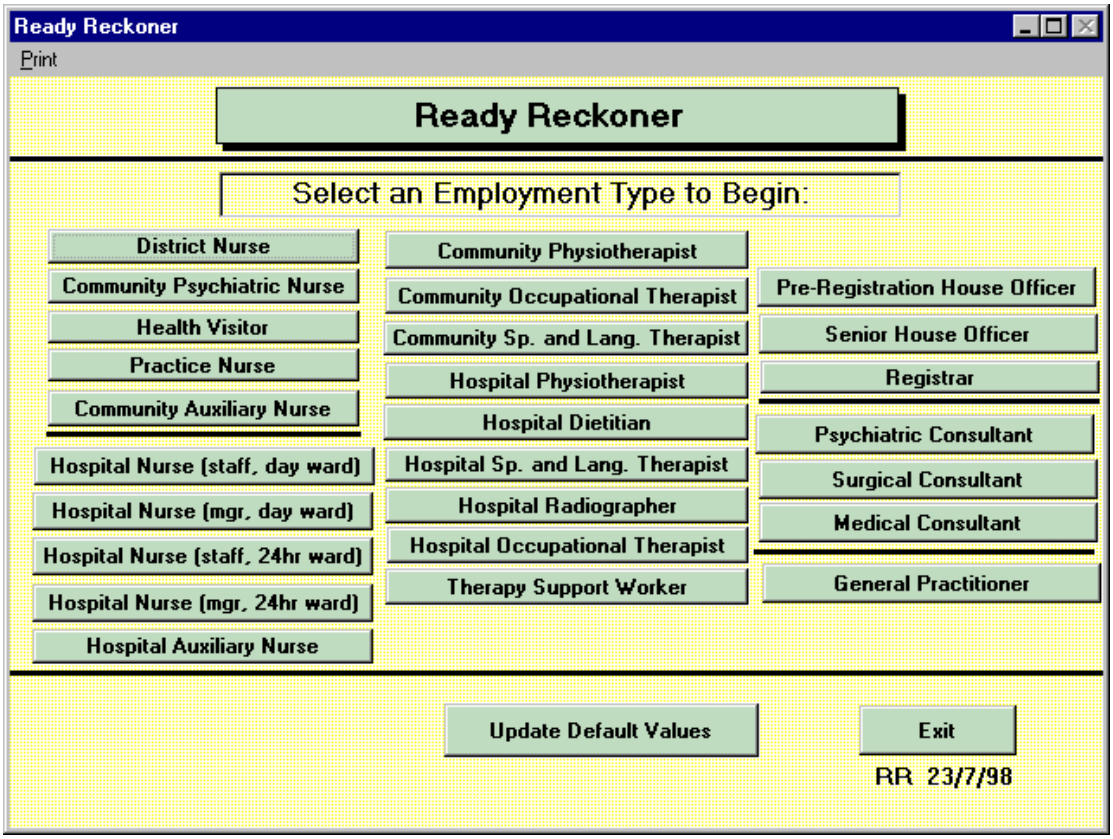
The installation program will lead you through a process that will install the 'Ready Reckoner' and create icons for running the program, and for de-installation.

Running the Ready Reckoner

Clicking on the icon created by the installation process starts the 'Ready Reckoner', which will present the index screen shown below. (Note: the appearance of the screens varies from one version of Windows to another.)

You can quit the program by clicking the **Exit** button on the bottom right-hand side of the screen.

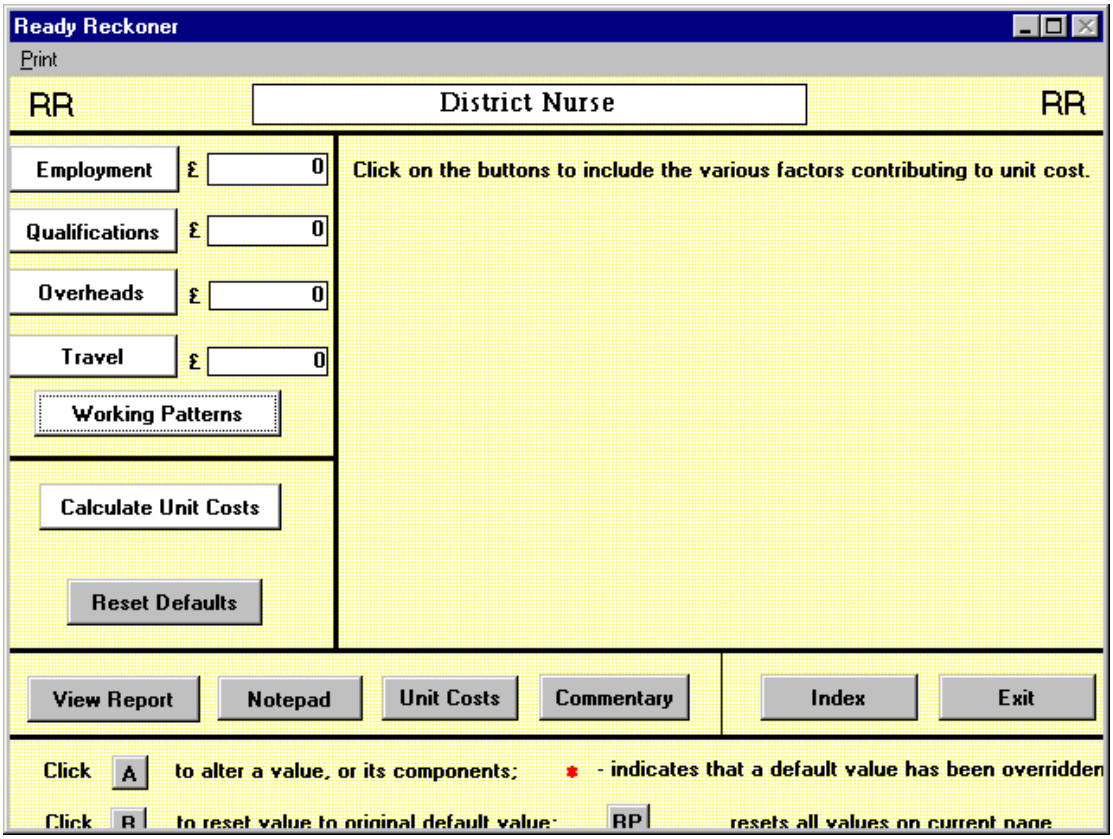
Figure C.1. The Index Screen



Update Default Values - Button not operational at present.

Click on the button bearing the text of the item you wish to cost. This will cause a screen, such as that shown below, to appear:

Figure C.2. The District Nurse Main Screen

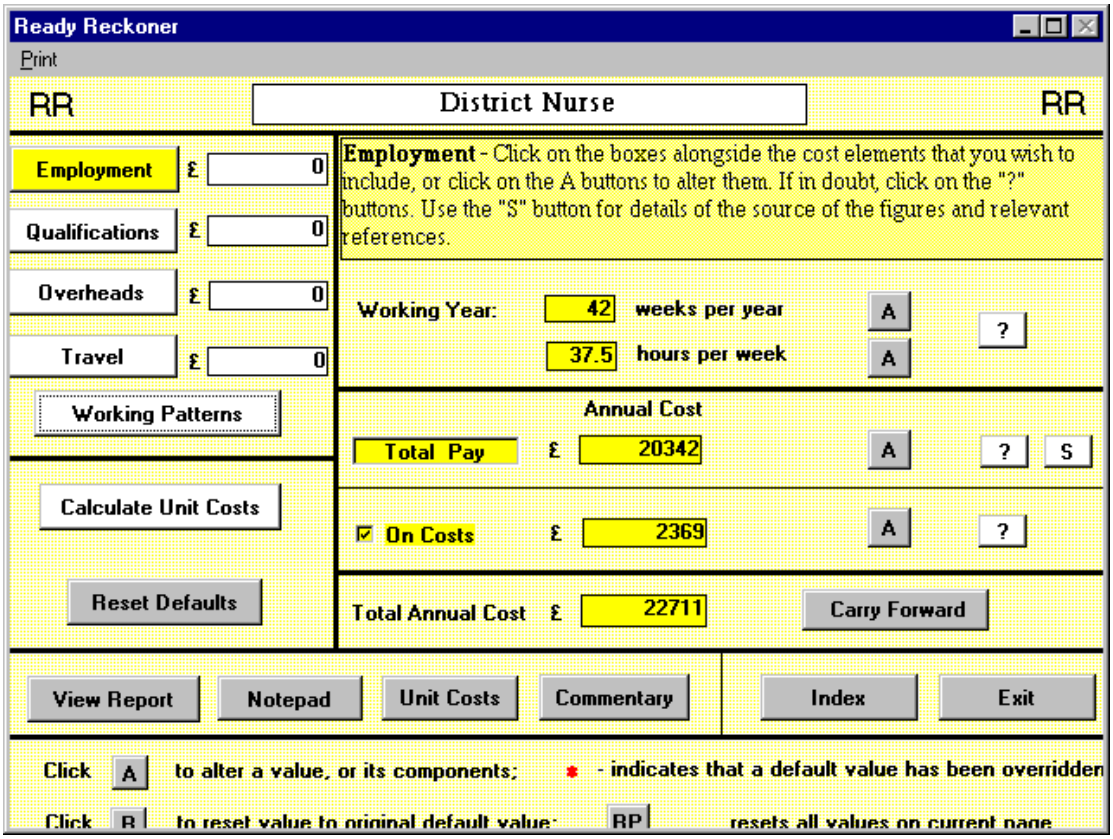


Selecting cost elements

In normal use, you will click the buttons on the left of the screen labelled **Employment, Qualifications, Overheads, Travel** and **Working Patterns** to enter the details of a costing exercise. After this, the next step will be to calculate a unit cost for the employment type by clicking the **Working Patterns** and **Calculate Unit Cost** buttons. You might also want to keep a printed record of the exercise by clicking on **Print...** on the top left-hand side of the screen. The other buttons on this screen are described later in the document.

From the District Nurse Main Screen, a typical action would be to click on the **Employment** button. This causes the right hand side of the screen to change and to allow you to specify employment details, as illustrated in Figure C.3.

Figure C.3. District Nurse Employment Screen



Entering data

The buttons labelled **A** may be clicked to allow the value in the adjacent field to be changed. For example, to change the value in the **On Costs** field, click the **A** button on the same line. This will display a new screen which allows the components of this **On Costs** figure to be altered, which is illustrated in Figure C.4.

Figure C.4. Salary On Costs

Salary On-Costs

Print...

Salary On Costs | District Nurse

A: National Insurance | B: Superannuation

Include National Insurance?

Percentage of salary contributed by employer

4 % A R

National Insurance £ 1554.9 ?

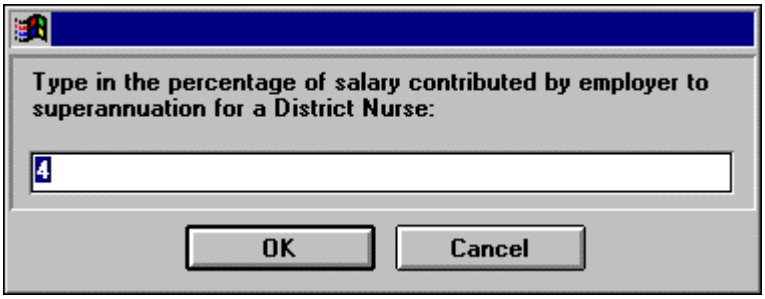
Superannuation £ 814 ?

Enter any additional employer on-costs here: £ 0 A R

Total Annual On-Costs £ 2369 Carry Forward RP

You now have a number of options regarding which components of the figure to include. For example, you may decide to alter the employer's percentage Superannuation contribution. To introduce your own figure in this way, click the **A** next to the employer's Superannuation percentage. A data entry box , Figure C.5, will be revealed:

Figure C.5. Data Entry Box



Key in the new value and click **OK**. Your own value will then replace the default value, and a red asterisk will appear alongside it to indicate that a default value has been overridden. The new value entered will then be used in subsequent calculations. If you wish to revert to the default value, click the button labelled **R** to the right of the **A** button. The default value will then re-appear and be used in subsequent calculations, and the red asterisk indicating a change to the

default value will disappear. If you have used the 'Notepad' button to annotate your changes, you should probably use it again to amend your annotation.

The **RP** button at the bottom of a screen can be used to restore all values on the current page back to default values.

Figures C.3 and C.4 illustrate the use of 'Check-Boxes'. They are used to select information to be included in a costing. Clicking any portion of the check-box either selects or excludes the corresponding value from a calculation. The values are included when the left hand portion displays an **x**. In the case of Figure C.4, National Insurance is included in the calculation of On-Costs, and in Figure C.3, the On-Cost amount is included in the calculation of total employment costs.

Clicking the **Carry Forward** button indicates that you have finished selecting or modifying the values on a particular page, and wish to move on to the next stage of costing.

When all required elements of the costs have been included, you must click **Calculate Unit Costs** to calculate and display the unit costs. This screen also allows you to apply a regional multiplier to the costs to reflect the increased or decreased costs of employment of those professionals working within or outside of London.

Other functions

From the screens illustrated in Figures C.2 and C.3 you can click on the following buttons:

View Report - Produces a summary of the data entered, which may be printed (see Figure C.6). Clicking the button causes a preview screen to be displayed. Current values can be compared with the default values. From this screen, you can select **Print** from the menu bar to print it. A button labeled **Unit Costs** allows you to view the unit costs and to compare these with the default costs.

Figure C.6. Preview of a Report

report

Print

District Nurse | 1998

Costs/Unit Estimation		Current Values £'s	Default Value £'s
Wages / Salary		0	20342
Salary OnCosts		0	2369
Qualifications		0	6113
Overheads (Revenue)		0	4271
Overheads (Capital)		0	1850
Travel		0	2215
Working Time	Wks / yr	42	42
	Hrs / wk	37.5	37.5
% time in patient contact		48	48

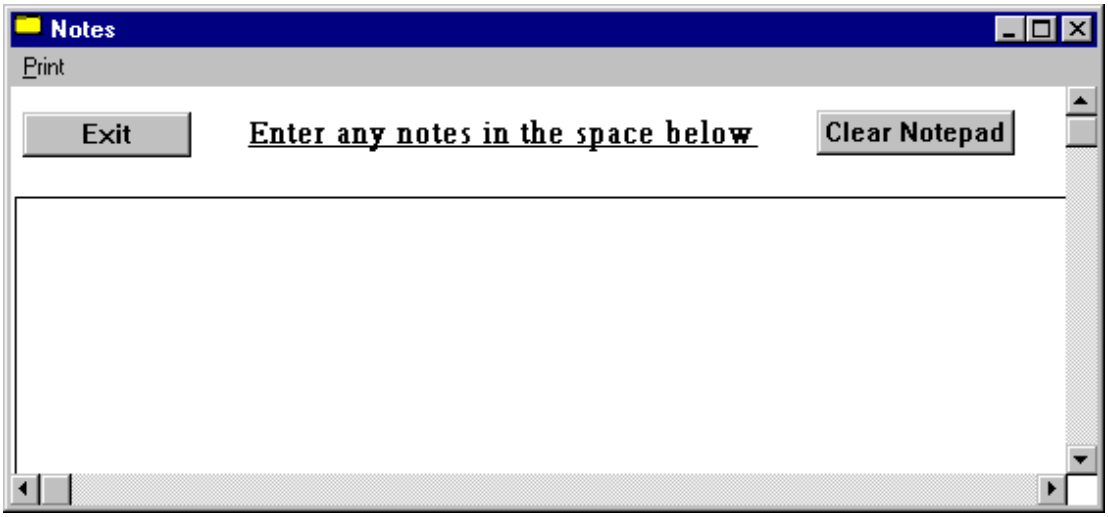
Unit Costs | Exit

Reset Defaults - Replaces any changes you have made to the values used in the costing exercise for your chosen type of employment with the supplied default values. This will cause any red asterisk on the screens to disappear. It will also delete the data you have entered!

Index - Returns you to the Index screen (see Figure C.1).

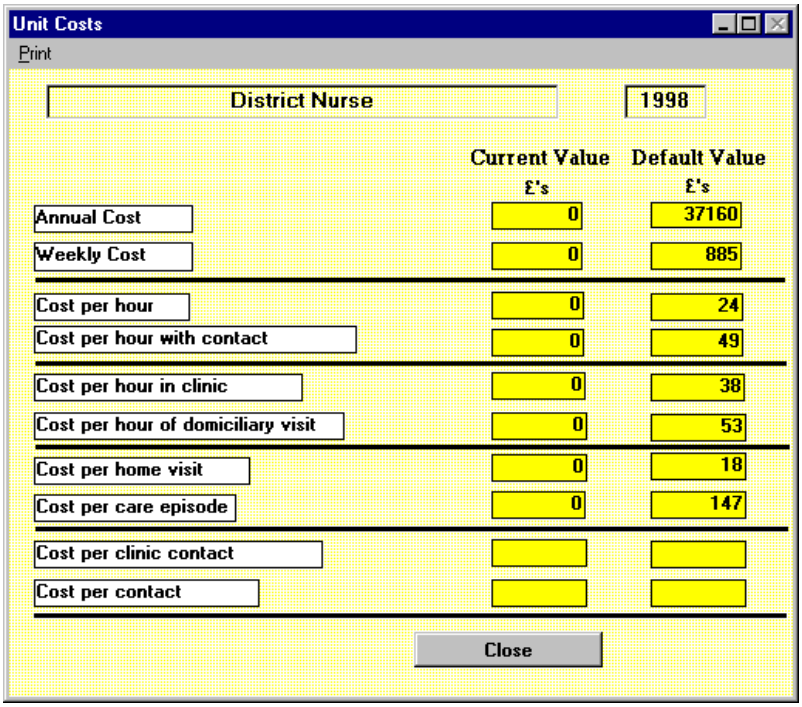
Notepad - Provides a means of annotating the software. Clicking this button reveals a screen which allows you to create and maintain notes associated with the selected employment type (see Figure C.7).

Figure C.7. Notepad viewer for annotations



Unit Costs - Displays a small viewer showing the unit cost figures based on the current data entered (see Figure C.8), and allows these to be compared with the default values.

Figure C.8. Unit Cost viewer



Commentary - Displays a short definition

Exit - Leaves the 'Ready Reckoner' program.

Print... on the top left-hand side of the screen allows you to print the current screen.

Help with the general use of the software is provided in the panel near the top right-hand corner and in the bottom margin of the screen in Figure C.2.

Further information

If you have any difficulty installing or running the 'Ready Reckoner' on your system, please contact Andrew Fenyo at the Personal Social Services Research Unit (telephone: 01227 827610).

If you would like to comment on the software and its embedded data, or discuss the project in general, please contact Jane Knight at the Personal Social Services Research Unit (telephone: 01227 824015; email: J.Knight@ukc.ac.uk).

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