

Health Service Workforce and Health Outcomes: A Scoping Study

*Report for the National Co-ordinating Centre
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Overview

The context for this scoping exercise is the increasingly prominent profile that workforce issues have in the delivery of effective, timely and appropriate health care. In a Refreshing of the National Listening Exercise carried out by the SDO Programme during 2002, workforce issues emerged as the top priority for further SDO research. They have come to the fore for a variety of reasons. Problems concerning the recruitment, retention and morale of staff have increased in recent years. At the same time attention has been drawn to the relationship between workforce issues and the organisation and delivery of health care in a number of documents, including *The NHS Plan* (Department of Health, 2000e) and the National Service Frameworks (NSFs). Along with other initiatives, this scoping exercise was designed to inform the SDO's Workforce Commissioning Group about research priorities in this area, and enable it to commission appropriate empirical research.

This report assesses the impact of different mixes of medical and nursing staff on quality, clinical effectiveness, health outcomes and length of hospital stay. Evidence on variations in outcomes between professional groups are examined.

Key conclusions

- **Ratios** Most studies revealed that better health outcomes were associated with higher doctor:patient and/or nurse:patient ratios. Some methodological weaknesses were identified.
- **Substitution** Because of the limited scope of the studies it is difficult to form a general conclusion. However, most studies suggest that patient outcomes have changed little in some areas where nurses substitute for doctors.
- **Skill mix** Quality of the studies was generally poor in this area, and results were contradictory.
- **Specialisation** Generalisation proved difficult because while studies were of high quality they were also issue specific. Findings suggest that there is little added value in specialists being involved in the treatment of common chronic conditions, but more value in areas where care was more specialised (such as cancer).
- **Integration** It was commonly found that length of stay and patient satisfaction improve with greater staff collaboration and co-ordination.

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- **Well-being** Evidence here was very limited, but it appears likely that there is a relationship between poor health outcomes and increased staff stress, frequent job turnover and lack of well-being.

More comprehensive research is needed to estimate the true relationship between staffing levels, skill mix and outcomes. The heterogeneity of studies makes interpretation and synthesis difficult.

The Report

Section 1 Summary of the research evidence

1.1 Quantity of the workforce

Forty-seven studies were retrieved (four from the UK) which examined workforce numbers in different ways:

- workforce to population ratios
- workforce hours
- availability of the workforce
- addition of a pharmacist.

Overall, six out of eight studies reported that higher nurse-to-patient (five studies) or doctor-to-patient (one study) ratios were associated with a reduction in mortality, failure-to-rescue events, infections, re-admissions and complications. The other two studies, which focused on night-time nurse-to-patient ratios, found inconsistent results for length of stay (LOS) and complications, and no significant difference in mortality. All of the studies were non-experimental although the majority made attempts to adjust for patient characteristics.

Fifteen studies focused on workforce hours per patient day: nine reported results by all staff hours and the relationship with different patient outcomes, eight of these focusing on the overall nursing staff levels mainly in secondary care. They were non-experimental with variable case mix adjustment and had conflicting results. The two studies with the most comprehensive case mix adjustments found a significant increase in pressure ulcers but not for six other adverse events or mortality.

Seven of the 15 observational studies based in secondary care investigated Registered Nurse (RN) hours per patient day: six found a significant reduction in pneumonia with an increase in RN hours but the largest and best study did not. The results for other complications and adverse events were inconsistent. However, this could be due to the low power of some to detect a change in rare outcomes. Two studies investigating Licensed Practice Nurse (LPN) hours found no association with adverse events and medication errors even after adjustments were made for patient and hospital characteristics.

Two studies examining the quantity of the workforce in nursing homes showed inconsistent effects on resident outcomes. One

found that increases in numbers of therapists and LPNs and a decrease in nursing aides were risk factors for infections; the second found that increases in licensed nursing hours (RNs and LPNs) decreased the risk of mortality. Both studies stated that adjustments were made for patient and hospital characteristics.

Two UK studies found a significant relationship between the GP-to-population ratios and mortality. However, they made inadequate adjustments for the severity of condition of patients. Taken together with another three studies which did not find the same relationship but which had significant weaknesses, firm conclusions cannot be drawn.

Of particular policy relevance is a study in a general internal medicine teaching service which investigated the impact of a New York State regulation, restricting house staff working hours to less than 80 hours per week. This found that overall in-hospital complications nearly doubled. Two studies, one in nursing homes and the other in hospitals, found that increased licensed nursing hours (RN and LPN) were associated with a lower risk of death and adverse events respectively. Adjustments were made for both patient and institutional characteristics.

A review and three primary studies explored the 24-hour presence of the workforce in the intensive care unit (ICU) and in trauma centres (two studies) and found that high-intensity staffing led to a significant reduction in ICU and hospital mortality and LOS for critically ill patients. However, in-house 24-hour presence policies for surgeons in trauma centres was not found to be associated with reductions in mortality except in the more severely injured patients.

Four US studies examined the impact of a pharmacist joining the hospital or medical centre team and found that both LOS and the number of adverse drug events decreased.

1.2 Substitution

1.2.1 Primary care

Two systematic reviews of trials found that patients were more satisfied with nurse practitioners (NPs), who had longer consultation times and made more investigations, than with general practitioners (GPs). Thus the potential savings of using NPs may be counteracted by lower productivity. Several primary studies found that NPs and medical practitioners achieved similar outcomes in managing open and closed wounds in rural areas, in patients with type II diabetes, in inserting IUD contraceptive devices, in handling acute minor illness, and in

running a telephone triage system (although this last study was very weak).

1.2.2 Secondary and tertiary care

Several poor-quality studies examined nurse-for-doctor substitution in hospital settings. There is some evidence that nurses can manage outpatient diabetes clinics and insert percutaneous endoscopic gastrostomies. Randomised controlled trials (RCTs) suggest that Parkinson's disease nurse specialists achieve similar outcomes to specialists and that clinical nurse specialists can manage people with arthritis, suture minor lacerations, and treat the eye condition chalazion.

In inpatient settings, similar outcomes were achieved for patients in medically directed wards and NP-managed wards. An RCT showed that nurse-led follow-up of patients with lung cancer led to better clinical outcomes. Another found that nurse-led routine pre-operative assessment achieved similar clinical outcomes and also reduced unnecessary tests. Nurses also have been shown to perform as well or nearly as well as doctors in removing femoral sheaths post angioplasty. However, there was some resentment about calls on senior nurse time. Similarly, weak studies indicate that a suitably trained clinical nurse specialist (CNS) can perform accurate, routine, non-complex cardiac catheterisation and another study that they can peripherally insert central catheters.

Several of these studies were conducted on just one nurse specialist. Few have attempted to explore the degree to which this could be extended.

1.2.3 Maternity care

The research suggests that the substitution of midwives for doctors in low/average-risk pregnancies is at least as safe, effective and acceptable to women as traditional medical care models, if not more so. Eleven studies came from North America, eight studies came from the UK, and four studies came from other countries. Several of these were RCTs.

One systematic review found that midwifery care was as good as that provided by obstetricians and physicians. Fourteen studies examined the substitution of midwife-managed care for obstetrician-managed care. The controlled trials of low-risk pregnancies, showed women under midwife care received fewer technological assessments, fewer interventions in labour and delivery, were more likely to have a natural birth, and were less likely to have an instrumental vaginal delivery or a perineal tear, had similar or reduced rates of morbidity, complications, Caesarean section, and were equally satisfied with care. One

trial reported higher birthweight under obstetrician care, while another showed a lower rate of admission to the special care baby unit under midwifery care. A further trial reported higher incidence of breastfeeding and fewer separations of mother and baby under midwifery care.

In higher-risk pregnancies two studies found that despite higher rates of complications under midwifery care, there were higher rates of natural births with fewer Caesarean sections and similar infant outcomes between the groups. One looked at high-risk home births for which midwives had higher antepartum and intrapartum death rates, while the infant mortality rates were similar.

For the studies where risk status was not clear the maternal outcomes of labour and delivery were generally similar for both groups. The midwifery groups had better infant outcomes in terms of lower infant mortality and higher average birthweights. Satisfaction was higher for midwifery care where measured.

1.3 Skill mix

The literature (two reviews, 18 primary studies – two from the UK) on the effect of skill mix on patient outcomes is generally of relatively poor quality and gives contradictory results. One review found more evidence that a higher proportion of RNs (or other qualified staff) results in improved patient outcomes. Evidence from primary studies supports this assumption by finding that a higher proportion of RNs is related to lower adverse events, reduced LOS for medical patients and improved pain control. This relationship, however, is hard to quantify precisely and may be non-linear, with one study showing a reduction in quality as the proportion of RNs reaches very high levels. No convincing evidence of a relationship between RN proportion or skill mix models and mortality rate was found. However, a recent US study found a correlation between the proportion of RNs holding Bachelor degrees and 30-day mortality and failure to rescue (a 10 per cent rise in RNs educated to degree level was associated with a 5 per cent decline in mortality).

1.4 Volume of activity of workforce

Six literature reviews and 19 subsequent primary studies (mostly from North America) were retrieved which examined the relationship between the volume of procedures carried out or patients managed by professionals and the outcomes.

In some procedures, there is reasonably strong evidence of a relationship between volume and improved patient outcomes.

These included AIDS treatment, surgery for pancreatic and oesophageal cancer, abdominal aortic aneurysm and paediatric cardiac procedures. The relationship was less strong for procedures such as CABG, angioplasty, carotid endarterectomy, other cancer surgery and orthopaedics. In these areas health gains may be achieved by encouraging health care professionals to specialise more and so reduce the numbers of clinicians carrying out low volumes of procedures. However, these effects appear only to be truly substantial in certain diseases and procedures. Therefore, this should not be taken to mean that general concentration of services is desirable or that it will improve outcomes automatically. In several of these procedures and conditions there is doubt whether associations are causal.

1.5 Specialisation of the workforce

Fifty-five studies were considered in this area, mostly from the USA and the UK and mainly examining medical practice.

One of the most commonly studied areas was cardiovascular disease. Overall these studies (seven) suggest that better outcomes (lower mortality rates) and lower LOSs are achieved by care for patients with acute myocardial infarction (AMI) being provided by cardiologists or specialist teams rather than by general physicians or general practitioners, while in hospital and after discharge. There is some evidence that much of the specialist advantage is due to the greater use of guideline-supported therapies than non-specialists. Similar results are found in other areas such as the management of heart failure (three studies) and vascular surgery for abdominal aortic aneurysm (three studies) and ischaemic stroke (one study).

Two reviews of research in several cancer sites (such as breast, ovarian, lung) found that there is some evidence of better outcomes if management is by specialist teams. Palliative care delivered by specialist palliative care teams also appeared to result in better patient outcomes. However, specific tasks within cancer care can be delivered as effectively by less-qualified staff. For example, trained non-physician endoscopists carry out sigmoidoscopies as accurately as board-certified gastroenterologists. Also supervised surgical registrars can perform rectal surgery for cancer of the rectum as well as surgical consultants.

Eight studies on aspects of emergency care were considered. These indicate that trauma patients may have improved survival with more specialist (A & E type) staff. Resuscitation outside of hospital by paramedics (especially those with medical back-up) achieves better outcomes than by technicians alone.

Similarly, critically ill patients were more likely to survive if a specialist medical or nursing team transported them.

Specialisation, however, did not always deliver improved outcomes. Several individual studies that compared specialist and generalist care for common and chronic conditions (for example, musculoskeletal) found that there is little evidence of added value and that generalists and specialists achieve similar outcomes in medical settings, particularly if they have a special interest in the condition (such as asthma). Primary care needs of patients attending A & E are better dealt with by primary care physicians, and at lower cost, than when seen by A & E doctors, and in North American walk-in centres interns performed as well as staff physicians. However, for rarer and more serious situations (such as appendicitis) specialists achieved fewer adverse outcomes.

Several trials have looked at specialist epilepsy nurses compared to routine care but while it is clear that information and advice are better recorded and the service is acceptable to patients, the studies were not robust enough to provide reliable information on patient health outcomes. Diabetes nurse specialists have been shown to improve outcomes and reduce costs in a UK hospital setting and a large trial found that patients receiving care from community-based nurses specialising in Parkinson's disease had equivalent outcomes and an improved sense of well-being compared with those managed by their GP.

Specialist infusion nurses may also have a lower rate of complications (for example, removal and leakage) with vascular infusion devices than general nurses.

The evidence was too weak to assess the outcome of nurse anaesthesiology, although there is some evidence that medically directed anaesthesiology may reduce mortality.

Overall, while there is relatively strong evidence of the benefits of specialisation in the delivery of some cancer, cardiology and emergency care, there is an absence of good evidence in nursing and other areas, and few controlled trials. Also, it is unclear to what extent these findings are generalisable to a larger workforce, beyond the innovators.

1.6 Collaboration and co-ordination in the workforce

Eight studies examined collaboration and co-ordination of the workforce. The reviews reported an increase in patient satisfaction and a reduction in LOS when staff collaboration was greater. Three of the observational studies found that patient

mortality fell with collaboration and that patient satisfaction, re-admission rates and LOS were also found to have a significant relationship with collaboration. Studies were limited by the use of inpatient mortality data, historical controls, and poor response rates.

1.7 Well-being of the workforce

Seven North American studies explored the relationship between staff job satisfaction, stress and burnout, and patient outcomes. Some evidence from three studies suggests that nurse job satisfaction is associated with patient satisfaction but the studies are weak and the direction of causality unclear. Two cross-sectional studies reported a positive association between nurse stress levels and medication errors, patient falls and patient satisfaction. However, these were not very reliable and it is possible that the stress is caused by the patient outcome or other intervening variables. Two studies examined the relationship between staff turnover in nursing homes and patient outcomes. One found a positive association between high RN turnover rates and infection rates, while the other found no link with mortality.

1.8 Day of admission

Two North American studies using administrative data reported that mortality was higher for patients admitted at weekends compared to those admitted during the week.

Section 2 Policy and research implications

2.1 Policy implications

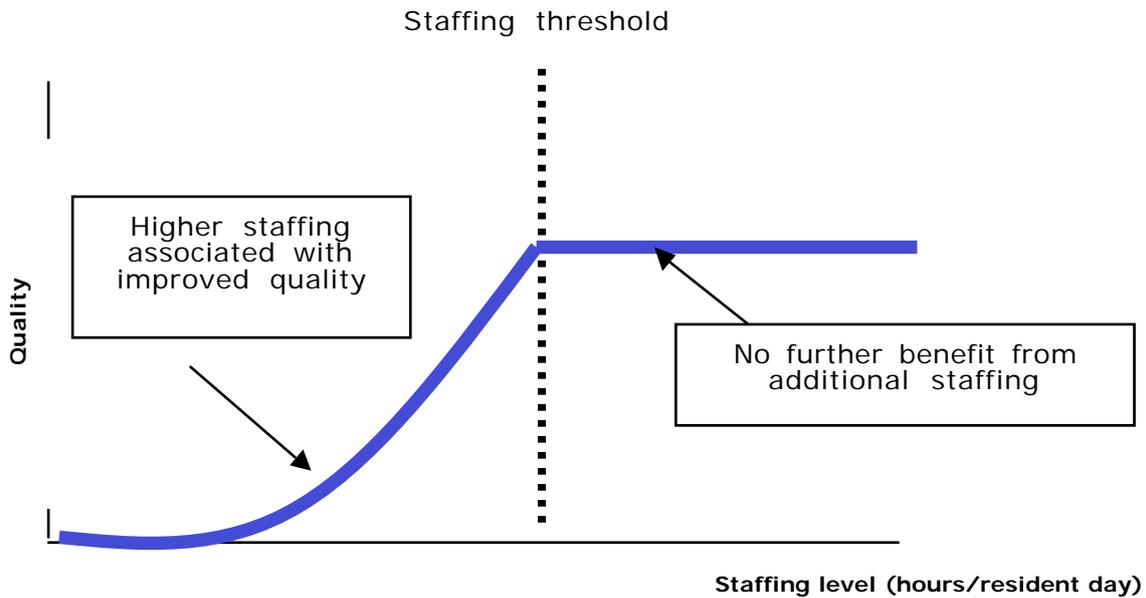
It is clear, both from the study of policy documents and from the interviews, that the driver for the NHS at present is that of activity, rather than outcomes, and that staffing decisions are being made on that basis. Relatively crude assumptions are made about workforce needs in relation to increases in activity rates. However, there appears to be a growing desire for a more sophisticated approach. As Workforce Development Confederations (WDCs) and care groups mature they will increasingly come to expect to be able to model the likely effects of workforce scenarios on expected outcomes and costs.

Frequent reference was made in policy discussions to one or more studies suggesting that more doctors per head of population results in reduced mortality rates. The methodological weaknesses of these studies and the uncertainties around these estimates do not appear to be appreciated. Even if these relationships are valid, the cost-effectiveness of this strategy and the implications for individual speciality numbers have not been sufficiently considered.

There is greater and possibly more robust (though not conclusive) evidence that higher nurse staffing levels and training/qualifications can improve the outcome of care in hospitals and other care settings. This prompted the recent introduction of the mandatory nurse:patient ratios in California. The results of the evaluation of this social experiment are awaited with interest, although it can be difficult sometimes to generalise from health services research findings in the USA to a UK setting.

As Figure 2.1 illustrates, careful research is required in order to estimate the true relationship between staffing levels or skill mix and outcomes. It may be, for example, that there are large initial gains to be made by increased staffing levels, but that these diminish or even reverse, resulting in reduced efficiency, as investment increases. Given that there are several ways to improve outcomes, it is important for policymakers to know the conditions under which increased staffing and skill mix are a good use of resources.

Figure 2.1 Illustration of staffing threshold



The area with the most reliable and consistent body of knowledge is maternity care. Several RCTs demonstrate that midwife-led services provide at least as good and usually better pregnancy outcomes than obstetricians, for women who are not at high risk of complications. This should prompt serious attention to the reconfiguration of maternity services away from the more expensive hospital settings and towards midwife-led care.

There is also reasonably good evidence that specialist provision can improve outcomes of care in a number of conditions. However, this is confined mainly to the more extreme or severe end of the spectrum. For more common and chronic conditions, care by generalists may not only be more effective but also more cost-effective. It is therefore important that the trend towards specialisation is carefully focused in areas where it is more likely to improve outcomes. Similarly, there are significant potential gains in concentrating activity in order to achieve higher procedure volumes in certain conditions, but by no means the bulk of health care. Thus it should not be seen as a strategy that will automatically improve quality.

In the UK, although the nursing workforce is growing it is being stretched over more services and over an increasing range of role specialisation and substitution). These new services and roles, by pulling staff out of more traditional settings, may result in a reduction both in the levels of staff in hospital services and in the skill mix of these services, which may negatively impact on outcomes. Because the entry gate to

nursing has been significantly widened as a result of *Making a Difference* (Department of Health, 1999) it is possible that as the more qualified and talented nurses are 'creamed off' for more specialist roles, the remaining core of ward staff could become on average less intellectually able. The consequent 'residualisation' of the ward staff may result in a deterioration of standards and outcomes. It is therefore important that research examines whether there are more general unintended adverse consequences to extending the role of nursing. It also means that research to evaluate such initiatives should have a broad scope so as to pick up these system effects.

This should remind policymakers and trust boards alike that even though at a task level substitution can make sense by increasing the proportion of less-qualified staff and non-professionals in the workforce providing the routine care, it may be that the quality of care falls. It is possible that the level of surveillance or sensitivity to signs and symptoms suggestive of complications, or the capacity to respond to an emergency, is diluted to a level that impacts negatively. If, as some work suggests, higher ratios of qualified nurses result in fewer complications, and a reduced re-admission rate, then trusts should cost these factors into their skill mix equation.

On the other hand, there is a risk that some of this literature will lead prematurely to policy conclusions and the establishment of arbitrary staffing ratios which are inflationary and do not improve patient care sufficiently to justify the costs. Such regulations, if contemplated, let alone implemented, have to be both evidence-based in terms of their costs and benefits and carefully costed at the system level.

While the move towards eroding arbitrary professional demarcations is to be welcomed and could lead to more efficient deployment of staff, care must be taken not to extrapolate too much from studies, often based on the single practitioner, which demonstrate that they can successfully take on some tasks from another professional. Firstly, it is not clear to what extent such successful substitution reflects the particular skills, talents and enthusiasm of the individuals and settings involved. If significant, these factors could have implications for successful replication elsewhere. Secondly, some nurses have concerns that if patients receive increasing amounts of care from health care assistants, their access to information about their condition and prognosis may decrease. Finally, by conceptualising health care as a series of discrete tasks which can be distributed to the cheapest or most available member of staff who can do the job to a certain standard, there is a danger that some of the holistic and patient-centred aspects of care may be neglected.

There is also the risk that as nurses and other health professionals become more 'vertically flexible' (able to take on the tasks traditionally done by people who are more qualified), they might lose their ability to move across areas of care ('horizontal flexibility'). It goes without saying that substitution may not be as efficient as anticipated because of the extra time that staff in new roles (nurse practitioners, for example) may take to carry out the same tasks, the costs of supervision, and also the uncertainty about how those released by substitution (such as GPs) are using their time. There is little evidence on the extent to which this increases productivity.

Another area where the research findings may usefully provoke some policy development is the potential for involving pharmacists in care teams. Pharmacists are possibly one of the most unexploited skilled resources in health care and their closer involvement in the planning and delivery of care may yield substantial benefits.

2.2 Implications for research

2.2.1 Quantity of the workforce

It appears that there may be a dose–response relationship between the nurse-to-patient ratio and patients' outcomes studied. However, what is unclear is the shape of the curve and the speed with which it tapers off (marginal return to increasing nurse numbers is likely to fall). More and better research in this area in the UK will be important in influencing target ratios.

Most research in this field examines one professional group or even subgroup (such as RNs). It would be interesting to investigate the effects of all key workforce-to-patient ratios and the influence they have on patient outcomes. Interactions between staff:patient ratios would need to be explored.

It is also possible that part of the relationship between staffing ratios and outcomes involves other processes or contextual factors, such as the organisation of nursing services, skill mix, the practice environment and institutional characteristics. So further research controlling for and/or exploring such factors would increase our understanding of this relationship.

A systematic review that comprehensively pools the research on different staffing ratios and patient outcomes may be valuable. However, given the methodological heterogeneity of the studies, and the lack of detail of what the staff are actually doing in the different settings, it is not clear how easy it would be to interpret the results of such a synthesis. To answer some of the questions reliably, more prospective studies and

controlled experimentation are needed to examine the effects of different workforce:patient ratios, in different settings, on patient outcomes, while controlling for potential confounders.

Most studies in this area report only the title or qualification of the nurse or other practitioner (for example, RN or health care assistant). This fails to acknowledge that what the person does and how many hours people work may differ between wards and institutions. Many studies also did not measure experience alongside qualifications.

It is likely that the impact of different staffing levels may differ according to disease severity or levels of patient dependency. Consideration of patient risk levels and the interaction between this and staffing levels is worth including in future research. This may also allow better targeting of investment in levels or skills of staff.

Future research needs to concentrate on a broader range of validated and important patient outcomes, other than mortality, that may be sensitive to differences in the workforce. Quite a lot of work has been conducted on identifying, for example, nurse-sensitive patient outcomes which may be worth synthesising.

If the workforce:population ratios are not related to patient outcomes, further investigation of the possible reasons why increases in supply may not be producing improvements in health are needed.

RCTs that control for a wider range of possible influential factors are needed to explore more reliably the effect of in-house 24-hour policy in trauma centres and to explain why any particular effect is found.

2.2.2 Role of pharmacists

There is growing evidence that pharmacists are an effective and hitherto relatively unexploited resource in the NHS. However, most of the research we reviewed – for example, on adding pharmacists to a team – originated in the USA and the results may not be generalisable to other health systems. Further research could usefully explore and evaluate the new and extended roles of pharmacists in hospitals, primary care and the community. We need to identify what these new roles entail and whether the experience, training or grade of the pharmacist is important to perform the role. If pharmacists do play an important role in the team, examination and perhaps revision of the current training and preparation for this role would be useful.

2.2.3 Substitution

There is clear evidence that some professions can substitute equally effectively for others (for example, nurses for doctors). From a policy perspective the issue is not just whether substitution can result in a less differentiated workforce with at least similar outcomes, but what might be the resource implications of this substitution.

What do doctors do when some of their activities are replaced by non-doctors? Do they shift their activity to other things they did not do before, increase activity, spend longer doing the same type of things as before? And what is the effect of this on quality and cost of care? Most substitution studies are micro-evaluations and do not look at the upstream and downstream implications. We need more meso- and macro-studies looking at the 'ecology' of the workforce.

Research is also needed on the more general effects of substitution on the quality of care. Much of the research into substitution reduces consideration of what health professionals do to a series of tasks or activities and then evaluating whether these tasks can be performed equally well by other professionals. It largely ignores the possibility that the task was part of an episode of care or an interaction which dealt with broader concerns than the carrying out of that task. For example, it might have provided the opportunity to find out more about the patient or for the patient to express concerns about their health. Evaluations rarely examine the broader outcomes and how patients perceive them.

The one area where the research evidence has been consistently of higher quality is that comparing the outcomes of midwifery and obstetrician-led maternity care.

Piloting the more successful models within the NHS in prospective studies on a local or regional scale may be desirable, however, before committing to a wider plan of implementation. This needs to be accompanied by economic evaluations to assess the relative costs of shifting models of care. Research is also needed to develop a better risk assessment tool for identifying the minority of women whose risk of a complicated pregnancy or delivery would indicate referral to obstetrics-led care.

2.2.4 Skill mix

More robust studies are needed to explore the effect of different skill mix on patient outcomes. These should explore the relationship between quality and cost of care and skill mix. This research will need to be more methodologically sophisticated and also consider interactions between different

staff and skills, the importance of organisation and context and other management factors such as leadership, the way staff are deployed and collaboration.

Multi-institutional studies for larger and more diverse patient populations will be needed to ensure the generalisability of the findings. Longer-term studies and prospective studies are also required to be able to observe the effects on outcomes over time.

Specifically, we need to replicate the US work on nurse educational level and outcomes, in other settings using prospective designs. The specific nursing interventions and other factors that may make a difference in patient outcomes have not yet been clearly identified.

There is also a need for comprehensive studies of the skill mix of other professionals such as therapists (about which hardly any studies were found).

It is difficult to produce defensible prescriptions for the optimal staffing mix. Not only is the evidence base insufficient to indicate the expected quality of care and outcomes associated with different staffing levels and skill mix, this will vary by case mix. Thus a flat-rate licensed nurse:patient ratio, without consideration of patient acuity, may over- or underestimate staffing needs in a particular unit or institution at a given point in time. Flexible staffing systems that take into account daily patient severity would be important for determining adequate and cost-efficient staffing.

2.2.5 Volume and specialisation

More controlled prospective research is needed to estimate the likely effects of increasing provider volumes of key procedures. The effect of concentration of services should be carefully evaluated to assess the impact on health outcomes. In addition, methods of assessing the trade-offs between outcomes and (say) access need to be considered. The interaction between clinician volume and health care organisation volume needs to be better explored, as do the reasons for the variations in the relationships found.

Finally, ways of improving the outcomes of lower-volume providers should be investigated by attempting to identify in clinicians achieving good outcomes those behaviours that are transferable and capable of being systematised, for example, in practice guidelines.

There is considerable research already on the impact of specialisation on outcomes. More research could usefully be carried out to see if the findings are generalisable – to UK

settings, to more routine situations which move beyond the deployment of the single specialist (or small numbers of them), and to other conditions. This will permit a more thorough examination not only of whether specialisation can deliver better outcomes but also the extent to which this is likely to be the case for a larger group of professionals who are not the innovators, early adopters or enthusiasts. This research will need to look more carefully at skill levels, training, and the degree of supervision. There is also a need to assess the costs of such specialisation and the effects of moving professionals from more general to specialist activities on the settings they leave behind. Such research should try to use more controlled or experimental approaches in order to better account for differences in case mix and setting.

2.2.6 Operation

Collaboration and communication

Given the drive to promote better collaboration, teamworking and networking in the NHS within and between institutions, research could usefully explore the effects of such collaboration on outcomes and the features of collaborations likely to lead to sustainable improvements in patient outcomes. This will require more work on the development of agreed validated instruments to measure the forms and extent of collaboration.

There are many other health professionals, managers and administrative staff who must interact with nurses and doctors to provide services. Hence, the full effect of collaboration on patient outcomes has not been investigated in the literature identified in this scoping study. The link with teamworking also needs exploration.

2.2.7 Well-being and human resources (HR)

Job satisfaction, stress and burnout

Since most of the research has been conducted only with nurses and in the USA, further studies would be useful to assess not only the relationship between these features of the workforce and patient outcomes, but more importantly the impact of interventions to improve the working lives of NHS staff on these outcomes. This work can build on insights from UK observational data analysis suggesting that HR practices can influence outcomes. However, new research should be prospective and well controlled. This research could include staff turnover as a variable for exploration as well.

2.2.8 Day of admission

Research is needed to replicate North American studies that indicated the adverse impact of weekend admissions on patient outcomes compared to weekday admissions. This research will need to better adjust the data for severity of illness and to explore the prevailing staffing levels and skill mix alongside the day of admission. In this way we can assess whether, if such a relationship holds in the UK, it reflects variations in staffing or other factors like the severity of illness.

Section 3 Introduction, aims and methods

Policymakers and academic researchers in health care systems internationally have tended to focus debate and analysis on funding methods and the processes of care. Given that by far the greatest proportion of health budgets is spent on the workforce, surprisingly little attention has been given over the years to research or policy thinking on aspects of the workforce compared to, say, the evaluation and regulation of health technologies.

With the advent of NHS workforce development confederations and a more strategic approach to the training, remuneration and deployment of NHS staff, the issue of the workforce is high on the policy agenda. Decision making about the numbers and types of staff required in the NHS is driven by historical patterns, the policies of the medical Royal Colleges, the specialist associations and the health professional regulatory bodies. Very little workforce planning and organisation has been informed by research evidence. In a review of the recommendations of the professional associations about the post-registration training of doctors, for example, the evidence base did not support many of the policies (Ferguson *et al.*, 1997).

The University of York was commissioned by the SDO Programme to conduct a scoping study to map out the research on the relationship between workforce issues and health outcomes. Particular questions we were asked to address include:

- What evidence is there about the relationship between workforce issues and health outcomes, including quality of care?
- What impact does the number and mix of medical staff (by specialist training and grade) have on the quality and clinical effectiveness of care?
- What evidence is there about the relationship between the number and mix of nursing staff (by specialist training and grade) and health outcomes such as length of patient stay?
- Is there any evidence of health outcomes being better when a particular service is provided by one professional group rather than another?

The aim of this scoping exercise is to advise the SDO Programme on research that might usefully be commissioned in this area. The scope includes:

- a map of the available published and empirical research literature from the health care sector

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- an analysis of the current NHS policy context
- the policy implications for the Department of Health, and the NHS, of the findings of the scoping exercise
- identification of areas for further research.

In order to organise the thinking and provide a framework for the scoping review, we developed a simple conceptual causal chain between the workforce, the features of the workforce and the patient outcomes. This framework is shown in Figure 3.1 and the way we interpreted the features is elucidated in Figure 3.2. The framework is used in reporting the results in Section 5 and was also used in the data extraction tables shown in Appendix 2.

Figure 3.1 Framework for the scoping review

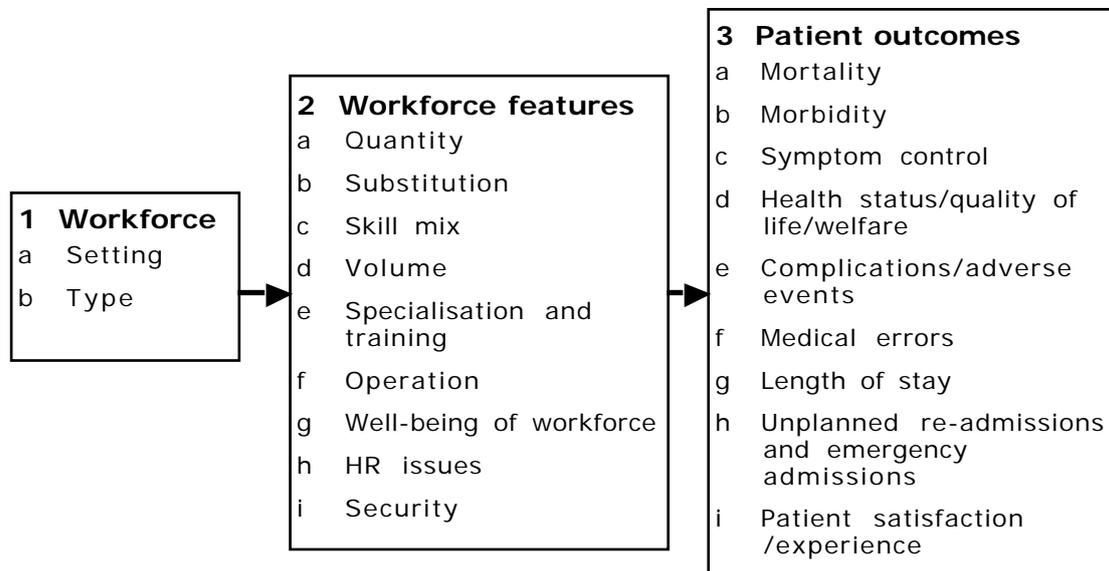
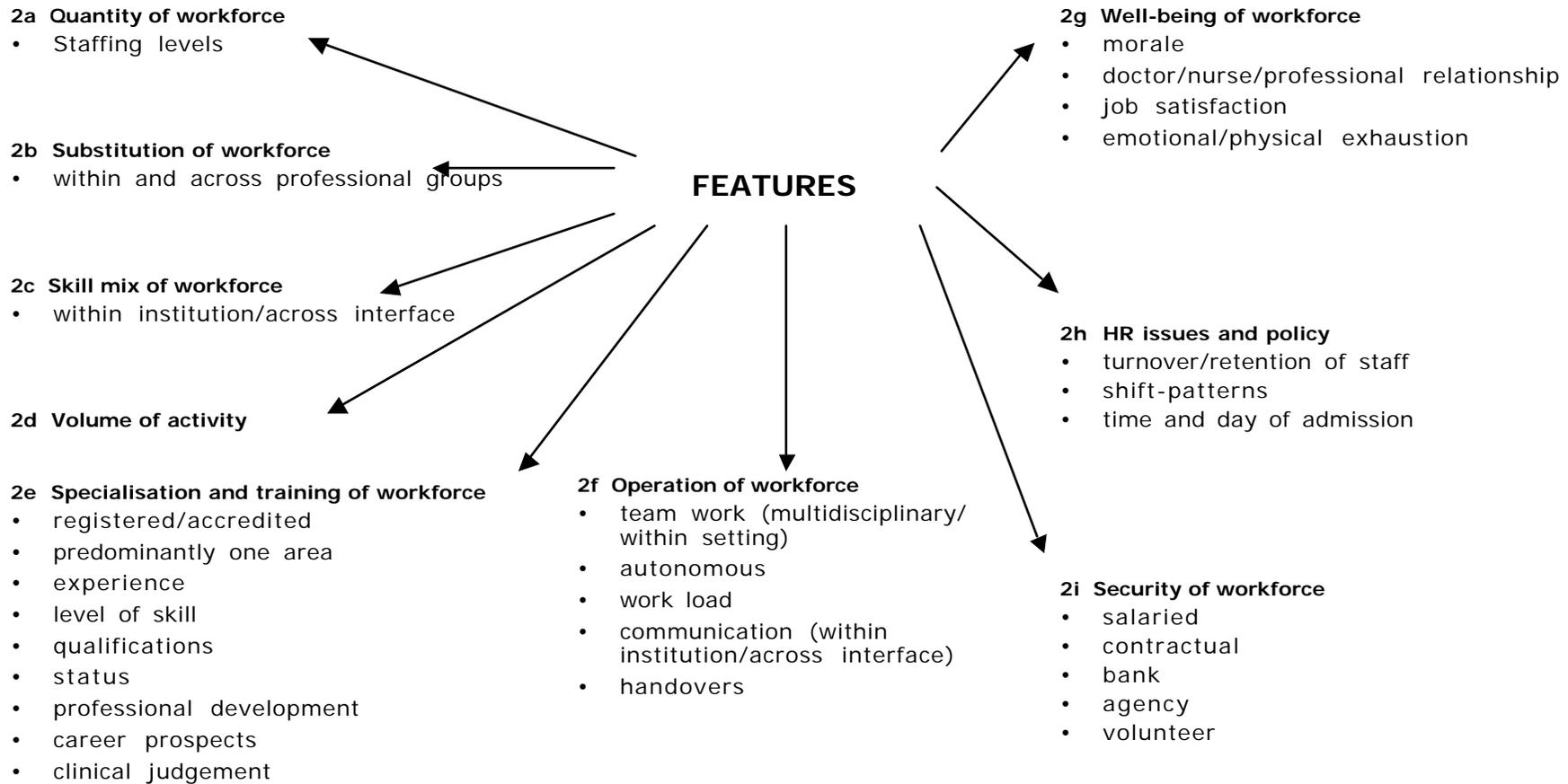


Figure 3.2 Features of the workforce



In the rest of this section we outline the methods used to conduct the scoping review. This is followed by a section which provides a review of the policy background to this area. Section 5 reports the results of the review, first in terms of the policy discussions and then the results of the review of the research evidence.

3.1 Methods

This scoping study used three approaches:

- 1 discussion with relevant policy stakeholders
- 2 analysis of relevant national and international policy
- 3 review of the research evidence on workforce and patient outcomes.

3.1.1 Interviews

In April 2003 we contacted by letter the heads of health-related organisations (Appendix 1) in the UK. The letter set out the aims and objectives of the project and posed the following questions:

- To what extent are workforce–staffing decisions historically determined?
- What examples exist of changes in staffing or staff management to improve outcomes and/or throughput?
- What evidence is currently being used to make staffing and staff contract decisions?
- Are there rational reasons for the considerable variation in staffing levels, as shown, for instance, in the independent analysis of hospital performance, *The Dr Foster Hospital Guide* (Dr Foster, 2002)?
- What specific questions regarding the relationship between staffing, staff contracts and outcomes are priorities for research commissioning?

Recipients were invited to contribute evidence to the research team by any of the following methods:

- enclosing a list of publications stating the organisation's position
- participating in an interview
- nominating another member of the organisation who could be approached for interview
- e-mailing views on the topic to the research team.

We received 34 responses: 9 agreeing to an interview, 15 referring us to a colleague, 4 submitting a letter or paper, 1 offering views by e-mail, 2 offering to assist with policy analysis and 3 stating that they had nothing that they wished to contribute. Where the response implicated another member of the organisation (or, in some cases, referred us to a member of another organisation) we contacted the

nominee explaining the nature of the scoping study and requesting an interview. Of the 15 nominees, 13 agreed to be interviewed. In all, 19 interviews were held within the time period, 2 of which were by telephone.

Interviews were semi-structured, being loosely based on the questions contained in the letter, but with freedom to follow the directions indicated by the respondent. All interviews were tape-recorded with the permission of the respondent, and an assurance given that no individual respondent would be directly quoted without their specific consent.

3.1.2 Reference group

A reference group was set up consisting of senior managers from local trusts, primary care trusts, Workforce Development Confederations and Department of Health bodies (Appendix 1). Its purpose was to assist us in developing an awareness of local policies and concerns about workforce and outcomes and a better understanding of the NHS context. The following questions were circulated for discussion:

- 1 To what extent are workforce–staffing decisions historically determined?
- 2 Are there examples of planned shifts in staffing?
- 3 What evidence has been used to make staffing decisions?
- 4 In considering staffing choices, do you ever consider why staffing levels apparently vary so greatly, as shown, for instance, in *The Dr Foster Hospital Guide*?
- 5 What specific questions regarding the relationship between staffing and outcomes are most pressing?

In the event, the number of apologies led to the first meeting being cancelled so the group had one meeting only, in July 2003.

The results of the interviews and reference group discussions are summarised in Section 5 of this report.

3.1.3 Review of the research evidence

We aimed to retrieve national and international published and grey literature relating to features of the workforce and health outcomes. Papers for possible inclusion were identified by searching a combination of electronic databases, the Internet, organisational web sites and by contacting experts in the field. The electronic databases below were searched in May 2003 to acquire references in medicine, nursing and health care management.

- Medline 1966–2003
- Cinahl 1982–2003
- EMBASE 1980–2003
- PsycINFO 1873–2003

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- HMIC (including DH Data 1983–2003, King’s Fund 1971–2003 and HELMIS)
- SIGLE
- The Cochrane Library
- The British Nursing Index.

Initial search terms were agreed by discussion within the project team. Additional terms were found by identifying key authors by their multiple references retrieved in the electronic database searches, selecting articles using agreed criteria and acquiring them to check their search strategies. No date or language limits were applied to the searches. As the project progressed, the search strategy was monitored for appropriateness and revised by looking at relevant studies both identified and not identified by the search.

The terms listed in Table 3.1 are a broad outline of those used in the search strategy, each being adjusted to take into account the terms listed in the thesaurus of each database searched; MeSH headings were used wherever possible. In databases without a thesaurus, keyword-only searches were constructed. To produce a sensitive search, both keyword and subject searches were applied when possible. The search strategies were peer reviewed by the staff in the NHS Centre for Reviews and Dissemination, University of York.

Table 3.1 Search terms used in the study

Staffing features	Patient outcomes
specialism	work schedule tolerance
health manpower	interprofessional relationsworkload\$ or work load\$
patient care team	stress\$ adj5 (workforce or work force)
primary health care	stress\$ adj5 manpower
medical staff	cross setting
hospital	infant mortality or mortality or hospital mortality or maternal mortality
contract services	length of stay
labo?r force or labo?r force	hospitalisation
nurs\$	labor complications
team\$	intraoperative complications or post-operative complications
physician\$ adj5 (number or workforce or work force). doctor\$ adj5 (number or workforce or work force)	medical errors
clinical nurse specialist\$ or modern matron\$ or helper\$ or unqualified assistant\$ or healthcare assistant\$ or clinical support worker\$	malpractice
secondary adj care	patient re-admission
specialisation	patient acceptance of health care
clinical competence	patient admission
professional competence	patient satisfaction
workload	absenteeism
professional autonomy	iatrogenic disease
stress	complication\$
psychological	adverse adj (event\$ or effect\$ or occurrence\$)
attitude of health personnel	outcome\$
morale	staffing level\$
personal satisfaction	(skill mix\$ or skillmix or skill-mix\$ or skills mix or skilling)
personnel management or personnel downsizing or personnel loyalty or personnel selection or personnel turnover	substitution
	specialisation

Initial search terms were identified in the literature. Additional terms were acquired by studying search strategies in documents suggested by persons identified as key researchers. As the exercise progressed, search terms were monitored for appropriateness and new terms identified and applied.

In addition the following sites were searched and contacted especially for policy documents and grey literature:

- American College of Physicians
- Audit Commission
- Australian College of Emergency Medicine
- Australian Medical Workforce Advisory Committee

British Medical Association
Department of Health
Health Select Committee
Higher Education Funding Council for England
King's Fund
Medical Protection Society.
Medical Workforce Standing Advisory Committee
MPS
National Audit Office
National Electronic Library for Health
National Institute for Clinical Excellence
National Institute for Health
NHS Alliance
Nuffield Institute for Health
Parliamentary Publications
Royal Australian College of Physicians
Royal College of Child Health and Paediatrics
Royal College of General Practitioners
Royal College of Nursing
Royal College of Obstetricians and Gynaecologists
Royal College of Physicians
Royal College of Psychiatrists
Royal College of Surgeons of England
Sainsbury Centre for Mental Health
World Health Organization

We contacted key researchers in the field (L .Aiken, B. Jarman, N. Donaldson, R. Cooper, M. West, J. Needleman, D. Guest, J. Buchan, A.-M. Rafferty, M. Marchington, J. Coles, B. Sibbald, C. Kovner), identified either through their published work, or referred to us by other researchers or interviewees, requesting any unpublished work or details of work in progress that fell within the remit of the study. Six of these researchers responded.

3.1.4 Access to unpublished literature

Internet web sites were searched for relevant publications, guidelines, papers, reports and other documents that discussed or reviewed aspects of workforce staffing under all types of health professional, especially doctors, surgeons, nurses, midwives, and allied health professionals in primary and secondary care. Links were followed up and the titles and abstracts were scanned for likely material.

All links on the site were explored and material that related in any part to a workforce issue was retrieved – including subjects that addressed staffing of health professionals under the following themes:

- training of the workforce
- workforce policy formulation
- impact of workforce on health outcomes.

Where a database was installed on the web site, the following terms were used to retrieve documents: workforce, staffing, skill mix, substitution, staff development, and staff/patient ratio. Free text searches using an Internet search engine were also performed with these keywords.

The documents were then stored in an online library and material that appeared relevant on further review was entered into an online database.

The abstracts of the articles were read and the inclusion and exclusion criteria described below were applied. A database of included and excluded references was created using Reference Manager software.

3.1.5 Inclusion criteria

Inclusion and exclusion criteria were developed and applied to the references retrieved from the search, and articles included if they investigated one or more relationships between feature of workforce and patient outcome; this is summarised in Figure 3.1.

Though conceptual and methodological research was retrieved in order to inform this scoping review, only studies empirically examining the relationship between workforce features and patient outcomes were abstracted and are summarised in this report.

3.1.6 Exclusion criteria

Studies were excluded from the review for one or more of the following reasons:

- Study used the same data sets for the same period of time, looked at the same workforce, features and outcomes as were used in other studies (for example, duplicate publications).
- Study looked at features of a workforce without reporting on patient outcomes.
- Study investigated only staff outcomes (for example, needle-stick injuries) and staff perceptions of quality of care.
- Study evaluated services/interventions (for example, NHS walk-in clinics) rather than a feature of the workforce.

Because of time constraints non-English-language publications were excluded.

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The inclusion and exclusion criteria were applied to all 34,737 references using titles and, where available, abstracts. To check for consistency between the reviewers, all four reviewers screened the first 100 citations generated by the search. The remaining citations from the first database were divided into two sets and two reviewers screened each set. All reviewers worked independently of each other throughout the process. For the remaining databases, only those studies deemed relevant and those that were unclear were double-checked by a second reviewer. Two reviewers then examined full texts of the selected studies for inclusion in the review and a third reviewer resolved any discrepancies.

Reference lists from the retrieved systematic reviews were cross-checked with the database. Those studies which were included in both were not abstracted, because the results had already been summarised in the review.

3.1.7 Data extraction

For each relevant study, data were extracted in a systematic way using pre-designed tables to emphasise the type and feature of the workforce, the setting, the outcome(s), the methods used, the results found, the quality of the studies, the limitations and research implications (see Appendix 2 for abstracts). One reviewer abstracted each study and a sample was checked.

Section 4 Background

4.1 International

In most health care systems, the dominant policy drivers are macro-economic cost control and access, usually debated intently in terms of waiting times. Health care 'crises' are regular occurrences, driven by the 'inflating' cost of care and media-led disapproval of 'high' waiting times and usually involve reform of organisational structures rather than the reform of micro-economic relationships that relate better provider behaviours to the objectives of the health care system. With the US health care system consuming 14 per cent of GDP, the German system in 'crisis' in terms of cost and efficiency, and the British system investing heavily in new capacity to improve patient access, there is an emergence of concern among policymakers, to varying degrees, about the quality of care.

Over the past few years concern has been growing about the effectiveness of care in the light of evidence of apparently unjustifiable variations in treatment and studies of inappropriate care; hence the rise of guidelines and regulations of health technologies. The Americans rediscovered medical error in 2000 with the publication of the Institute of Medicine report which asserted that more citizens die annually from mistakes in hospitals than from HIV-AIDS, road traffic accidents or breast cancer (Kohn *et al.*, 2000). Research in Australia and, to a lesser extent, in the UK has also highlighted concerns about medical errors.

This literature on errors, together with concern about clinical practice, is part of a growing international awareness that policy must not only focus on issues of expenditure control and access but also on issues of quality effectiveness, in particular, and cost-effectiveness.

Against this background, in particular the rediscovery of the interest in quality in the USA, the emergence of a literature on staffing and quality has strong policy implications in terms of the level of resources as well as its deployment of skill mix.

4.2 The new NHS

Following the general election of 1997, the Labour government's vision of the 'Third Way' (Giddens, 1999) demanded a programme of 'modernisation' in all public service institutions (Hill, 2000; Clarke, 2000; Newman, 2000; Klein, 2001) with an emphasis on 'joined-up thinking' and 'partnerships'.

The goals, together with the size of the investment required in both capital and human resources, were expressed within *The NHS Plan* (Department of Health, 2000e), published three years into the

government's first term. The emphasis was on organisational improvement such as reducing waiting times for surgery and faster treatment in A & E. The details of service improvement at specialty level were set out in the National Service Frameworks.

4.3 Workforce requirements

The NHS Plan set out an array of new services and identified challenging targets for the improvement of the Service. To this end, a significant increase in the number of consultants, GPs, nurses and therapists was promised, as was a rise in the number of medical school places – an indication of the long-term commitment to maintaining the rise in investment. The actual figures given in the Plan were revised upwards within the 2002 Spending Review report (Wanless, 2002) to:

- 15,000 GPs and consultants
- 30,000 more therapists and scientists
- 35,000 more nurses, midwives and health visitors.

The human resource strategy was underpinned by the funding recommendations contained in the Wanless report (2002) written to inform the Treasury of the NHS funding requirements in the long term (to 2022). The report used three scenarios (optimistic, realistic and pessimistic) in its projections. It stated:

Overall under the three scenarios the health care workforce might need to increase by almost 300,000 over the 20 years. The rates of increase are not uniform across the different staff groups.

(Wanless, 2002)

The NSFs set out in broad terms the staffing levels required to fulfil the targets within their specialties. The Policy Implementation Guidance for the Mental Health NSF, for example, was quite specific on the staffing of the new services described in the main document. Assertive Outreach Teams, which were to work with 'hard-to-engage' clients, were to have 8 whole-time equivalent (wte) caseworkers, 0.5 wte psychiatrists, 0.5 wte non-consultant career grade psychiatrists and 1 wte administrator for every 90 clients. *The Cancer Plan* (Department of Health, 2000d) recognised that the NHS had 'too few cancer specialists of every type' and promised recurrent funding of £80 million a year (for staffing and equipment) to improve standards and cut out patient waiting times. It pledged:

By 2006 there will be approaching 1,000 extra cancer specialists, an increase of nearly a third in the number of cancer doctors since 1999. Other specialties crucial to the treatment of cancer will also increase; for example there will be some 120 more urologists (a 32% increase) and some 200 more gastroenterologists (an increase of over 50%). Numbers of cancer nurses and therapy radiographers will also increase. And the number of general surgeons will increase by an extra 257 (a 20% increase).

(Department of Health, 2000d)

The Cancer Plan compared the UK with Europe, concluding that our eight oncologists per million population represented half of the European average. This, however, begged the question as to whether the UK has too few or the rest of Europe too many oncologists.

The new services designed to increase access and reduce waiting lists have been and will be staff-hungry, and these were factored into the above figures, largely based on the premise that a percentage increase in activity equated to an equivalent increase in staffing within the specialty. However, with the announcement of the development of the first private sector contracts for the privately run Diagnostic and Treatment Centres (Department of Health, 2003a), comes the possibility that these centres will be permitted to recruit some of their staff from the NHS. This would establish these bodies as competitors to the NHS in the area of staff recruitment, rather than as complementary to it.

4.3.1 Workforce planning

For some years there has been a debate within the Department of Health and the NHS as to the best means by which workforce numbers should be determined. For many years, medical staffing decisions were taken at regional and national level by bodies such as the Advisory Group in Medical and Dental Education, Training and Staffing (AGMETS), the Medical Workforce Standing Advisory Committee (MWSAC), the Specialty Workforce Advisory Group (SWAG), the Medical Practices Committee (MPC), and Local Medical Workforce Advisory Groups (LMWAGs).

In contrast to this top-down approach, numbers of nurses and the allied health professionals were, during the 1990s, calculated by a bottom-up method of asking NHS trusts and other bodies to forecast their staffing needs. Until 1990 nurse education was based on an apprentice model and student nurses were recruited in the numbers required to staff the hospitals in which they trained. When the service component of nurse education was reduced in the early 1990s, the numbers of training places fell by 28 per cent (Department of Health, 1999) and only began to rise again in 1994 (National Audit Office, 2001). From 1990 to 1996 education commissioning for nurses and allied health professionals was carried out by regional health authorities, and from then until 2000 was controlled by education and training consortia, who commissioned education from higher education institutions in England.

In an attempt to improve the accuracy of workforce predictions and to ensure the proper integration of workforce and service planning, *A Health Service of All the Talents* (Department of Health, 2000a) proposed the establishment of a National Workforce Development Board, supported by Care Group Workforce Development Boards. The main principles underpinning the report were:

- that service and workforce planning should be more closely linked

- that staff should be more flexibly deployed
- that staff development should be considered on a multidisciplinary basis and across sectors
- that the medical and dental education levy (MADEL) should be combined with the non-medical education and training budget (NPET).

At a local level, 28 Workforce Development Confederations (WDCs) assumed responsibility for all education commissioning for the NHS. In 2004, these bodies merged with their corresponding strategic health authorities.

4.3.2 Medical staffing

The increase in consultant numbers outlined by the NHS Plan is not only intended to improve the quality of care, but is deemed to be central to relieving the pressure on doctors in training. The 1991 New Deal (NHS Management Executive, 1991) set out to restrict the working hours of junior doctors. Staffing problems caused by this constraint were not confined to the medical workforce, for one key factor in the resolution of the resulting staffing problems was the empowerment of nurses to undertake roles previously carried out by doctors. Almost ten years later, the Audit Commission (2002) found that only 2 per cent of trusts were fully compliant with the New Deal and warned that by August 2003 non-compliant trusts would be in breach of contract. The cost of compliance for trusts is high, with new money and scarce management time being absorbed by these new working arrangements and while it is frequently implied that staff working shorter hours may offer higher-quality care, this assertion has no empirical basis.

A second major obstacle to increasing medical input is the European Working Time Directive (EWTD), described as 'the greatest challenge currently facing medical workforce planners in the United Kingdom' (Thorpe, 2002). With its unequivocal requirement for 11 hours' rest in every 24, for a 48-hour week and an average 8-hour night shift, this requirement will have the effect of reducing de facto the total medical workforce. In addition, on-call arrangements in hospitals will not count as rest time. The President of the Royal College of Physicians has recently called for a delay in the implementation of the Directive, warning that the compliance requirements for 2004 would entail the closure of many A & E departments. The results of an Royal College of Physicians survey demonstrated that:

In June 2003, 14 months before the Working Time Directive is due to be implemented, 166 acute hospitals in England (78.7%) do not have sufficient SpRs ... for continuous cover of acute medical admissions.

(Royal College of Physicians, 2003)

The position is even more acute in the islands of Scotland, where population numbers do not support the deployment of doctors in the

numbers required to implement the Directive, and radically new service models are performance being examined (Temple, 2002).

Yet another issue to be factored into the staffing equation is the proposed change to medical education described in *Unfinished Business* (Department of Health, 2002c) and ratified by the four UK Health Ministers in *Modernising Medical Careers* (Department of Health, 2003d). What is proposed is a two-year foundation programme, of which the second, Senior House Officer (SHO), year will be better managed and more educationally led than is the case at present (Heard, 2003). As the SHO grade accounts for almost half of the total number of junior doctors in training (Department of Health, 2002c) the implications for service are considerable. Despite this, the plans have been broadly welcomed for addressing a largely unmanaged area of medical education. The removal of the SHO 'holding tank' for junior doctors (and those trained overseas) awaiting specialist registrar (SpR) posts has implications for the number of higher-grade posts made available. Hitherto the number of SpR posts has been engineered to produce the required number of consultants (although, because of the time-scales involved, it was very difficult to get any sort of meaningful demand information from the NHS) but the ministerial message at present is to create as many of these posts as is economically viable. In order to create more posts at this level, trusts have been given the opportunity to map posts into the Education and Training levy or to fund posts directly in order to create other training opportunities – a prospect likely to be attractive in areas of shortage and where the pressure from the EWTD is greatest. If the proposals for the overall shortening of time to achieve the Certificate of Completion of Specialist Practice – also suggested in *Unfinished Business* (Department of Health 2002c) – were to be accepted, this would go some way to address the shortfall. The proposal for the creation of generalist consultants would also relieve service pressures, although this proposal is being carefully considered by the Royal Colleges.

At the supply end, the number of doctors in training has risen by 26 per cent in the UK in the decade from 1989 (Walker and Maynard, 2001). Having proposed an increase of 1100 medical students in 1997, the NHS Plan promised a further increase of 1000 by 2002 and to that end four new medical schools were commissioned in areas of relative medical shortage.

The British Medical Association reported a total of 93,000 qualified doctors practising in 2000 – a 2.7 per cent increase over the previous year (British Medical Association, 2001). However, the organisation warned that these numbers represented a shortfall in relation to the targets in the NHS Plan. There was support in this view from Wanless (2002) who, in his consideration of the resource needs into the second decade of the 21st century, argued that current plans would result in a significant shortage of doctors to deliver the service envisaged in the middle of the three scenarios:

The gap in the number of doctors starts to emerge before the end of this decade and is estimated to be around 25,000 after 20 years.

(Wanless, 2002)

There is evidence of significant variation in the numbers of practising doctors in different areas, with London Teaching Hospitals employing twice as many doctors per admission as District General Hospitals. In a report published in 2002, the Audit Commission found that the number of doctors employed by trusts per 1000 admissions varied from 2.7 to 14.1, and even when comparing similar trusts, wide disparity was found (Audit Commission, 2002). Although the 2002 report made reference to an earlier publication (Audit Commission, 1994) that had linked numbers of fixed sessions to *activity*, no link was made between staffing levels and *outcomes*.

In summary, however, the challenges of the EWTD, the New Deal and altered training arrangements mean that, while the stock of practitioners is rising, the supply of clinical time is not rising *pari passu* and the deployment of doctors, once qualified, raises significant questions.

4.3.3 Nurse staffing

A significant body of work on nurse staffing levels and quality has been developed in North America. The American Nursing Association has, for many years, campaigned for the development of hospital quality indicators and recently the Joint Commission on Accreditation of Healthcare Organizations has developed a standard requiring organisations to assess staffing effectiveness (Kovner, 2003). Much of this work is based on research relating to the concept of 'magnet hospitals' which were identified during the major US nursing 'shortage' in the 1980s and defined as hospitals that, in stark contrast to their neighbours, had little difficulty in recruiting and retaining staff. Research designed to investigate the attributes of these institutions has shown that they exhibit organisational features that support autonomous nursing practice. In 1999 legislation was passed in California in respect of nurse:patient staffing ratios that became mandatory in July 2003. The ratio for medical and surgical wards is set at 1:6, moving to 1:5 (Aiken *et al.*, 2002), and this in a state where the nursing shortage is acute (Coffman *et al.*, 2001).

In Britain, recommendations are in existence for nurse staffing levels for paediatric wards (Executive, 1997), paediatric intensive care (Department of Health, 1997; NHS Executive, 1997), adult intensive care (Intensive Care Society, 2002; Royal College of Nursing, 2003a) and generic and specialist community mental health teams (Department of Health, 2001b). Even in critical care, however, where the standard has been in place since 1967 (Royal College of Nursing, 2000) the Audit Commission (1999) could find no evidence on which to base this figure – and this in a specialty that costs the NHS £675–725 million, of which 40 per cent is attributable to nurse staffing costs.

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The Audit Commission (2001) report, *Ward Staffing*, addressed three questions:

- 1 How much do trusts spend on ward staffing and how can differences be explained?
- 2 Is there any evidence that resources can be used more efficiently and effectively in the delivery of patient care?
- 3 Does the level of resources relate to clinical risk or the quality of the care delivered?

(Audit Commission, 2001)

Having corrected for the type of ward, the Audit Commission reported wide variation in staffing costs per bed with the highest costs in the South West Region and the lowest in Northern and Yorkshire. High costs were associated with high numbers of staff, rather than higher-graded staff. Within some trusts there was a high degree of disparity between the staffing on different wards relative to the national average, suggesting a historical rather than rational allocation of funds. The report also suggested that the impact of high numbers of non-ward-based 'specialist nurses' (such as stoma therapists) should be reviewed. Wide disparity in staffing levels was also evident in a recent study carried out in Scotland (Audit Scotland, 2002).

In response to the Audit Commission report, the Department of Health commissioned the University of Leeds to undertake a review of staffing 'calculators'. In January 2003 the Chief Nursing Officer asked all Directors of Nursing to consider their staffing levels in relation to the report (PL CNO (2003)1). The accompanying review of staffing models (Hurst, 2003) included the following 'methods for estimating the size and mix of nursing teams':

- the professional judgment method (Telford, 1979)
- nurses per occupied bed (NPOB) (Barr, 1983)
- acuity quality (Ball *et al.*, 1984; Barr, 1967; Department of Health, 1997; Royal College of Nursing, 1998)
- timed task/activity approaches (Cameron, 1979; Department of Social Security, 1998)
- regression-based systems (Bagust *et al.*, 1992).

However, the models are not based on likely impact on the quality of care. There is evidence of considerable interest from the UK in US models. Trent Workforce Development Confederation is considering staffing levels published by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), which has recently established a nursing council and Magnet Hospitals (personal communication). One trust, Rochdale Healthcare Trust (now part of Pennine Acute Hospitals Trust), gained magnet accreditation in March 2002, the first organisation outside the USA to achieve this.

However, the search for the 'ideal' formula is only the first step, as a report by the Auditor General in Scotland reminds us (Audit Scotland,

2002). Despite the local utilisation of a wide range of tools for calculating the establishment, the auditors found that only two-fifths of the 325 wards studied had the numbers of nurses in post indicated by their establishment figures.

4.4 Shortages

Since the publication of *The NHS Plan* it has been clear that increasing the numbers in the workforce would be difficult given the severe level of shortages against the existing establishment figures (House of Commons Health Committee, 1999). The Plan recognised that staff shortages were the greatest constraint to the achievement of the government's vision for the NHS. Thus in addition to changes in working hours other policies have been put in place such as investment in child care and training, and the adoption of a strong position on discrimination and violence.

Shortages in the health care professions are not new phenomena. Indeed, since the second World War, the demand:supply ratio in both the USA and the UK has been in constant flux. In both countries, shortages in the health care workforce are attributable to demographic factors and also to expanding alternative educational and work options. In addition the global pressure to contain costs and to achieve maximum efficiency in health care has kept pay awards down, increased workload, reduced working lifespan and created working environments unattractive to two generations (known as generations x and y) known to be less comfortable working in inflexible bureaucratic environments. Past attempts to alleviate shortages in both medicine and nursing have included importing staff from overseas and improving pay (Barry-Walker, 2000).

4.4.1 Nurses and midwives

Any discussion of nursing numbers and of shortages must come with a number of caveats. Interpretation of data must take into account both the definition of what constitutes a vacancy and the potential availability of staff qualified to fill the post. On the supply side, Hemsley Brown (1997) points out that:

- nursing figures may include midwives, health visitors or students
- not all qualified nurses are working as nurses
- there are nursing posts outside the NHS
- nursing tasks are being undertaken by people who are not nurses.

Buchan (2004) disputes the OECD estimate for the UK of 4.5 wte nurses per 1000 population, a figure that puts the UK at the bottom of the league table of developed countries. He argues that if the population denominator were to be correctly aligned with the nursing numbers and if nurses practising outside the NHS were to be included, the figure should be around 6.5 per 1000.

A survey of 6000 nurses carried out by the Royal College of Nursing in 2000 revealed that 26 per cent of the respondents intended to leave the profession within two years (Royal College of Nursing, 2000). The most recent figures produced by Department of Health show a three-month vacancy rate for qualified nurses of 2.9 per cent (Department of Health, 2003b). In addition to the drop in training numbers in the early 1990s as identified above, the shortage is attributed to poor pay, feeling undervalued, low morale and the failure of 34 per cent of new graduates to register (Finlayson *et al.*, 2002), as well as retirements in an ageing workforce (Seccombe and Smith, 1996; Robinson *et al.*, 1999; Royal College of Nursing, 2003a), one-quarter of whom are aged over 50 (Royal College of Nursing, 2003b).

The loss of nurses from the profession is, however, reported to be balanced by gains from overseas. Buchan (Royal College of Nursing, 2003b; Buchan, 2004) reports that, in 2001–2002, over 16,000 nurses entered the Nursing and Midwifery Register from EU and non-EU sources, principally the Philippines, South Africa and Australia. In fact the Department of Health claims to be ahead of its target to employ 20,000 more nurses by 2004. It is important to note, however, that this figure represents nurses employed, not whole-time equivalents.

The midwifery profession provides an illustration of the complexities inherent in any discussion of 'shortages'. While figures from the Department of Health indicate that there are sufficient trained midwives in the country to meet the needs calculated using the Royal College of Midwives' own figures (Department of Health, 2003 – personal communication), there are widespread reports of shortages. Evidence presented by the Royal College of Midwives to the House of Commons Health Committee on 'Choice in Maternity Services' made the following statement:

There is a shortage of midwives in the NHS and that shortage is widespread. The 2002 Annual Staffing Survey of senior midwifery managers, conducted by the RCM, revealed that overall and long-term vacancy rates are the highest we have recorded since the survey was first carried out in 1996, with more units than ever carrying unfilled posts. Vacancy rates had increased in every region of England with the exception of London, where vacancy rates were already high. Vacancies remaining unfilled for three months or longer (long-term vacancies) accounted for 59% of all vacancies in England.

(Royal College of Midwives, 1999)

4.4.2 Allied health professionals

According to Department of Health figures, there are in excess of 98,000 scientific, therapeutic and technical staff in the NHS, of whom almost 44,000 are qualified therapists. Despite rising numbers of people in these professions, the 2002 Pay Review Body report indicated the total vacancy rate for the group at 4.3 per cent, with a turnover rate for allied health professionals of almost 17 per cent and a wastage rate of 11.5 per cent. In the 2002 vacancy survey, radiography, pharmacy

and physiotherapy were reported to have the highest vacancies for any NHS professions except GPs (Department of Health, 2002b).

4.4.3 Consultants

Shortages of consultants are said to be particularly acute in radiology, pathology and mental health (Sainsbury Centre for Mental Health, 2003; Sierchio, 2003). The Royal College of Surgeons, in its 2001 annual report, identified a shortfall of 100 wte consultants between the target to be achieved by 2002 and the output from training schools. In Obstetrics and Gynaecology, the Royal College's report in 2000 simultaneously called for a significant increase in the consultant population and a reduction in training numbers to reduce the glut of those who had completed their certificate of specialist training but were unable to find a consultant post. The results of the survey carried out in 2001 by the Royal College of Physicians of London indicated that there had been an increase in consultant numbers of 2.9 per cent in the year from September 2000 to 2001, but that 31 per cent of advertised consultant posts were unfilled owing to lack of suitable candidates, indicating a severe lack of suitable candidates in some specialties (Royal College of Physicians, 2001). As for psychiatrists, census data demonstrate that as the number of posts grows, the vacancy rate increases, standing at an average of 12 per cent, although five regions demonstrated 20 per cent vacancy rates (Royal College of Psychiatrists, 2002).

The Royal Colleges have noted that given the rising number of trainees choosing to train flexibly, it could be expected that these would add to the 'increasing numbers of flexible, part-time and job-sharing consultants' (Royal College of Surgeons of England, 2001). The same source revealed that 60 per cent of medical graduates are female, traditionally inclined to part-time working. In 2003, Department of Health figures showed a vacancy rate among all medical and dental consultants of 4.7 per cent (Department of Health, 2003e), ranging from 2.3 per cent in South-West London to 6.9 per cent in County Durham and Tees Valley. In the light of these medical staffing constraints and in pursuit of waiting list reduction, the then Secretary of State, Alan Milburn, wrote in May 2002 to the four Directors of Health and Social Care inviting them to identify sites which would benefit from the introduction of medical teams from other countries.

4.4.4 General practitioners

The national three-month vacancy rate for GPs is reported as 3.3 per cent by the Department of Health and 3.4 per cent by the British Medical Association (BMA). These figures, however, hide a wide range with much higher vacancy rates being reported in the most deprived, inner city areas of the country (Department of Health, 2003e; British Medical Association, 2003). In the year 2000–2001, the number of doctors completing vocational practice as GPs was 1689 – significantly

fewer than the 2563 reported in 1981 (British Medical Association, 2002c). The situation again is exacerbated by the fact that many of the new entrants are women who are more likely than their male counterparts to wish to work part-time.

The publication *Human Resources in the NHS Plan* noted:

We are close to a 25-year low in unemployment and many other employers (especially public sector) are planning to expand their own workforces. We must persuade huge numbers of school and college leavers that the NHS is an attractive place to work. And this is against the backdrop of a largely negative media spotlight.

(Department of Health, 2002a)

The *Improving Working Lives* initiative, launched by the Department of Health in 2000, promoted improvements in the work environment, such as tackling abuse and racism, encouraging flexible working, providing child care facilities and reducing stress (Department of Health, 2000f). In relation to what have become known as the '3 Rs' (recruitment, retention and return) the Commission for Health Improvement, summarising findings from 175 review visits to trusts, concluded that overall, trusts have poor workforce planning, poor recruitment and retention strategies and are poor at providing career opportunities (Commission for Health Improvement, 2002).

They are also, it seems, poor at caring for staff. Current staffing shortages are attributed to factors which include poor conditions of service and career structures, low pay, morale and status, and absence of support for those with family commitments. Increasing workload, stress and violence in the workplace were also cited (paragraph 6), although the precise nature of these problems was not elaborated and no links were made with patient outcomes. In their evidence to the Select Committee in 1999, the Manufacturing Science Finance Union (MSF) reported greater job opportunities for allied health professionals in the private sector, while noting that some of these groups also have the potential to offer services directly to the public and can become self-employed (Manufacturing Science Finance Union, 1999).

4.5 Incentives

For front-line staff the incentivisation process takes the form of new employment contracts, offering salary increases linked to increased activity.

4.5.1 Consultant contract

The intent behind the Government's proposals for the consultant contract was to achieve the shift to the more heavily consultant-delivered care system necessitated by the New Deal and the Working Time Directive and to increase activity to achieve Government targets. In its original form, it sought to prevent new consultants from engaging

in private work and to provide incentives for those demonstrating the highest levels of productivity in pursuit of national and local priorities (Department of Health, 2001c).

The contract was substantially revised in the wake of its rejection by the consultant body. In its new form it introduces job plans and appraisal coupled with a contingent pay structure and a significant rise in salary. Merit awards, long the subject of concern for their opaque quality and unfair distribution, are to be replaced by a clinical excellence scheme. The revisions have reduced evening and weekend obligations to work. There is some concern that consultants will receive considerable pay increases with little return in terms of maintaining, let alone improving, activity and quality.

4.5.2 GMS contract

The new General Medical Services (GMS) contract (Department of Health, 2003c), intended to increase resources for primary care, control workload and improve career opportunities in general practice, was implemented in 2003–2004. The contract, held by the practice and not the individual practitioner, includes ten clinical 'quality' areas with specified fee-for-service incentives. The standards contained within the contract (such as the maintenance of practice registers for specific groups of patients and the regular recording of blood pressure for those on anti-hypertensives) are process, rather than outcome oriented, but the quality rewards may improve outcomes. Monitoring the impact on patient outcomes, however, will be challenging.

4.5.3 *Agenda for Change*

The *Agenda for Change* proposals (Department of Health, 2004) are a high priority in the Department of Health. The contract, which has, to date, had an easier passage than either of the proposals for doctors, will, it is claimed, be the key to developing a more flexible workforce. The contract offers:

- greater scope to create new kinds of jobs, bringing more patient-centred care and more varied and stimulating roles for NHS staff
- fairer pay
- harmonised conditions of service for NHS staff
- a more transparent system of rewards for staff who work flexibly outside normal working hours
- better links between career and pay progression.

(Department of Health, 2003c)

After job evaluation, each post in the NHS, with the exception of doctors, dentists and senior management will be assigned to one of eight pay bands. In addition there will be a knowledge and skills definition for each post, which will inform personal development planning. Each band will have two gateways through which people will

only pass after assessment against the set knowledge and skills criteria. For the first time, the investment by individuals in education and training will be subject to monetary reward. There is, it is felt, potential to service the substitution agenda without developing new professions, such as physician assistants, which would in due course be likely to seek to describe and protect their own boundaries. At the time of writing, 12 early implementer sites are developing mechanisms designed to operate the new contract.

4.5.4 Temporary contracts

Agency and locum staff are brought in to provide patient care when permanent staff are not available. Such cover is required to cover the period:

- between one member of staff leaving and their replacement being appointed
- of sick, maternity or annual leave.

Replacement staff may be employed by the NHS or by a commercial agency. The temporary use of nursing staff was investigated by the Audit Commission (2000), which estimated a shortage of 10,000 in the nursing workforce. In the report *Brief Encounters*, the following figures were given:

- On a typical day, about 20,000 bank and agency staff work in NHS trusts, covering 10 per cent of shifts.
- Use of bank and agency staff is growing and costs are escalating rapidly.
- In 1999–2000 NHS expenditure on agency staff grew by one-third (to £360 million in England, £8 million in Wales).
- Expenditure on bank staff grew by 14 per cent (to an estimated £430 million in England and £10 million in Wales).

(Audit Commission, 2000)

In a later report the Audit Commission demonstrated that, on average, trusts were spending 7.2 per cent of their medical staffing budget on locums (Audit Commission, 2002). The trusts with the highest use of locums (5 per cent) were devoting 15 per cent of their medical staffing budget to temporary staff. While initiatives like NHS Professionals and the flexible career scheme for doctors may help trusts to cut expenditure on these topics, they will do little to ensure continuity of care, which, it is feared, may impact negatively on the quality of care.

4.6 Skill mix

The term 'skill mix' is variously used, but is, according to Buchan and Dal Poz (2002):

... usually used to describe the mix of posts, grades or occupations in an organization (strictly speaking, this is more accurately referred to as 'grade mix'). It may also refer to the combinations of activities or skills needed for each job within the organization.

(Buchan and Dal Poz, 2002)

Sibbald *et al.* (2004) point out that:

Skill mix change may be brought about through:

- *Enhancement – increasing the depth of a job by extending the role or skills of a particular group of workers;*
- *Substitution – expanding the breadth of a job, in particular by working across professional divides or exchanging one type of worker for another;*
- *Delegation – moving a task up or down a traditional unidisciplinary ladder;*
- *Innovation – creating new jobs by introducing a new type of worker.*

(Sibbald *et al.*, 2004)

Although skill mix issues affect all professions, by reason of the numbers involved, much of the literature focuses on medicine and nursing. In their review of the literature conducted for the World Health Organization, Aiken and colleagues (Aiken, 1996) reported that the early work on skill mix in the USA tended to focus on the effects of changing the proportion of qualified nurses (Registered Nurses – RNs) to less qualified (Licensed Practical Nurses – LPNs) and unqualified (nursing aides).

In the USA, as in the UK, skill mix reviews have resulted in the transfer of non-nursing duties to unqualified staff (Aiken, 1994) and gradually began to encompass clinical duties. In the UK the transfer of nurse education to the higher education sector in the early 1990s involved the replacement of the student nurse labour market with a mixture of qualified nurses and health care assistants (United Kingdom Central Council, 1997). It can be argued that the delegation of clinical tasks to non-professionally qualified staff in the UK was increased by the abolition of the second-level State Enrolled Nurse. In this respect, Britain differs from both Australia, which retained the Enrolled Nurse (Francis and Humphries, 1999) and the USA, which retained the Licensed Practical Nurse. There is some evidence that nurses tended to resist these changes, while health care assistants embraced them (Daykin, 2000; Seccombe and Smith, 1996).

The NHS Plan criticised existing NHS workforce strategy for failing to deploy staff to areas of greatest need (Department of Health, 2000e, paragraph 2.15), permitting the existence of demarcations between staff groups that did not work in the patient's interest (2.17) and were inefficient. The recommendations of the Health Committee report fed into the consultation document entitled *A Health Service of all the Talents*

(Department of Health, 2000a), which enshrined the principles of teamworking across professional and organisational boundaries, flexible working and the provision of education to enable all staff to maximise their potential. In short, the strategic human resources aim for the New NHS is promoted by its architect in just four words – ‘More staff working differently’ (Shifrin, 2003). The mechanisms for achievement were those of a careful local review of the staffing needs identified within the Health Improvement Plan (now the Local Development Plan), through clinical governance reviews and robust recruitment and retention strategies, coupled with the use of the skills escalator and a flexible reward structure.

In addition to analysis of skill mix in nursing, there is a literature on skill mix and substitution possibilities between nurses and doctors. This literature is limited in quantity, quality and scope (Richardson *et al.*, 1998).

Internationally, especially in the USA, there have been high levels of investment in what Americans call ‘non-physician clinicians’ but whether these nurses and other skill groups are substitutes or complements for doctors is unclear. Aiken (2003) reports that the ratio of doctors to other health professionals in the USA fell from 1:3 at the beginning of the 20th century to 1:16 in the early 1980s. Indeed, in the USA, the number of non-physician clinicians has grown to such an extent that it is estimated that they saw 36 per cent of outpatients in 1997 (Aiken, 2003).

Overall, the profile of tasks undertaken by nurses has changed dramatically during the last decade, prompted first by the skill mix review undertaken as part of the introduction of the Project 2000 training proposals which removed student nurses from the workforce, and secondly, by the publication of *The Scope of Professional Practice* (United Kingdom Central Council for Nursing, 1992) which derestricted nursing practice, placing the onus on each individual professional to ensure that he or she was properly prepared to undertake any task or duty. In hospital settings, the pace of change was aided by the reduction in junior doctors’ hours (NHS Management Executive, 1991) which resulted in skills previously in the medical domain being passed to nursing staff and others (Greenhalgh, 1994). In primary care, the number of practice nurses began to grow after the introduction of the 1990 GMS contract, which rewarded GPs for the routine observation and management of patients with chronic diseases. In both settings, nurses began to run clinics, make preliminary diagnoses of disease and prescribe treatment for minor ailments in GPs’ surgeries (Marsh and Dawes, 1995; Kinnersley *et al.*, 2000; Shum *et al.*, 2000; Horrocks *et al.*, 2002) and to treat minor injuries in hospitals without Accident and Emergency Departments (Tye, 1997; Crux, 1997).

Over time, the scope of these activities has broadened, to such areas as pain management, pre-admission assessment and cardiology day care (British Medical Association, 2002d), assisted by the creation of

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nurse consultant posts that have empowered well-educated and highly skilled specialist nurses to offer new and innovative services. The development of five nurse-led Primary Medical Services (PMS) pilots pushed the boundaries further, although a report by the King's Fund noted that these nurses were seriously hampered by their restricted prescribing rights and their inability to sign sickness or death certificates.

Nursing's regulatory body has failed to define and restrict the use of the title 'nurse practitioner'. This has resulted in the title being adopted by, or conferred on, nurses who may have completed anything from a few days' training up to a Master's degree. Lewis (2001) records the frustration experienced by many of the nurses in the PMS pilots in their attempts to make and receive referrals and their awareness that the consultants with whom they were dealing were reasonably wary given that the ubiquitous title did not carry any assurance of competence. It is also true that what cannot be defined cannot be counted, so although we know that there are 840 nurse consultants in the country no figure can be placed on nurse practitioners (Royal College of Nursing, 2003b).

In a speech to the Royal College of Nursing Congress in 2000, Secretary of State Alan Milburn listed ten things that any nurse with the appropriate skills should be able to do:

- order diagnostic investigations, such as pathology tests and x ray examinations
- make and receive referrals to, for example, therapists and pain consultants
- admit and discharge patients for specified conditions and with agreed protocols
- manage their own patient caseloads, for example, for diabetes or rheumatology
- run their own clinics, for example, for ophthalmology or dermatology
- prescribe medicines and treatment
- carry out a wide range of resuscitation procedures, such as defibrillation and intubation
- perform minor surgery and outpatient procedures
- use computerised decision support to triage patients to the most appropriate health professional
- take a lead in the way that local health services are organised and run.

Extending nursing roles as indicated can, it is claimed, reduce waiting lists and improve staff morale (Stokes, 1997).

The upskilling of the NHS workforce, however, is not restricted to nurses although they were the first and largest group to make substantial

alterations to their practices. The strategy document *Meeting the Challenge* (Department of Health, 2000c) set out a number of changing roles. In some parts of the country, radiographers have learned to read mammograms and X-rays, compensating for the shortage of radiologists, and radiology assistants have been trained to substitute for their trained counterparts. The Royal College of Anaesthetists has recently recognised the possibility of training others in the maintenance of anaesthesia, a practice well-established in the USA (Cooper, 2004). However, when, in August 2003, the Department of Health published ten key roles for allied health professionals (AHPs), these were less specifically task driven and more aspirational than those developed for nursing – probably inevitable given the broad range of professions subsumed within the banner of AHP:

- to be a first point of contact for patient care, including single assessment
- to diagnose, request and assess diagnostic tests, and prescribe, working with protocols where appropriate
- to discharge and/or refer patients to other services, working with protocols where appropriate
- to train and develop, teach and mentor, educate and inform allied health professionals, other health and care professionals, students, patients and carers, including the provision of consultancy support to other roles and services in respect of patient independence and functioning.
- to develop extended clinical and practitioner roles which cross professional and organisational boundaries
- to manage and lead teams, projects, services and case loads, providing clinical leadership
- to develop and apply the best available research evidence and evaluative thinking in all areas of practice
- to play a central role in the promotion of health and well-being
- to take an active role in strategic planning and policy development for local organisations and services
- to extend and improve collaboration with other professions and services, including shared working practices and tools.

In 2002, the Modernisation Agency brought together a series of pilots under the umbrella of the Changing Workforce Programme (CWP) and extended them to assist the NHS to 're-engineer' patient services. Assisted by the dual concepts of the skills escalator and the Agenda for Change pay provisions, the aim of the programme is to concentrate on the patient experience, and to promote the most efficient and effective ways of delivering care. That the optimum patient journey might entail staff carrying out tasks traditionally undertaken by members of other professions or occupational groups is an explicit component of the plan to create flexibility in the workforce. CWP pilots include new roles for assistants to allied health professionals, such as the use of assistant

audiologists to run an analogue hearing aid project, and the development of foot care assistants. Generic rehabilitation assistants provide a seven-day service supporting the work of physiotherapists, occupational therapists and speech and language therapists in stroke care and continue rehabilitation care at home. In North Derbyshire health and social care assistants work with the elderly at home and a nurse consultant in dementia carries out mental health assessments, supports families and prescribes under protocols. The creation of the paramedic as first responder in emergencies was the initial step towards the development of an emergency practitioner role where nurses, paramedics and physiotherapists are trained to work flexibly in response to calls for emergency doctors and ambulances, staffing A&E, and undertaking home visits for GPs.

In June 2003 the Standing Conference of Workforce Development Confederations produced a draft proposal to develop a national framework for assistant practitioners and advanced practitioners. In the field of mental health, psychology graduates are being used in inpatient care and more recently in primary care. One pilot study developed in the north of England captured the skills of pharmacists to take patient drug histories and to titrate doses to minimise side-effects of long-term drugs, roles hitherto firmly in the domain of psychiatrists.

The European Working Time Directive has spawned 19 confirmed pilot projects and discussion is under way on one related to the practice of anaesthesia. Most of these involve redefinition of roles and include development of medical support workers (for example, the use of pharmacy technicians to manage patient medicines, extensions to the role of critical care practitioners and further development of the emergency medical assistant role) and a number aim to introduce or increase senior nurses or nurse practitioners to substitute for or support night cover by doctors in training. Extension of nursing roles includes the introduction of peri-operative practitioners.

In his report considering the future of the NHS, Wanless (2002) reported that while nursing projections were sound, if the potential for transfer of work from doctors to nurse practitioners was fully exploited, this would have implications for capacity:

If 20 per cent of GP and junior doctors' work were shifted to Nurse Practitioners, this would eliminate any potential capacity constraint in doctor numbers. However, it would then introduce a potential shortfall in the supply of nurses.

(Wanless, 2002)

Other authors, while welcoming the substitution agenda in nursing, have echoed similar concerns about the capacity of the workforce to embrace new roles while maintaining their traditional responsibilities (Calpin-Davies, 1999; Royal College of Nursing, 2003b). Herein lies the dilemma of workforce study – that it is not possible to examine the one profession's impact on patient outcomes without taking into account its relationship with other groups. In the case of registered nurses, for example, other relevant variables include the availability and

expectations of doctors, health care assistants, ward clerks and housekeeping staff.

Neither is the impact purely one of juggling numbers. A recent paper by Charles-Jones and colleagues has examined the changing discourse in primary care since the development of triage nurses and nurse practitioners (Charles-Jones *et al.*, 2003). The authors suggest that in this setting the patient is reduced to a biomedical need and the decision is taken on the basis of who could meet that need. Access to primary care may be increased, but access to the doctor is in fact restricted to those patients who can prove that they are worthy of the time of the GP. In staff terms, far from blurring role boundaries, the new freedoms have in some senses tended to sharpen them, the nurse practitioner being able to see patients with urinary tract infections but not chest infections and delegating dressings and travel vaccinations to a lower-grade nurse. While the rhetoric of the changing workforce programme is about rationalisation and streamlining of work from the viewpoint of the patient, the reality in this case was of fragmentation and a loss of holism. Furthermore, the system may be less efficient for the patient, who may have to return to the surgery on more than one occasion to attend appointments with different members of the skill-determined team.

The achievement of a more flexible workforce is being facilitated by the careful placing of educational contracts with organisations that can deliver flexible training packages geared to individual and corporate development needs. The acceptance of the NVQ3 qualification as an access criterion for nurse education has assisted the smooth transition of health care assistants to qualified nursing status. However, there is less flexibility in pathways to become a doctor (Davies *et al.*, 2001).

Indeed, the BMA's response to consultation on human resources in the NHS Plan makes it clear that the concept of the skills escalator is welcome for 'nursing and other professional training', and welcomes the concept of generic training in as much as it will assist 'doctors wishing to retrain in another specialty' (British Medical Association, 2002a). This separation of medicine from all other professions is exemplified by omitting doctors from the Agenda for Change.

4.7 Staffing and adverse events

The documents *Organisation with a Memory* (Department of Health, 2000b) and *Building a Safer NHS for Patients* (Department of Health, 2001a) tackled the issue of adverse events in hospitals. The former recognised that adverse events occur in 10 per cent of admissions and put the cost of these in extended hospital stays at an estimated £2 billion. It recommended the development of an open and safe culture, in which mistakes could be recognised and dealt with, and the establishment of a National Patient Safety Agency. It also proposed a national reporting system to promote the dissemination of lessons

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learned with a view to reducing mortality and morbidity arising from medical error.

Cohen (1999: 20.8) cites 'errors resulting from excessive workload' as being a contributory factor in medication errors and this is supported by evidence from Australia (Peterson *et al.*, 1999).

The New Deal for hospital doctors, referred to above, responds to fears that the long hours worked by junior doctors contribute to error (Strachan, 1993). The BMA's paper *Patient Safety and Clinical Risk* (British Medical Association, 2002b) listed heavy workloads as implicated in the cause of adverse incidents.

The public inquiry concerning Bristol Royal Infirmary made recommendations on staff management and outcomes. The report criticised the availability of paediatric nursing staff on the unit (Kennedy, 2001) and recommended the adoption of the standard staffing ratio. Another, relating to staff management, included that of compulsory and (incentivised) commitment to continuing professional development (Kennedy, 2001) and regular appraisal, both of which necessitate time away from direct patient care.

Section 5 Results

5.1 Findings from interviews and reference groups

Analysis of the data from the Department of Health interviewees was consistent and reflected the information given within the policy background. A number of key themes were evident in the analysis from all respondents, which are presented as follows:

- Drivers for change/current agenda
- New workforce numbers systems
- Staffing levels
- Skill mix
- Research priorities
- Other issues.

5.1.1 Drivers for change

There was little evidence of outcomes data directly featuring among the factors influencing staffing decisions, although the NSFs are outcomes focused. Thus, for example, as the evidence indicates that revascularisation improves the outcome for patients who have coronary artery disease, it should follow that an increase in the number of cardiac surgeons with a commensurate increase in the number of revascularisation procedures taking place should lead to improved outcomes for patients.

Key determinants for changes in staffing decisions are government activity targets and the European Working Time Directive.

- Relevant government activity targets include the goals of increasing access to the most appropriate treatments, reducing waiting lists and having more care delivered by consultants.
- The European Working Time Directive was viewed as both a threat and an opportunity.
- Two respondents suggested that general medicine would be the area worst hit by the imposition of the Directive.
- Size of population of remote rural areas may not support doctor numbers required to fulfil the Directive – may require fast transfer to larger centres.
- The Directive offers an opportunity to review working practices and patterns of service provision

5.1.2 New workforce numbers systems

- The principle of grounding staffing numbers in service developments through the creation of the care group teams was felt by Department of Health respondents to be a more rational way to proceed, although for some other respondents the new system was less rigorous than the ratios laid down by the Royal Colleges.
- Rise in numbers represents percentage rise in activity translated into staffing. At local level, the demand-side analytical model underpinning the local development plans was said to mirror the methodology used to construct the NHS spending review bid to the Treasury.
- On the supply side, the decision process was assisted by the Department of Health dividing up the country into 28 weighted elements and shared out the national target for staff increases, giving strategic health authorities (SHAs) a benchmark figure. Using this average weighted figure, SHAs were required to calculate their actual requirement based on their relationship to the national average.
- Each of the seven care group workforce teams has a lead confederation and has representation from policy, workforce experts and membership from Royal Colleges.
- Care groups permit a view of all staff, not just one profession.
- One respondent argued that there was a tendency for careful planning of numbers to give way to political priorities following adverse publicity.
- Human resource information is good for doctors, showing speciality and grade, but poor for other staff. It is claimed that the electronic staff record will address this.
- Specialties not covered by an NSF and corresponding care group team fare badly.
- Workforce Development Confederations are performance-managing all human resource targets

5.1.3 Staffing levels

Doctors

- UK is under-staffed for doctors in comparison with rest of the world.
- General acknowledgement of shortfalls in the medical workforce required to achieve the NSF targets.
- Establishing new consultant post involves getting agreement from all primary care trusts with which a trust articulates, gaining the agreement of consultants in post, obtaining Royal College approval and finding a suitable candidate. At least one respondent identified problems in each of these areas.

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- Increase in training capacity under way, with a view to producing as many consultants as the system can support – a departure from the carefully regulated numbers used hitherto which led to a build-up in the Senior House Officer (SHO) grade. Extra Specialist Registrar (SpR) posts announced and trusts have freedom to fund others.
- Current proposals for modernising medical training would offer more flexibility.
- Siting of new medical schools intended to address shortages in specific regions, although there is a recognition that medicine is a highly sophisticated profession with international job opportunities.
- Four respondents reported anecdotal evidence of consultants opposing new appointments, preferring an increase in support staff, said to be linked to protection of private practice.
- Despite messages from Centre, the Mental Health NSF Policy Implementation Guide was prescriptive along professional lines.
- Flexibility has also been introduced into the allocation of specialist registrar posts, with trusts being given the opportunity to map their requirements into the multiprofessional education and training levy.
- Sufficient numbers of GPs trained for strong growth in GP numbers, but graduates choose not to work as GPs. Actual return from training reported at 60 per cent after after 5 years. GPs also tend to gravitate to more affluent areas.
- Overseas recruitment of cardio-thoracic surgeons opposed by UK consultants who believed that they had the capacity to increase their own productivity. The constraints were said to lie in shortages of staffed theatre time.
- Overseas recruitment of physicians said to be hampered by requirement to assume a share of the workload in general medicine – a rare requirement overseas.
- Reducing stress among senior consultants might relieve shortage by encouraging older members of the profession to continue in the NHS.
- Development of DTCs will have an impact on numbers.

Nursing, midwifery and professions allied to medicine

- Nursing numbers running ahead of the model, but general agreement that the model underestimates numbers required by NHS.
- Mental Health Care group has recognised insufficient numbers entering this specialty. There has been no attempt to redistribute training places to areas of shortage. Those who can train more, get more places.

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- Working from the modelling system devised by the Royal College of Midwives it is estimated that there are sufficient midwives in the country. Shortage attributed to fact that not all trained midwives choose to work in that capacity.
- Shortage of nurse educators – no pay incentive to move from NHS to higher education and no clear pathway.

5.1.4 Skill mix

- Innovative changes in working patterns being developed in response to the European Working Time Directive.
- The Skills Escalator and Agenda for Change provisions were hailed as pivotal to the process, allowing the recognition of individual skill packages that were a good fit for local requirements.
- One trust has imported some qualified physician's assistants.
- Eight trusts are experimenting with nurse anaesthetists.
- Not all changing roles involve a downward shift – increasing amounts of direct care being given by consultants.
- Protocol-based care is designed to reduce 'hand-off' gaps (errors caused by inadequate handover between professional groups or shifts).
- Nurses may be cheaper to employ but three respondents queried whether they were necessarily cost-effective – they give longer consultations and order more investigations.
- HCAs could take over more nursing work based on individual competencies. Soft skills sometimes overlooked in competency approach – health care assistants may be able to give direct care but not be able to answer questions and reduce anxiety.
- One respondent reported that for the first time some GPs are beginning to view nurses as rivals.
- Radiographers being upskilled to take over some duties of radiologists was said by three respondents to be an important development in increasing quality of care.

Outcomes

- As skill mix changes, recognition that non-clinician physicians may subscribe to different sets of outcomes, such as improving the quality of life at the expense of its length.
- In mental health, outcomes need to include user satisfaction and quality of life measures, including success in entering work.
- It was pointed out that there was a time lag of about two years between the availability of staffing data and outcomes data.

5.1.5 Research priorities

Skill mix

- At what level does skill mix change begin to have an adverse effect on outcomes including error rates?
- Substitution – is there a need for evaluation to continue into later generations to test whether initial quality is maintained?
- What do doctors (GPs and consultants) do with time freed up by nurses?
- Supervision costs and increased consumption of resources need to be factored into the assessment of cost-effectiveness in skill mix change studies.
- Impact of changing workforce programme work on patient outcomes.
- Assessing cost-effectiveness of move to consultant-delivered service.
- As nurses undertake more specialised work, is there an effect on general quality of nursing care?
- In primary care, investigate trade-off of loss of continuity versus greater access and relate to outcomes.

Numbers

- What is the impact of nursing numbers on outcomes and the impact of nurse staffing models on patient outcomes?
- What is the impact of nurse staffing levels on deaths from acute myocardial infarction (AMI)?
- As ratios of cardiologists to population rise, does mortality rate decrease? MINAP data needs to be interrogated.
- Outcomes data needed to support Royal College benchmarks.

HR issues

- Assessment of the impact of use of agency staff: patient outcomes.
- Relationship between hospital staffing ratios and standardised mortality rates.

New services

- Impact on patient outcomes of the development of special interests among GPs.
- Effect of active management of chronic disease on outcomes.

5.1.6 Other issues

- Requirement for robust national data on human resources by staff group, specialty, grade, contract status and age.
- One respondent suggested that patient outcomes were closely bound up with staff outcomes, staff satisfaction and sickness.
- Patients should be involved in the design of research and in the definition of outcomes.
- In primary care, outcomes of consultations should feature among outcomes.
- Links between specialty figures and mortality rates for physicians difficult to assess because of high percentage of time spent in general medicine.

5.2 Findings from the research: quantity of the workforce

This section examines the literature under the broad heading of 'quantity of the workforce'. It focuses on different 'numbers' of a professional group and the subsequent impact on patient outcomes. The mix or the proportion of a professional group, which is closely linked and often explored in studies simultaneously, is dealt with in the skill mix section. Within the area of quantity of the workforce forty-seven studies were retrieved and the literature broke down into four categories: workforce to patient/population ratios, workforce hours, availability of the workforce and the addition of a pharmacist to the team. A summary of the findings for each category is detailed below.

5.2.1 Workforce ratios

Workforce ratios are summarised in three parts:

- 1 workforce:patient ratios
- 2 workforce hours:patient day ratios
- 3 workforce:population ratios.

Workforce:patient ratios

Workforce:patient ratios can be defined as the number of a particular health professional available per patient and they are important because they are often reduced in an effort to reduce costs. However, by increasing the number of patients each member of staff cares for, the time available for direct patient care is potentially reduced and increasing ratios could be counter-productive because of the increased the cost of treating negative outcomes. For example, allowing sufficient time for surveillance should ensure early detection of potential adverse events and allow prompt interventions to prevent these outcomes developing further. However, if workforce:patient ratios are decreased the potential time available for such surveillance is reduced.

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Eight studies (nine papers) were found that examined the relationship between workforce ratios and patient outcome(s). Three of these were observational studies by the same team looking at nurse:patient ratios in the intensive care unit both at night and during the day for different patient groups (Dang *et al.*, 2002; Dimick *et al.*, 2001b; Pronovost *et al.*, 2001; Amaravadi *et al.*, 2000). All of these studies used the same data source, collection methods and survey data to investigate this area in Maryland. Overall, six of the eight studies reported that higher nurse:patient ratios were beneficial for patients in terms of a reduction in mortality, failure to rescue, infections, re-admissions and complications.

Mandated nurse:patient ratios were implemented in July 2003 in California after legislation was passed in 1999. In response to this a study was carried out in Pennsylvania to assess the effect of these ratios on mortality and failure to rescue (Aiken *et al.*, 2002). This cross-sectional study of 232,342 patients found that the risk of both outcomes was significantly lower if the nurse:patient ratios were higher (more patients per nurse). These relationships continued after adjustments for patient and hospital characteristics. Direct standardisation techniques were used to predict excess deaths in all patients and patients with complications that would be expected if the nurse:patient ratios were at various levels in the California staffing mandates. They found that ratios of 6:4, 8:6 and 8:4 were associated with 2.3, 2.6 and 5 additional deaths per 1000 patients and 8.7, 9.5 and 18.2 additional deaths per 1000 patients with complications.

Two studies compared outcomes in wards where night-time nurse:patient ratios were at least one nurse per two patients with outcomes where each nurse cared for three or more patients (Dimick *et al.*, 2001b; Amaravadi *et al.*, 2000). The analyses were based on 353 oesophagectomy patients in 32 acute care hospitals and 556 hepatectomy patients in 33 acute care hospitals. After adjustments were made, no significant differences were found in the risk of in-hospital mortality between the two ratios. No statistically significant difference in length of stay was found when properly analysed, but the number of patients was small. In one study, four of the nine post-operative complications were found to be more frequent with higher workload., although, it was unclear whether adjustments for patient or hospital characteristics were made. After adjustments in the second study only one of the nine complications, re-intubation, remained statistically significant.

A case-control study based in the Netherlands also investigated differences in ratios during the day, evening and night and found that the greatest number of falls by stroke patients occurred in the daytime, when most nursing staff were present (Tutuarima *et al.*, 1993). This study matched patients on a number of characteristics and involved a convenience sample of nine hospitals that included 349 patients. However, patients are more likely to be active during the day as compared to other times, highlighting that patients will spend more

time at risk of having a fall during the day. Therefore the appropriateness of the outcome measure in this study is questionable and consequently will not be considered further in this scoping exercise.

Another study used a data set of 2606 patients in 38 hospitals across Maryland to investigate complications of patients undergoing abdominal aortic surgery with overall nurse:patient ratios and nurse:patient ratios during the day (Dang *et al.*, 2002). The overall estimate defined low as a ratio of 1:3 or more on both shifts, medium 1:3 or more on either shift, but not both, and high 1:2 or less on both shifts. The study looking at overall staffing ratios found lower rates of complications for patients treated on units with higher nurse:patient ratios. Patients cared for on units with low-intensity staffing were more than twice as likely to have respiratory complications as patients on high-intensity staffing units. Ratios during the day also highlighted an association between fewer ICU nurses per patient and an increased risk of medical complications. The surgical complication results were more ambiguous, but were based on a smaller number of complications.

A further study, based in a surgical intensive care unit (SICU) at a university-affiliated Veterans Affairs medical centre in Arizona, investigated possible factors that affected an 'outbreak' in central venous catheter-associated bloodstream infections (Fridkin *et al.*, 1996). It utilised both a case-control and a retrospective cohort study design and indicated that a ratio of one nurse to at least 1.26 patients was associated with the occurrence of one or more infections in the SICU. A Scottish cross-sectional study of 23 general hospitals found that registered nurse:patient ratios varied across trusts from 0.71 to 1.66 qualified nurses per patient (Hunt and Hagen, 1998). Multiple regression analysis indicated that increased re-admission rates (but not mortality) were associated with lower total nurse:patient ratios.

Over a four-year period, eight million admissions were analysed to investigate factors that best explain variation in death rates across the UK (Jarman *et al.*, 1999). Higher hospital-standardised mortality ratios were associated with lower numbers of hospital doctors per 100 hospital beds. However, the measures used to adjust for the severity of illness may have been inadequate. The effect of other staffing ratios was not considered simultaneously.

Overall, six of the eight studies reported that higher professional:patient ratios (fewer patients per professional) were associated with a reduction in mortality, failure-to-rescue events, infections, re-admissions and complications. The other two studies focused on night-time nurse:patient ratios and found inconsistent results for length of stay and complications, but no significant difference in mortality between hospitals with a ratio of one nurse to two patients or less and those with more than two patients per nurse. All of the studies were non-experimental and although it was clear from the majority of studies that adjustments were made for patient characteristics it is not clear how this has been done.

Workforce hours:patient day ratios

Fifteen studies were retrieved that explored the relationship between workforce hours per patient day and patient outcomes. Workforce hours:patient ratio in this report refers to both overall numbers of staff (for example, nursing personnel) per patient day and numbers of an individual professional group (such as RN) hours per patient day, but not the proportion or mix of staff (this is summarised in the section on skill mix). Standardising the workforce hours by patient days controls for the size and occupancy of the units.

One state-wide study of 59 nursing homes looked at staffing levels of directors of nursing, Registered Nurses (RNs), Licensed Practical Nurses (LPNs), aides, therapists, physicians, volunteers and administrators and the relationship with infections (Zimmerman *et al.*, 2002). The results found that more therapist full-time equivalents (ftes), more LPN ftes and fewer nursing aides were associated with increases in infection rates. The authors state that adjustments for patient and hospital characteristics were performed but as the point estimate did not differ substantially the unadjusted figures were quoted.

Two studies carried out by the same author investigated the relationship between the number of fte staff per adjusted patient day and adverse events (Kovner and Gergen, 1998; Kovner *et al.*, 2002). The earlier study represented a stratified probability sample of 506 acute care hospitals from ten of the 17 states in the National Inpatient Sample. It investigated nurse-sensitive adverse events (those that can be directly linked to care given by nurses) and non-nurse-sensitive outcomes with adjustments for patient and hospital characteristics (Kovner and Gergen, 1998). A significant inverse relationship was found between fte of RNs and urinary tract infection (UTI), pneumonia, thrombosis and pulmonary compromise. Hospitals with nurse practitioners did not have a statistically significant relationship with adverse events. However, those with more physician assistants had higher rates of pneumonia and thrombosis after surgery. The second study focused on RNs, LPNs, physicians and dentists, residents and interns (Kovner *et al.*, 2002). After controlling for other variables the authors found that RN hours per adjusted patient day was significantly inversely related to pneumonia. LPN hours per adjusted patient day was not significantly associated with any adverse event. Physicians and Dentists hours were only significantly related to thrombosis. However, a significant difference was found with resident/intern hours and three of the four adverse events. Similar adjustments were made for this study as described above. One limitation of this study is that the data used did not distinguish between direct-care RNs and those RNs employed by the hospital in indirect or management roles.

Predefined hypotheses were investigated in a cross-sectional study of various types of the workforce and mortality of chronic obstructive pulmonary disease (COPD) patients (Robertson and Hassan, 1999). The hypotheses were that higher staffing intensities of nurses, ancillary

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nurses, respiratory care practitioners, radiographic workers and laboratory personnel would have lower risk-adjusted mortality rates. Three of the four hypotheses were not supported by the data, but it was found that hospitals with higher staffing intensities of respiratory care practitioners indeed did have lower risk-adjusted mortality rates. No information was given on the sample size and the geographical distribution of the study hospitals.

Survey data from 1116 hospitals throughout eight regions in the USA were used to explore the relationship between levels of the workforce and medication errors (Bond *et al.*, 2001). Multiple regression was used to investigate the relationships and the authors found that a decrease in medication errors was associated with the number of medical residents, registered nurses and pharmacists while rising numbers of other staff showed a significant positive association with medication errors. Only 46 per cent of people responded to this survey and the only adjustments made were for the severity of illness in the multiple regression analyses. The study also used data from 1992 but was published in 2001 and hence may not be representative of health care today.

A secondary analysis of observational data was used to explore the relationship between nurses' worked hours per patient day and various complications (Whitman *et al.*, 2002). The analysis was based on 95 patient care units across ten adult care hospitals and split into five specialty units: cardiac intensive care (CICU), non-cardiac intensive care (NCICU), cardiac intermediate care (CIMC), non-cardiac intermediate care (NCIMC) and medical-surgical (MS). No statistically significant relationships were found between the outcomes of central line infections and pressure ulcers and the worked hours across all of the specialty units. Inverse relationships were found between worked hours and falls in the CIMC units and medication errors in the CICU and NCIMC units. Adjustments for case mix were not made.

The total productive hours worked by all nursing personnel per patient day and those worked by RNs were retrospectively assessed for their impact on adverse events (Cho *et al.*, 2003). Data for 232 hospitals in California were used and adjustments were made for patient and hospital characteristics. The results found that RN hours had a significant inverse relationship with pneumonia (OR = 0.91) but all hours had a positive relationship with pressure ulcers (OR = 1.13). However, the other relationships (patient falls, adverse drug events (ADEs), UTIs, wound infections and sepsis) were not statistically significant.

A retrospective design was used to explore the effects of nursing-related hospital variables on 30-day mortality (Tourangeau *et al.*, 2002). The study analysed data from 75 acute-care teaching and community hospitals and represented 4 per cent of all patients discharged from acute care hospitals in Ontario. The results indicated that nurse staffing, which was measured as the total inpatient clinical

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nursing workload hours per Ontario case weight, was not related to 30-day mortality. Adjustments were made for both patient and hospital characteristics. The hours worked per patient day for all staff, for RNs and for unlicensed assistive personnel and patient outcomes were investigated in another study using a retrospective cohort design (Sovie and Jawad, 2001). The results from 29 university teaching hospitals in one state found that increased RN hours and all staff hours worked per patient day were associated with lower fall rates and higher patient satisfaction levels with pain management. Increased hours by all staff were also associated with a reduction in UTI rates. However, different survey instruments with different scales were used to collect the data on patients' satisfaction. Adjustments were made for age and total dependence score.

Two papers, by the same primary author, investigated the correlation between all hours of nursing personnel care per patient day and adverse events (Blegen *et al.*, 1998; Blegen and Vaughn, 1998). Multivariate models were evaluated for each dependent variable. In one of the models, which contained patient acuity, all hours and the RN proportion it was reported that higher total hours of care were associated with significantly higher incidence of decubiti, complaints and death (Blegen *et al.*, 1998). Multiple regression was then used with an additional dummy variable for the upper 25 per cent of RN proportion and found that the outcomes increased as the overall staffing increased, apart from medication errors; however, they were all non-significant. The second study had a sample of 39 units from 11 hospitals that were members of the Institute for Quality Healthcare (IQH) and looked at the relationship between all hours of care and three adverse events (Blegen and Vaughn, 1998). Multiple regression was used again, with variables included to control for patient severity. Units with greater hours of care per patient day from all staff had statistically higher rates of medication errors.

A cross-sectional study using administrative data for 799 hospitals in 11 states representing 26 per cent of all hospitals in the US examined the relationship between the amount of care provided by nurses at the hospital and various patient outcomes (Needleman *et al.*, 2002). Consistent relationships (the changes being in the same direction among all of the models of nursing) were found between RN hours and length of stay, UTIs, pneumonia and upper gastrointestinal bleeding for medical patients, and failure to rescue for surgical patients. After adjustments for patient and hospital characteristics, as staffing increased the incidence of the adverse events decreased. This study represents 26 per cent of all hospitals in the USA.

The American Nurses Association used data from California, Massachusetts and New York to explore RN staffing, length of stay (LOS) and adverse events (American Nurses' Association (ANA), 1997). Nursing Intensity Weights (NIWs) are used to recognise differences in patients' acuity of need for nursing care. For New York in 1994 an increase of one hour of nursing care per NIW would predict 4.4 per cent

lower hospital LOS than the average state. Similar relationships were found for 1992 in New York, both years in California and 1992 for Massachusetts. Infection rates were not significantly related to total hours per NIW and the results for pneumonia rates and pressure ulcers were inconsistent across states and years. The authors stated that the quality of the data received from the reports was very uneven, especially nursing hours. In each state a large proportion of hospitals had to be excluded from the study due to non-reporting or obvious errors.

Finally, a study of 782 admissions assessed the effect of fluctuations in cardiac ICU monthly nursing hours per patient day on nosocomial infections (Archibald *et al.*, 1997). The data suggested that although the infection rate initially fell with increased numbers of hours worked by RNs, there was a threshold, 7600 hours, above which infection rates increased. This study was based in a single children's hospital in Philadelphia and made no adjustments for case mix.

Overall staffing levels: Nine studies were found that investigated overall staffing and the relationship with different patient outcomes. Eight of these focused on the overall nursing personnel staffing levels (Whitman *et al.*, 2002; Sovie and Jawad, 2001; Fridkin *et al.*, 1996; Cho *et al.*, 2003; Blegen *et al.*, 1998; Blegen and Vaughn, 1998; American Nurses' Association (ANA), 1997; Tourangeau *et al.*, 2002) and the remaining study considered all staff (Bond *et al.*, 2001).

- The study investigating the all-staff hours (Bond *et al.*, 2001) found a positive relationship with medication errors; hence, as the total hours of care increased so did medication errors. Adjustments were made for severity of the patient's condition. The eight studies looking at nursing personnel staffing levels found conflicting results for the outcomes studied. All of the studies were non-experimental and the majority based in secondary care. The statistical adjustments were mixed, with three studies controlling only for the hospital characteristics of size and occupancy (Whitman *et al.*, 2002; Blegen *et al.*, 1998; Blegen and Vaughn, 1998). One study adjusted for hospital characteristics and the acuity of patients (American Nurses' Association (ANA), 1997), one study for patient characteristics, size and occupancy (Sovie and Jawad, 2001), and the final two studies adjusting for both hospital and patient characteristics (Cho *et al.*, 2003; Tourangeau *et al.*, 2002).
- Together the two studies with the most comprehensive adjustments found a significant increase in pressure ulcers but not for six other adverse events or mortality (Cho *et al.*, 2003; Tourangeau *et al.*, 2002). The two studies that did not adjust for patient characteristics both reported a beneficial effect for patients by increasing the overall workforce hours per patient day (Whitman *et al.*, 2002; Fridkin *et al.*, 1996). Hence, the type of adjustments made for case mix could potentially explain some of the variation in the results.

Registered nurses: Seven studies investigated RN staffing levels and the impact on patient outcomes (Needleman *et al.*, 2002; Sovie and Jawad, 2001; Bond *et al.*, 2001; Cho *et al.*, 2003; Archibald *et al.*, 1997; Kovner *et al.*, 2002; Kovner and Gergen, 1998). Six out of the seven studies looking at pneumonia found a significant decrease with an increase in RN hours. However, the study that did not (Needleman *et al.*, 2002) was the largest of the studies, representing 26 per cent of all discharges from non-federal hospitals in the USA during 1997, and was one of the best-quality studies. The results for other complications and adverse events were inconsistent. However, this could be due to the low power of some of the studies to detect a change in rare outcomes. All of the studies were non-experimental and based in secondary care, and six of the studies made adjustments for both patient and hospital characteristics (Needleman *et al.*, 2002; Sovie and Jawad, 2001; Bond *et al.*, 2001; Cho *et al.*, 2003; Kovner *et al.*, 2002; Kovner and Gergen, 1998).

LPNs' hours: The two studies that investigated LPN hours (Bond *et al.*, 2001; Kovner *et al.*, 2002) both found no association between adverse events and medication errors. Adjustments were made for patient and hospital characteristics in one study (Kovner *et al.*, 2002) and severity of the patient's condition in the other study (Bond *et al.*, 2001).

Other staffing hours: Four of the studies also focused on the relationship between other types of staffing hours and patient outcomes (Bond *et al.*, 2001; Robertson and Hassan, 1999; Kovner *et al.*, 2002; Kovner and Gergen, 1998). One study also looked at physician assistants, therapists, physicians, administrators, residents/interns, pharmacists, medical technologists, dieticians and social workers (Bond *et al.*, 2001). Inverse relationships were found for medical residents and pharmacy residents with medication errors. Conversely, the remaining significant relationships, for administrators, registered pharmacists and physical therapists, all found increases in medication errors. However, severity of the patient's condition was the only factor used to adjust for case mix. A second study (Kovner *et al.*, 2002) found that physicians and dentists had an inverse association with thrombosis, as did residents/interns with three out of four adverse events. Finally, no statistically significant relationship was found between mortality and ancillary nurses, radiological workers and laboratory technicians. However, increases in respiratory care practitioners were found to reduce mortality.

Nursing homes: Two studies were found that investigated the size of the workforce in nursing homes and its impact on resident outcomes (Zimmerman *et al.*, 2002; Bliesmer *et al.*, 1998). The two studies gave conflicting results. While one found that increases in therapists and LPNs and a decrease in nursing aides were all risk factors for infections (Zimmerman *et al.*, 2002), the second found that increases in licensed nursing hours (RNs and LPNs) decreased the risk of mortality (Bliesmer *et al.*, 1998). Both studies stated that adjustments were made for

patient and hospital characteristics but the second study reported only unadjusted figures.

Workforce:population ratios

Five studies focused on the supply of a workforce and its association with mortality. A UK ecological study that considered the availability of doctors in primary care, measured by the number of GPs per 10,000 population, found that infant mortality, all-cause mortality and mortality from acute myocardial infarction were all lower in areas with more GPs (Gulliford, 2002). However, after adjustments for deprivation, social class and race there was only weak evidence for the association and when limiting long-standing illness was included there was no association. Another UK study investigated factors to help explain the variation in hospital death rates across the country (Jarman *et al.*, 1999). Eight million admissions were analysed over a four-year period and the general practitioners per head of the population were significantly related to mortality. The measures used to adjust for the severity of illness may have been inadequate and as no causal relationship can be inferred from the data.

A second ecological study, this time focusing on 67 counties in Florida, found that by increasing the supply of primary care physicians by 1 per cent a reduction of 0.08 deaths per 100,000 population occurred. In contrast, when overall physician supply, both in and out of primary care, was considered it was found to be unrelated to mortality (Roetzheim *et al.*, 2001). The supply of primary care physicians was defined as the proportion of all physicians who were in a primary care speciality. Adjustments were made for age, but it is unclear if any further adjustments were made. An ecological study focusing on 148 countries for physicians and 149 countries for nurses, found that countries with high infant and under-5 mortality rates also had low numbers of physicians and nurses (Robinson and Wharrad, 2000). Multiple regression analyses found that 2 per cent of the variation in infant mortality was associated with physicians per 1000 population and that physicians per 1000 population were associated with 66 per cent of the variation in under-5 mortality, but nurses added nothing further to the outcome. However, there are many problems associated with this study, including the ecologic fallacy, no global definition of a nurse, and inadequate adjustments for population characteristics related to likely health outcomes.

Linked birth and death records for the 3,892,208 newborns that formed the 1995 US birth cohort were used to assess the association between supply of neonatologists and neonatal intensive care beds per capita and the risk of mortality, with adjustments for case mix (Goodman *et al.*, 2002). The risk of neonatal death was lower in regions with 4.3 neonatologists per 10,000 births. However, little additional benefit was seen with further increases in the supply of neonatologists. An association between a very low supply of neonatologists and an

increase in the risk of death was limited to infants with the lowest birthweight.

The two UK studies found a significant relationship between the workforce:population ratios and mortality. However, these two studies made inadequate adjustments for the severity of the patient's condition. The other three studies did not report the same relationship, but the two ecological studies are open to the ecologic fallacy and the third study used data from 1998 and 1999 to calculate the supply of neonatologists for the 1995 cohort. Hence, all of the studies have limitations and consequently firm conclusions cannot be drawn.

5.2.2 Workforce hours

The three studies in this section reported workforce hours, which are not adjusted per patient day or per bed. The first study, in a general internal medicine teaching service, investigated the impact of a New York State regulation, which restricted house staff working hours to fewer than 80 hours per week, on mortality, LOS and in-hospital medical complications (Laine *et al.*, 1993). While the most serious outcomes were statistically unchanged, overall in-hospital complications were more frequent after the regulation. Adjusted odds ratio was reported only for patients with at least one complication and was 1.9. However, the low power of the study reduced its ability to detect differences in less frequent, more serious outcomes.

A second study focusing on nursing homes found that increased licensed nursing hours, which included registered nurses and licensed practical nurses, were associated with a lower risk of death for the three years studied (Bliesmer *et al.*, 1998). The results for non-licensed nursing hours increased in significance throughout the study period from being non-significant to a significant difference at the 1 per cent level. Adjustments were made for both patient and nursing home characteristics. Finally, a convenience sample of 211 hospitals in Pennsylvania was assessed to examine the relationship between licensed nursing staff and adverse events (Unruh, 2003). It was reported that hospitals with more licensed nurses had significantly lower incidences of atelectasis, ulcers, falls and UTIs, but higher rates of pneumonia. Adjustments were made for patient and hospital characteristics.

Maternity

Three studies examined the variations in nursing and medical staffing levels within different environments on the health outcomes for the mother and/or infant, as measured by mortality.

A UK ecological study using United Nations data from 144 countries was used to examine the incidence of national maternal mortality in relation to the national distribution of doctors and nurses (Robinson, 2001). No exclusion criteria were presented and crude socioeconomic

indicators were used to help explain the results. Statistical adjustments were required to deal with nonlinearity and underlying variances in the data. Adjustments were made for health professionals, GNP and female literacy. Strong positive associations were shown to exist between the ratios of doctors and nurses to the population, and between the proportion of trained health personnel in attendance at birth and maternal mortality rates. High numbers of health personnel were found to correlate with low maternal mortality and vice versa.

The second study was a retrospective observational study carried out in 1988 that focused on activity in 20 maternity units in the West Midlands over a six-year period (Stilwell *et al.*, 1988). The number of overall cases analysed within these units was not reported. The study examined high-risk admissions only, and clinical risk was estimated using the birthweight distribution (low birthweights, and very low birthweights) and single/multiple birth. Socio-demographic variables were not reported; inclusion and exclusion criteria were clearly stated. No case mix adjustment was reported. This study examined the mortality rates of low-birthweight and very low-birthweight infants in relation to the specialist medical staffing of a neonatal intensive care unit. In most years studied there was a strong significant correlation between perinatal or first-week deaths and the proportion of very low-weight births. However, mortality was also negatively correlated with measures of staffing such that mortality was lower when staffing ratios were higher. A stronger correlation was then found between mortality and the number of paediatricians per low-weight births. Overall, it appears that the variation in perinatal mortality is primarily associated with the proportion of low birthweights, but higher paediatric staffing levels are associated with lower mortality rates.

An Australian retrospective study examined the mortality rates of very low-birthweight infants in relation to the nurse staffing of a neonatal intensive care unit (Callaghan *et al.*, 2003). The risk status of this group is unknown and a sample size of 692 was used. Exclusion criteria were stated and although maternal socio-demographic variables were not reported, clinical characteristics were presented. Case mix adjustment was performed using the Clinical Risk Index for Babies (CRIB) and further adjustment was made for dependency. The results found that an increase in the infant:staff ratio did not increase the risk of mortality. In comparison with the lowest infant:staff ratio, the odds of mortality were reduced.

These three studies examined the impact of variations in medical and/or nursing staff on infant or maternal mortality in different settings. At a country-wide level, one study found a rise in health professional levels was indirectly related to attendance at birth and maternal mortality (Robinson, 2001). In the environment of the neonatal special care unit, one study found a rise in nurse staffing levels was directly related to infant mortality (Callaghan *et al.*, 2003), while another study found a rise in the specialist medical staffing levels was indirectly related to infant mortality (Stilwell *et al.*, 1988).

5.2.3 Workforce availability

The literature found in this area explored 24-hour presence of the workforce in the intensive care unit and in trauma centres and the impact on mortality and LOS. One systematic review and a further three primary studies were found that investigated the relationship between the availability of the workforce and patient outcomes. Two other literature reviews also focused on the same topic area as the systematic review and therefore were also not abstracted, but the results were assessed for agreement with the conclusions drawn from the systematic review. The remaining three articles were abstracted and are commented on below.

Intensive care units

The systematic review focused on both randomised controlled trials and observational studies on physician staffing patterns and their effect on mortality and LOS for critically ill patients in the ICU (Pronovost *et al.*, 2002). The staffing patterns were classified as high-intensity staffing, which was either a closed ICU (primary physician is intensivist (critical care physician)) or mandatory (no primary intensivist, but consultation is mandatory) and low-intensity staffing as elective (intensivist consulted at request of physician), or no intensivist (intensivists were unavailable). Twenty-seven cohort and cross-sectional studies were included in the final analysis (including seven primary studies identified by the search (Diringer and Edwards, 2001; Pronovost *et al.*, 1999; Carson *et al.*, 1996; Manthous *et al.*, 1997; Dimick *et al.*, 2001a; Mirski *et al.*, 2001; Ghorra *et al.*, 1999)) and the results indicate that high-intensity staffing led to a significant reduction in ICU and hospital mortality and LOS for critically ill patients. High- versus low-intensity ICU physician staffing led to a pooled unadjusted relative risk of 0.71 and 0.61 for hospital and ICU mortality respectively. Additionally, 10 out of 13 studies looking at LOS reported a reduction in LOS with high-intensity physician staffing. Although on the whole this was a well-conducted, systematic review, the authors pooled the results in the presence of qualitative heterogeneity and the funnel plot presented in the article appeared to be asymmetric, indicating the possibility of publication bias. This would lead to an overestimate of the effect of high-intensity ICU physician staffing and hospital mortality. The first literature review agreed that 24-hour coverage by on-site physicians is mandatory to maintain the service, but at night the presence of an intensivist is not necessary, as long as they are available on call (Burchardi and Moerer, 2001). The second literature review supports the outcomes of the systematic review, but acknowledges the inability of all hospitals to provide this type of cover and proposes that other factors, such as collaboration, continuity and collegial relationships between the ICU team and a patient's primary physician, are important to the successful running of the unit and in maintaining positive patient outcomes (Carlson *et al.*, 1996).

Trauma centres

Two cohort studies in level I trauma centres from the USA were retrieved that considered in-house 24-hour presence policies for surgeons and their effect on mortality and LOS (Arbabi *et al.*, 2003; Doolin *et al.*, 1999). Overall, it appears that the presence of the policy had no effect on the outcomes measured. However, sub-group analysis in one of the studies revealed that reductions in mortality were found for the severely injured. One of the studies also looked at the effect of a fellowship programme and found a decrease in both outcomes for blunt trauma patients but not for penetrating trauma patients (Arbabi *et al.*, 2003). A third US study comparing a teaching hospital without operating room staff in house at night with data from three affiliated level I trauma centres discovered that there was also no apparent difference in mortality rate between the groups (Barone *et al.*, 1993). All three studies made adjustments for case mix, but all had limitations.

5.2.4 Addition of a pharmacist to the team

Four studies were found that examined the relationship between the addition of a pharmacist to the team and patient outcome(s). The overall aims of the studies were to assess the effect on the quality of care, compliance, adverse drug events and costs.

The roles of the pharmacists in the study and control groups differed for all of the identified studies. Two of them defined the pharmacists' role in the control group in a more traditional way, which is typically reactive, that is, responding to prescription requests and errors without having direct contact with the patient (Leape *et al.*, 1999; Boyko *et al.*, 1997). However, the study groups intended to utilise the specialised knowledge of the pharmacist by including them on rounds. This provided an opportunity for the pharmacist to evaluate the treatment of new patients and suggest changes in their drug regimens. In one of the other studies the control group had no input from a pharmacist and the pharmacist in the study group fulfilled a more traditional role as described above (Bjornson *et al.*, 1993). The final study arranged for hypertension patients in the experimental group to attend monthly scheduled appointments with the pharmacists to monitor long-term therapy, review drug regimens and have their blood pressure taken (Carter *et al.*, 1997). In comparison, the control group had their blood pressure taken by the pharmacist, but had no scheduled appointments.

A study of 3638 patients in an army medical centre, which focused on morbidity, as defined by LOS, and mortality as outcomes, found no difference in mortality but significant differences in the log LOS in favour of the pharmacist intervention (Bjornson *et al.*, 1993). This study made adjustments for case mix. A second study of a community pharmacist in a group medical practice was investigated and the results revealed that although all eight quality of life domains increased from baseline to six months, only three of these were statistically significant

(Carter *et al.*, 1997). A sample size calculation was performed, using the primary outcome measure blood pressure control, and the correct number of hypertension patients recruited to the controlled trial. A third study found that the addition of a pharmacist on an internal medical team in a tertiary care teaching hospital resulted in a significant reduction in the LOS from 5.5 days in the control group to 4.2 days in the treatment group (Boyko *et al.*, 1997). All three controlled trials used non-random methods for allocation to the different groups and it was only clear from one study that adjustments for case mix were made.

Finally, the fourth study identified used two approaches to look at the prevention of adverse drug events (ADEs) after the pharmacist joined the team (Boyko *et al.*, 1997). In a before-and-after comparison, the rate of error in the ordering of drugs decreased in the study unit by 66 per cent from pre-intervention to post-intervention. When the intervention unit was compared with the control unit during the same time period (post-intervention), the rate of preventable ordering ADEs in the study unit was 72 per cent lower than in the control unit. While the rate of adverse drug events and preventable ordering per 1000 patient days decreased significantly from 33 to 11.6 and 10.4 to 3.5 respectively in the study unit, the rates increased in the control arm but were not statistically significant. However, no case-mix or other adjustments were made.

Overall, the studies found that both LOS and the number of adverse drug events decreased when the pharmacist joined the team. However, there was no difference in mortality between the two groups, and the results for the outcomes of quality of life and patient satisfaction were inconsistent. It was clear from only one study that adjustments were made for case mix (Biorson *et al.*, 1993) and this study focused on LOS and mortality. Hence, it is possible that pharmacists do not impact on serious outcomes, such as mortality, but would play an important role in reducing adverse events, complications and consequently LOS.

5.3 Findings from the research: substitution

5.3.1 Nurse–doctor

Primary care

The impact of substituting nurses for doctors in primary care settings has been reviewed in at least two systematic reviews: a meta-analysis conducted in 1995 (Brown, 1995) and a more recent UK review (Horrocks *et al.*, 2002). The older review found that the randomised studies demonstrated that nurse practitioners resulted in greater patient compliance with treatment recommendations than did physicians, that they were possibly also associated with better treatment outcomes, and that in most other respects outcomes were equivalent. The review by Horrocks *et al.* only included randomised

controlled trials (11) and prospective observational studies (23) (Horrocks *et al.*, 2002). Overall, the review found that patients were more satisfied with nurse practitioners, who had longer consultation times and made more investigations than GPs. However, there was no evidence of difference in health outcomes, partly due to the low statistical power of studies included.

A recent analysis of this area by Sibbald (Sibbald *et al.*, 2004) suggests that some of the potential savings which might be generated by using nurse practitioners, due to their lower unit costs, may be eroded due to their lower productivity and lower lifetime workforce participation rates.

A randomised controlled trial carried out in Australia randomised 232 patients with open or closed wounds to either medical practitioners or trained nurse practitioners working in remote or rural settings (Chang *et al.*, 1999). This showed no significant differences between the groups with respect to patient satisfaction or other patient outcomes. It was also found that medical staff accepted nurse practitioners in this role.

Two Dutch studies compared the outcomes of physicians and nurse practitioners in managing patients with type-two diabetes (Vrijhoef *et al.*, 2001; Vrijhoef *et al.*, 2002). Both of these quasi-experimental studies with 121 and 175 patients respectively found that nurse specialist care achieved generally equivalent outcomes and slightly improved glycaemic control; however, both these studies are relatively methodologically weak with comparison groups either being historic (Vrijhoef *et al.*, 2002) or non-equivalent (Vrijhoef *et al.*, 2001).

Two studies set in developing countries used randomised controlled trial designs to evaluate the effect of adequately trained non-physicians inserting intra-uterine devices (IUDs) compared to physicians (Farr *et al.*, 1998; Lassner *et al.*, 1995). One study (Lassner *et al.*, 1995) set in one clinic in Brazil included over 1700 women, the other study (Farr *et al.*, 1998) randomised 367 women at three sites in Nigeria, Turkey and Mexico. Both studies found that trained nurses provided IUD services as safely and effectively as physicians with similar use-effectiveness. However, in the Brazilian study there was a high loss to follow-up in both groups.

The impact of establishing an acute minor illness service managed by a practice nurse/health visitor in UK general practice was evaluated using a before-after-study design. Patients requesting urgent GP appointments were offered a practice nurse or health visitor consultation (Pritchard and Kendrick, 2001). Over 2000 urgent consultations were reviewed and a higher general satisfaction rate was reported by those consulting the health visitor compared to those consulting either the GPs or the practice nurses. There was no difference in rates of prescriptions or re-consultations, although GPs had a marginally statistically significant higher referral rate compared to the other groups. GPs were also more likely to initiate further investigations.

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A before-and-after study in a South Tyneside general practice was used to evaluate the impact of nurse-led telephone triage of requests from patients with acute illness to see the doctor on the same day (Gallagher *et al.*, 1998). Over three months, 1263 consultations were recorded and the GPs' workload fell by approximately one-half. Approximately one-quarter of telephone requests were successfully dealt with without a surgery visit. A postal questionnaire showed high levels of patient satisfaction. However, without proper randomisation or a more robust experimental control, and without assessment of patient outcomes, one cannot assess reliably the impact of nurse telephone triage on patient outcomes.

Secondary and tertiary care: outpatient

A small retrospective cohort study of 87 patients receiving outpatient care for HIV/AIDS was used to compare care by physicians (57 patients) with those having a nurse practitioner as their primary care provider (30 patients) (Aiken *et al.*, 1993). Nurse practitioner patients had poorer self-reported health at baseline and had a higher average number of symptoms experienced at follow-up. However, they reported fewer problems with their care than patients managed principally by doctors. Because of the observational nature of the study, the non-equivalence of the groups, and the single setting, it is difficult to draw any conclusions.

A prospective observational study compared nurse practitioner with physician care in 160 low-income US outpatients with diabetes and/or hypertension receiving care at a county teaching hospital (Pinkerton and Bush, 2000). No significant difference in reported health or satisfaction (using the SF20 and a patient satisfaction instrument) was found. However, no power calculations or baseline differences in patient groups or clinical outcomes were reported.

A UK prospective cohort study of 100 patients evaluated the ability of an experienced endoscopist nurse who had been specially trained in inserting percutaneous endoscopic gastrostomy (PEG) (Sturgess *et al.*, 1996). The study found no difference in the 30-day mortality or three-month outcome of PEG placement. However, although the patient groups appear similar at baseline, randomisation would have yielded more valid results and thus needs to be repeated in other centres to see if it is generalisable to other nurses and units.

A UK randomised controlled trial compared the outcomes of patients managed by a consultant neurologist and a Parkinson's disease nurse specialist (PDNS) in patients with newly diagnosed Parkinson's disease who had had at least one medical consultation (Reynolds *et al.*, 2000). This study examined 180 patients in three outpatient centres over a follow-up period of 12 months. Overall, there appear to be no differences between the groups with the exception of a slight improvement of the physical functioning and general health in the consultant-only group. While this study is suggestive of the potential

role of Parkinson nurse specialists this would need to be replicated in centres with newly established PDNS services.

A randomised controlled trial in the Netherlands compared the outcomes of care of patients with rheumatoid arthritis (experiencing difficulty in activities of daily living) who were recruited from outpatient clinics, managed by either a clinical nurse specialist (CNS) or inpatient or day patient multidisciplinary team provided by a single rheumatology clinic (Tijhuis *et al.*, 2002). The role of the CNS was to provide information about rheumatoid arthritis and prescribe in consultation with the rheumatologist if needed. All outcomes improved in all groups and no sustained significant differences were found between groups. However, patient satisfaction with care was significantly lower in the CNS group.

The effectiveness of a CNS in suturing minor lacerations was evaluated in a randomised controlled trial in Australia (Charles, 1999). Eighty patients with simple lacerations presenting at the emergency department were randomised after triage to care either by a CNS or a doctor. No difference was found in wound healing, wound complications or waiting times and those receiving nurse-led care had higher ratings of the quality of their care and services received. This study provides strong evidence that CNSs can provide high-quality care to individuals with minor lacerations.

The outcomes of nurse treatment of chalazion were compared with SHO treatment in a London eye clinic in 129 patients over a five-month period (Jackson and Beun, 2000). Patients were allocated to either nurse or SHO cyst treatment clinics on the basis of availability of the next clinic. Patients who re-attended with a recurrent chalazion were allocated to the next available clinic and thus might have been seen by two different clinics (by both nurse and SHO clinics). Nurses were trained in conservative and surgical treatment of chalazion and followed a treatment protocol. There were no significant differences in baseline characteristics between the clinics. Overall, there appears to be no difference in clinical outcome, although this could not be assessed in the majority of patients. Patient satisfaction was significantly higher and costs of treatment lower in the nurse-led clinics. Because this study was not randomised the estimates of difference in clinical outcomes may be biased. However, it does demonstrate that nurses can carry out this role safely and it is sufficiently suggestive to justify a more rigorous study.

Secondary and tertiary care: inpatient

Fewer studies have examined nurse practitioner–doctor substitution in inpatient settings. An RCT set in a US academic teaching hospital randomised 381 patients to general medical wards staffed either by nurse practitioners and a medical director or medical house staff (Pioro *et al.*, 2001). Patients were followed up using routine data and comparisons were made at discharge and up to six weeks after

discharge; 50 per cent of patients who were randomised to nurse practitioner care were actually admitted to a ward run by medical house staff rather than nurse practitioners, at the request of the nurse practitioners. Overall, there were no differences in LOS, 30-day mortality or patients' assessment of care when analysed either on an intention to treat (ITT) or actual treatment basis. This study is worth replicating in order to see if it is generalisable but also because of the potential biases introduced by crossover and a lack of statistical power to detect clinical differences in this relatively small study.

A UK randomised controlled trial assessed the effectiveness of nurse-led follow-up in the management of patients with lung cancer (Moore *et al.*, 2002); 203 patients were randomised to one of two clinical nurse specialists in lung cancer who followed them up using a protocol. Clinical nurse specialists were responsible for the entire care of those in the nurse-led follow-up group unless further treatment was required. The conventional care group consisted of routine care outpatient appointment for medical assessment. Patients receiving the nurse-led intervention showed improvements in several clinical measures at three months (less dyspnoea) and at 12 months (emotional functioning and peripheral neuropathy); patients in this group also expressed higher satisfaction levels, had fewer consultations with hospital doctors and were more likely to die at home. This study needs to be replicated in other settings to assess its generalisability.

The role of nurses in carrying out pre-operative assessment has also been evaluated in a randomised controlled trial (Kinley *et al.*, 2002); 1907 patients waiting for general anaesthetic for elective surgery were randomised either to assessment by an appropriately trained nurse or by a pre-registration house officer (PRHO). Both process and outcome evaluation took place. No difference was found in terms of underassessment and PRHOs ordered significantly more unnecessary tests. This substitution was calculated to be neutral. On the basis of this UK-based study, appropriately trained nurses might be an appropriate substitute for PRHOs for carrying out routine pre-operative assessment.

The use of nurses to remove femoral venous and arterial sheaths post percutaneous transluminal coronary angioplasty (PTCA) was evaluated using an observational study in a cardiology interventional unit in a Canadian teaching hospital (Rubin *et al.*, 1996). The outcomes of 139 patients whose femoral sheaths were removed by doctors were compared with 122 patients whose femoral sheaths were removed by registered nurses. Bleeding was significantly greater in patients managed by doctors, particularly with the sheaths in-situ. However, this may be because of a lack of comparability between the (non-randomised or matched) groups. Nurses gave more analgesia and anxiolytic before removal than doctors. Some concern was expressed on the effect on nurse team workload of taking responsibility for this task and it was the source of some dissatisfaction with staff.

A retrospective study was carried out in order to assess the feasibility and safety of a clinical nurse specialist performing diagnostic cardiac catheterisation (Boulton *et al.*, 1997): 100 cases performed by an appropriately trained CNS were compared with 100 consecutive cases performed by each of two cardiology registrars in training over the same period. Complex cases were excluded and the same techniques and level of supervision applied in each group. Compared with registrars the nurse achieved the same level of diagnostic accuracy and complications but slightly shorter procedure durations and fluoroscopic times. Although this study suggests that a specialist nurse can be trained to perform standard transfemoral cardiac catheterisation procedures safely and competently this was only studied in one nurse and although patients appeared similar in both groups a more rigorous evaluation is needed.

Another study using a prospective analysis compared the peripheral insertion of central catheters (PICCs) by registered nurses and interventional radiologists (Fong *et al.*, 2001). A total of 322 (130 by radiologists and 192 by RNs) PICCs were placed in 256 patients. PICCs placed by RNs appeared to have a lower rate of occlusion and lower rate of premature removal. However, this was not a randomised study and the patient groups were not comparable. Although this study shows that nurses, suitably trained, can insert central catheters safely the study is not sufficiently robust to make comparisons between their performance and that of interventional radiologists.

A retrospective observational study was used to assess the effectiveness of advanced neonatal nurse practitioners (ANNPs) in resuscitation of pre-term babies at time of birth (Aubrey and Yoxall, 2001). Data on 245 pre-term babies born in Liverpool Women's Hospital were collated. The process and outcomes of resuscitations led by an ANNP were compared with data from those for whom a doctor had led the resuscitation. There were no significant differences in the level of resuscitation provided by the two groups. However, time to intubation was shorter in the ANNP-led team and medically led babies were more likely to be hypothermic even after adjusting for birthweight. Survival rates or the event of any other adverse outcomes were similar. Although this was a non-randomised study there were no significant differences between the groups in basic details, except that a higher percentage of the nurse-led babies had been delivered by Caesarean section. While this suggests that suitably trained ANNPs have a potential role in resuscitation of the pre-term newborn further studies are required to check the reliability of these findings and to measure clinical outcomes more powerfully.

5.3.2 Midwife–obstetrician

The report included 23 studies that examined the impact of substitution of midwives for obstetricians and family physicians on patient outcomes in maternity care or neonatal care. These related to

the antepartum, intrapartum and postpartum events and experiences of the mother and the newborn infant.

Often the authors studied low-risk or high-risk groups. When distinguishing between studies on the basis of risk status, it is important to remember that transfers from the midwifery care group to the obstetrical care group can often occur. Those studies that do not adjust for this attrition have the effect of biasing the outcomes against obstetricians as they come to manage an increasingly high-risk group. However, some studies also report a degree of interdisciplinary collaboration or supervision of midwifery practice by obstetricians, diluting the nature of care provided and tending to bias the outcomes against midwives.

Substitution of midwifery models of care for traditional care

Each of the studies compared populations of women who were under the care of midwives with women under the care of physicians (usually obstetricians). However, they differed in the stage at which the comparisons were made.

One review was found that looked at the substitution of midwife-managed care for medical or shared care (Renfrew, 1995). This pre-Cochrane review from the UK was taken from the Cochrane Pregnancy and Childbirth Database and summarised three controlled trials conducted between 1969 and 1987. Two of the trials were described as being of good quality, while the other used a non-secure method of allocation to groups. The care settings were not reported. The comparison was between midwifery care with access to medical back-up and medical or shared care throughout pregnancy, labour, delivery and the postpartum period and midwifery care without this access. Two of the trials examined low-risk women and the other examined women from a low-income area. The majority of the review's conclusions were based on one trial and the total number of participants was not reported. Overall, the information supplied on the individual trials was very basic. Inclusion criteria were stated; however, the sources searched, the validity criteria for included studies, the method of combining studies any investigation into differences between studies and any sources of bias were not reported. The results of the pooled log odds ratios for the outcomes among a population of mainly low-risk women showed that the patients' experience was improved for those under midwife care. Women under midwifery care felt better prepared for labour and child care and were more able to discuss problems and anxieties of pregnancy and the postpartum. They were also more in control and enjoyed the experience more than those under medical care. Interventions including augmentation of labour, use of regional anaesthesia/analgesia, episiotomy and operative vaginal delivery were less frequent for midwifery care. The infant outcomes were also improved for women under midwifery care, with fewer incidences of neonatal resuscitation and admissions to the special care nursery. The chance of infants having a birthweight less than 2500 g was also

reduced for women in the midwife group. There were no differences in the incidence of Caesarean section, stillbirth, and neonatal death.

Substitution of midwife-managed care for obstetrician care

Fourteen studies examined the substitution of midwife-managed care for obstetrician care and are summarised below.

A randomised controlled trial set in a midwife unit in Canada compared care throughout labour, delivery and the immediate postpartum period by a team of midwives to standard obstetric care (Harvey *et al.*, 1996). Low-risk women were recruited based on the Alberta perinatal risk-scoring system. There were 218 patients in the trial and analysis was by intention to treat. Case mix adjustment was not reported. Low-risk women under midwife care received fewer technological assessments and fewer birth interventions of intravenous infusions, amniotomies, and episiotomies during delivery and labour. There was no statistically significant difference in the rates of instrumental vaginal delivery. In the midwife group women had similar maternal morbidity antenatally, and similar rates of complications postnatally compared to the obstetrician group. The midwife group also had fewer Caesarean sections and experienced shorter hospital stays, while infants born to the midwife group had fewer neonatal intensive care unit admissions.

Two UK studies conducted in 1994 used a single randomised controlled trial to examine different aspects of care of a sample of low-risk women (Hundley *et al.*, 1994; Hundley *et al.*, 1997). Intrapartum care and delivery received in a midwife-managed delivery unit was compared with standard obstetric care. There were 2844 patients in the trial, who were allocated to treatment groups in a 2:1 ratio of midwifery to medical care. Socio-demographic variables were reported and the groups were similar at baseline. The study groups were analysed by intention to treat and no case mix adjustment was reported. Among low-risk women in the midwife group, there were fewer episiotomies and higher use of simpler monitoring techniques, with accordingly lower rates of fetal distress (Hundley *et al.*, 1994). Women were more likely to use natural methods of pain relief and to have more freedom of movement in labour in the midwife group. In the study of satisfaction (Hundley *et al.*, 1997) continuity of care, women's views of support during labour and delivery, choice, and control were measured. All women in the study were satisfied with care received, and most women under midwife care were satisfied, but there was no statistically significant difference between the groups in satisfaction with the overall experience.

A randomised controlled trial from the USA of a sample of low-risk women compared outcomes under midwifery management in a birth centre with a group of women in labour under obstetrician management on a traditional labour and delivery ward (Chambliss *et al.*, 1992). The sample size was 492, socio-demographic variables were not reported, analysis of the groups was by intention to treat, and case mix

adjustment was not reported. In low-risk women, the care received from midwives led to fewer instrumental vaginal deliveries while the midwife group had fewer episiotomies and fewer third- and fourth-degree extensions. Operative vaginal deliveries were associated with these extended tears. There was no statistically significant difference between the groups for Caesarean section rates. Neonatal outcomes between the groups were similar, mean birthweight was higher in the obstetrician group, and there was no difference in Apgar scores. Obstetricians used internal fetal scalp electrodes more often than midwives.

A US non-randomised controlled compared the care given by a group practice of midwives in pregnancy, labour and the postpartum period with standard obstetric care (Oakley *et al.*, 1996). The sample was of low-risk women and excluded women with medical complications, multiple gestation and planned Caesarean delivery. The sample size was 1464 and analysis was on an intention-to-treat basis. Adjustments were made for case mix in the regression model. The results indicated that the care received from midwives was as good as the care received from obstetricians for women of low-risk status and there were no significant differences between the groups for many of the indicators. The midwife group had less haemorrhaging postpartum, fewer major perineal lacerations, and fewer complications overall. The infant outcomes were similar for both groups except that the midwife group had more babies breastfed immediately after delivery and neonates were more likely to stay with their mothers throughout her hospital stay.

A UK prospective cohort study compared the care of low-risk women who booked an appointment with a midwife unit in one hospital and women who booked under a consultant unit at a nearby hospital (Campbell *et al.*, 1999). Care was provided throughout the antenatal period and delivery, although the transfer rate from the midwife group was significant. The sample size was 1499 and analysis was by intention to treat. Only the characteristics of the patients were recorded but the groups were similar. Case mix adjustment was not reported. For low-risk women in the midwife group fewer interventions of augmentation or induction resulted. The midwife group was more likely to use no anaesthesia with fewer women using nitrous oxide, pethidine, an epidural or spinal anaesthetic. Women in the midwife group were less likely to have an assisted delivery and had shorter duration of labour. There were fewer episiotomies in the midwife group, and the infant outcomes as measured by Apgar score and resuscitation were also better for the midwife group. There were similar rates of spontaneous vaginal delivery and Caesarean section in each group.

High-risk cases were compared in an US retrospective cohort study using 803 midwife births at a single hospital clinic with a sample of births attended by various providers from a national dataset (Davidson, 2002). The patients were matched using risk factors including a mix of medical and antenatal complications. It was not possible to distinguish the type of care received by the two groups, and due to variation a

statistical comparison was not performed and only percentages were presented for outcomes comparison. Basic socio-demographic variables were reported and the groups were dissimilar yet no adjustment was made for this. This comparison of outcomes between midwives and various care providers of activity in one clinic showed that midwifery care in high-risk women resulted in favourable outcomes. The midwife sample showed a spontaneous vaginal birth rate that was higher than the national average and a vaginal birth rate after Caesarean section that was considerably higher than the national average. Instrumental vaginal delivery rates and Caesarean section rates were also lower for midwife births.

Another US retrospective cohort compared the outcomes of supervised antenatal midwifery care for deprived, indigent women and obstetric antenatal care for women in private care provided by a group of midwives in a primary care perinatal access clinic (Blanchette, 1995). The sample was not described as high or low risk and exclusion criteria were not clearly stated. However, the midwives dealt with women from a socioeconomically higher-risk group and some patients were excluded owing to medical complications and the need for transfer. The sample size was 1077, demographic variables were well reported and there were significant differences between the cohorts for which no adjustments were made. Midwife care was comparable to obstetrician care, resulting in similar obstetric outcomes while carrying a higher rate of antenatal risk factors including late entry to antenatal care, smoking, urinary tract infection and small-for-dates. In the midwife group, the maternal intrapartum and postpartum complications were also higher overall, including for positive toxicology screen, amnionitis, and postpartum haemorrhage, but the incidence was thought to be low given the antenatal complications and socioeconomic risks. The midwife group had fewer Caesarean sections and more attempts at vaginal birth after Caesarean section; however, the successful vaginal birth rates after Caesarean section were similar in both groups. Infant outcomes were also similar in both groups.

A retrospective cohort study from the US matched cases of high risk for certain characteristics compared care between midwives and family physicians (Mehl-Madrona and Madrona, 1997). There were 2000 women in the study. Socio-demographic variables were not reported but the inclusion criteria were clearly stated. The regional data were acknowledged to be imperfect and a method of case mix adjustment was described. A modified Problem Oriented Pregnancy Risk Assessment System (POPRAS) was used to rate medical risk at 36 weeks. Midwives attended more of these high-risk deliveries in the home, and the outcomes showed that midwife-attended births were not as safe as family physician-attended births. After adjusting for complications, the differences between the groups were non-significant.

A retrospective cohort study including a questionnaire survey carried out in the USA compared care provided by midwives throughout pregnancy, labour and delivery with care provided by obstetricians (Olivo *et al.*,

1994). The risk status of the groups studied was not reported and a convenience sample was used without any stated exclusion criteria. The setting was a group practice in a university hospital. The total sample size was 535, socio-demographic variables were poorly reported and the groups were dissimilar for education. No adjustments for case mix were reported. There were no differences in delivery outcomes as measured by Caesarean section rates or rates of successful vaginal birth after delivery. High levels of satisfaction were expressed by all women as measured by the Care Provider Maternal Satisfaction Survey. The midwife group was more satisfied and scored more highly on four of five satisfaction measures. The midwife group was more likely to plan for using the same care provider for future needs, and was more satisfied with the level of experience of the care provider. The midwife group was more informed about the availability of different types of providers. Infants in the midwife group were more likely to have higher birthweights.

A matched retrospective cohort study performed in the USA in 1987 was based on a pilot study using a low-risk sample, although the risk factors were not stated (Mayes *et al.*, 1987). The care was provided by a newly established midwifery service in a university hospital setting, throughout pregnancy, labour and delivery and the comparison was with standard obstetric care. The total sample size was 58, sociodemographic variables were reported, and the groups were similar except for marital status and occupational group, for which no adjustments were made. The sample size was too small to comment on the outcomes with certainty; however, outcomes appeared comparable between groups. Women in the midwife group were less likely to have a major perineal tear, less likely to use anaesthetic, analgesia or sedation, and were less likely to receive interventions of amniotomy, IV fluids, induction and augmentation and electronic fetal monitoring during birth. There were no differences in the infant outcomes.

A retrospective cohort study in one hospital compared the outcomes of labour of a private practice where midwifery care was throughout pregnancy and labour with standard obstetric care (Davis *et al.*, 1994). It was based on a sample described as low risk, having been screened for those fetal and maternal complications that could increase the risk of Caesarean delivery. It included 8795 women, basic demographic variables were reported, and the groups were similar except for race. Exclusion criteria were stated and case mix adjustment was not reported. This comparison of outcomes found a higher rate of successful vaginal trial of labour, a lower rate of augmentation and narcotic or epidural anaesthesia and also a lower rate of total instrumental deliveries and especially use of forceps. In the midwife group primiparas and multiparas were less likely to have a Caesarean section, and the number of women undergoing Caesarean section for failure to progress was lower. The status of care provider – whether midwife or obstetrician – was not significant for predicting Caesarean

section although associated interventions were significantly higher in incidence in the obstetrician group. Infant birth outcomes were similar in both groups.

National US data were used in a retrospective cohort study to compare outcomes of births delivered by midwives with all births of a national dataset over one year in a secondary care setting (MacDorman and Singh, 1998). It was not possible to distinguish the type of care received by the national sample, although midwives provided care in labour. There were 153,194 midwife deliveries, and 686,644 randomly chosen obstetrician deliveries. The risk status of the groups was high and these risk factors were stated in the study. Basic socio-demographic variables were reported and the groups were dissimilar, for which an adjustment was made. Adjustment was also made for case mix – medical risk factors and delivery complications in the multivariate logistic regression. The study analysed infant outcomes and found midwifery care to compare well to obstetric care in high-risk and low-risk women. Before and after certain socio-demographic variables, medical risk factors and complications were adjusted for, the risk of infant mortality and neonatal mortality was lower for midwives than for obstetricians. Also, the risk of delivering a low-birthweight infant was lower for midwives while the mean birthweight was higher for midwives than for obstetricians.

A retrospective cohort study examined the outcomes of a sample of low-risk women with midwives providing continuous one-on-one supportive labour care and obstetricians providing standard care (Butler *et al.*, 1993). The antenatal inclusion criteria were: those who had at least five prenatal visits at the obstetric department, of 37–42 week gestation, with a singleton, live-born, occiput presentation and who were free from the exclusion criteria of one or more given medical and antenatal complications. The sample size was 4607, and patients were allocated in a 1:3 ratio of midwives to obstetricians. Demographics were reported but the groups were dissimilar for race, parity, and age – these differences were adjusted for in the analysis. For low-risk women the supportive labour care received from midwives resulted in a lower incidence of Caesarean delivery than resulted from obstetric care. After statistical adjustment for age, race, year of delivery, infant size and parity, the midwife sample experienced fewer abnormal labours, especially deep transverse arrest, arrested descent and prolonged labour. The midwife group also experienced fewer cases of fetal distress, a risk factor for Caesarean section. The obstetrician sample was more likely to undergo an operative vaginal delivery and was more likely to receive epidural anaesthesia. There was a slight increase in the number of obstetrician deliveries that were admitted to the neonatal intensive care unit, and the birthweight for midwife-delivered babies was higher.

Fourteen studies examined the substitution of midwife-managed care for medical care models under hospital physicians or obstetricians. In five studies, the midwife care was provided in a midwife unit, a birth

centre or a team midwife practice (Harvey *et al.*, 1996; Chambliss *et al.*, 2003; Hundley *et al.*, 1994; Hundley *et al.*, 1997; Campbell *et al.*, 1999; Oakley *et al.*, 1996), while in seven studies midwife care was provided in a clinical or hospital setting (Davidson, 2002; Blanchette, 1995; Olivo *et al.*, 1994; Mayes, 1987; Davis *et al.*, 1994; Butler *et al.*, 1993; MacDorman and Singh, 1998). For one study, the care setting was in the home (Mehl-Madrona and Madrona, 1997).

Three studies were described as randomised controlled trials including a pair of linked studies (Hundley *et al.*, 1994; Hundley *et al.*, 1997), and one as a controlled trial. Of the remaining comparisons, one was a prospective cohort study and eight were retrospective cohort studies, for which three of these comparisons used sample sizes under 1000, and six used samples of 1000–5000 or greater. Nine studies examined low-risk births and five studies examined high-risk births, or births for which the risk status was unclear.

- **Low-risk women** In general, for the randomised controlled trials (Harvey *et al.*, 1996; Hundley *et al.*, 1994; Hundley *et al.*, 1997; Chambliss *et al.*, 2003) and one controlled trial (Oakley *et al.*, 1996) of low-risk births, the outcomes showed that women under midwife care received fewer technological assessments and fewer birth interventions in delivery and labour and were more likely to have a natural birth and less likely to have an instrumental vaginal delivery or a perineal tear (Harvey *et al.*, 1996; Hundley *et al.*, 1994; Chambliss *et al.*, 2003; Oakley *et al.*, 1996). Women under midwife care had similar or reduced (Oakley *et al.*, 1996) rates of morbidity and complications, and similar or reduced (Harvey *et al.*, 1996) rates of Caesarean sections. Women under midwife care were equally satisfied (Hundley *et al.*, 1997) with the care received. For the cohort studies (Campbell *et al.*, 1999; Butler *et al.*, 1993; Davis *et al.*, 1994; Mayes *et al.*, 1987) of low-risk births, the outcomes reflected those established for the trials. Women under midwife care had fewer birth interventions of augmentation and induction and a more natural birth, with fewer electronic assessments of fetal well-being, fewer episiotomies (Campbell *et al.*, 1999; Butler *et al.*, 1993; Davis *et al.*, 1994; Mayes *et al.*, 1987), and fewer perineal tears (Mayes *et al.*, 1987). Women under midwife care also had fewer assisted or instrumental deliveries (Butler *et al.*, 1993; Campbell *et al.*, 1999; Davis *et al.*, 1994), fewer abnormal labours (Butler *et al.*, 1993), and similar or reduced rates (Davis *et al.*, 1994) of Caesarean section.

Infant outcomes were prone to less variation between the groups overall and differences were fewer. Again, the midwife group achieved similar and occasionally better outcomes. Among the trials, one reported a higher birthweight under obstetrician care (Chambliss *et al.*, 2003), while another trial showed a lower rate of admission to the special care baby unit (Harvey *et al.*, 1996) for the midwife group. A further trial reported a higher incidence of breastfeeding, and fewer absences of infants from their mother

postpartum (Oakley *et al.*, 1996) when in the observation ward, for women under midwifery care. For the cohort studies, one study reported more favourable Apgar scores and resuscitation outcomes (Campbell *et al.*, 1999) for the midwife group, and infants born to women under midwife care in other studies had lower rates of resuscitation (Campbell *et al.*, 1999) and lower admissions to intensive care (Butler *et al.*, 1993). One study reported a higher birthweight among babies in the midwife group (Butler *et al.*, 1993).

- **High-risk or unknown-risk women** The health outcomes among the midwife groups for the high-risk studies were more variable (Blanchette, 1995; Davidson, 2002; Mehl-Madrona and Madrona, 1997). These studies had different risk backgrounds but two studies found that despite higher rates of complications (Blanchette, 1995; Davidson, 2002) in the midwife group, there were higher natural birth rates with fewer Caesarean sections, and similar infant outcomes between the groups. One study looked at a high-risk set of complicated home births for which midwives had higher rates of maternal intrapartum death and maternal deaths before labour, while the infant mortality rates were similar (Mehl-Madrona and Madrona, 1997).

For the studies where risk status was not clear or where a statistical adjustment for risk was made (MacDorman and Singh, 1998; Olivo *et al.*, 1994), the maternal outcomes of labour and delivery were generally similar between the groups and midwifery care was as good as obstetrical care. The midwife groups had better infant outcomes in terms of lower infant mortality and higher birthweights (MacDorman and Singh, 1998), or a higher average birthweight (Olivo *et al.*, 1994). Where measured, women were more satisfied with midwifery care than with obstetrician care (Olivo *et al.*, 1994).

Based on these studies, the outcomes of midwifery care compared favourably to obstetric care, especially in low-risk women. Midwives adopted a less interventionist approach and a greater dependence on natural methods of birthing, with a lower overall rate of Caesarean section at no expense of an increase in complications, morbidity or mortality. Women were as satisfied with midwifery care as with obstetrician care, if not more so.

Substitution of midwife-managed care for shared-care models

Six studies examined the substitution of midwife-managed care for shared-care models.

A recent randomised controlled trial in Australia, of both high-risk and low-risk status women, compared a team midwifery model of care in a hospital setting throughout pregnancy, labour and the postpartum period with standard shared care under midwifery and obstetrical staff (Biro *et al.*, 2000). The sample size was 1000, basic socio-demographic variables were reported, and the groups were similar. The study groups were analysed by intention to treat. The care received from a team of

midwives was shown to compare well to midwife–doctor shared care. Continuity of midwifery care was associated with improved maternal outcomes. Women in the midwife group experienced fewer problems overall with fewer invasive procedures including more natural analgesia, fewer technological assessments of fetal well-being, fewer episiotomies and sutured tears, and a shorter length of stay. No statistical difference in instrumental deliveries or overall Caesarean section rates was found. Infant outcomes were also similar.

A UK randomised controlled trial of low-risk women compared midwife-only managed care on a midwife development unit throughout pregnancy, labour and postpartum with standard shared care under various combinations of providers (Turnbull *et al.*, 1996). The study had a sample size of 1299, basic socio-demographic variables were reported, and the groups were similar. The study groups were analysed by intention to treat. In low-risk women, midwife-managed care on a midwife development unit resulted in reduced rates of interventions for induction of labour and episiotomy, and reduced perineal tears. Pain relief was more natural in the midwife group while labour and delivery outcomes were similar. Rates of complications for the mother were also similar except for antenatal hypertension and intrapartum haemorrhage, which were lower in the midwife group. The satisfaction outcomes in the antenatal, intrapartum, hospital-based postnatal, and home-based postnatal periods were recorded. Overall women were satisfied with care received in both groups but for midwife-managed care there was greater satisfaction with care for all stages, with the greatest differences in satisfaction found in antenatal care and hospital-based postnatal care. Women in the midwife group were more satisfied with choice, information, decision making, and individualised care. There were no differences in the infant outcomes.

Two recent studies from Australia examined different aspects of the same population within a randomised controlled trial (Waldenstrom *et al.*, 2001; Waldenstrom *et al.*, 2000). The women recruited were low risk, having been screened for previous obstetric complications and previous history of significant medical disorder. Both models of care were provided in a university hospital setting in the clinics, delivery suites and postnatal wards over pregnancy, labour and the postpartum period. The comparison was the standard shared care under various combinations of providers. A questionnaire survey was conducted to collect the outcomes of satisfaction. The total sample size was 1000, socio-demographic variables were well reported, and the groups were similar. The study groups were analysed by intention to treat. For low-risk women it was found that team midwife care was similar to midwife–doctor shared care. In the study of maternal and infant health outcomes (Waldenstrom *et al.*, 2001), fetal assessments and interventions were fewer but not significantly so. Overall the trial showed no differences between the team midwife care and standard care with regard to medical interventions, maternal health and infant health outcomes. In the study of satisfaction (Waldenstrom *et al.*,

2000a), the outcomes measured were satisfaction with antenatal care, satisfaction with intrapartum care, and satisfaction with postnatal care. The team midwife care had the greatest impact in the antenatal period, followed by the intrapartum period and then the postpartum period. In all measures in the antenatal period women in the team group were more satisfied with antenatal care. Women in the team group were generally more satisfied with care received during labour and delivery, though the differences were less than for care during the antenatal period. Postnatal care did not differ greatly between the two groups, except for visits by a team midwife in the team care group that focused on the mother's feelings and well-being. There was no statistical difference in the overall assessment of postnatal care, but mothers in the team care group felt better informed and perceived their care providers as more sensitive, understanding, encouraging, reassuring, and less rushed. They were also happier with the physical aspects of care provided by doctors and midwives.

A UK randomised controlled trial of low-risk women cared for by midwives was compared with obstetrician-led shared care throughout the antenatal period and the delivery (MacVicar *et al.*, 1993). The facilities for delivery were provided in a simulated home-from-home environment for the midwife care, and a clinical delivery environment for the shared care. The sample size was 3321, demographics were reported, and the groups were similar except for smoking. Follow-up was by intention to treat. For low-risk women the care provided by midwives resulted in more women having a spontaneous onset of labour, fewer women undergoing electronic fetal monitoring, and fewer diagnoses of fetal heart irregularity. Women in the midwife group also had a longer labour (due to the lower incidence of induction and augmentation), and were more likely forgo anaesthesia or to use only nitrous oxide and oxygen. Women in the midwife group were more likely to have an intact perineum, with fewer episiotomies but a greater number of perineal tears. There were no statistical or clinical differences in the outcomes for maternal and fetal mortality and morbidity. Satisfaction outcomes were recorded for care received in the antenatal period and during the labour and delivery. The midwife group was more satisfied with antenatal care and more satisfied with care during delivery.

A recent UK retrospective cohort study and a questionnaire survey were based on seven practices within a trust region (Spurgeon *et al.*, 2001). Low-risk women were studied although 'low risk' was not defined. The comparison was between those groups (A and B) receiving one-to-one, midwifery-led care under the Changing Childbirth scheme, and those receiving standard shared care (group C) under various providers outside of the Changing Childbirth scheme. Care was provided throughout pregnancy, labour and the postpartum period. Each woman in group A was cared for by one of five named midwives, while each woman in group B was cared for by one of five midwives working in a team. The setting was a large trust covering a number of participating

general practices and groups A and B originated from the general practice setting, while group C was drawn from an obstetric unit. The total sample size was 333, demographic variables were poorly reported, but the groups were similar. No loss to follow-up was reported and case mix adjustment was not reported. This comparison of outcomes between midwives and midwife–doctor shared care for low-risk cases showed no difference in maternal and neonatal clinical outcomes. The focus of the study was choice, control and continuity of care as defined by the Changing Childbirth scheme and the satisfaction outcomes recorded were: personal preferences; antenatal care, labour and delivery; postnatal care; information and advice. Among the women there was a general preference for, and a high satisfaction with continuity of midwife-led care rather than for a particular carer, and midwives achieved higher levels of satisfaction overall.

In general, these six studies found that midwifery care resulted in outcomes as good as or better than shared medical care. The overall rate of birth interventions in the midwifery group was lower for episiotomy, induction, and technological assessments of fetal well-being, and women were more likely to have natural births (Biro *et al.*, 2000; Turnbull *et al.*, 1996; MacVicar *et al.*, 1993). There was no difference in maternal morbidity and perineal tears were less common in the midwife groups (Biro *et al.*, 2000; Turnbull *et al.*, 1996). Where measured, complications were fewer in the midwife group (Turnbull *et al.*, 1996). There was no difference in Caesarean sections, but the satisfaction with care received was higher for the midwife group (Turnbull *et al.*, 1996; Waldenstrom *et al.*, 2000a; MacVicar *et al.*, 1993; Spurgeon *et al.*, 2001). Only two studies showed no improvements in the outcomes for labour and delivery (Waldenstrom *et al.*, 2001; Spurgeon *et al.*, 2001) under midwifery care. Among these studies, infant outcomes were similar overall.

Substitution of midwife–general practitioner shared care for medical care models under physicians or obstetricians

One study examined the substitution of midwife–GP shared care for medical care models under physicians or obstetricians.

A UK multi-centre randomised controlled trial of low-risk women compared routine antenatal care in pregnancy by GPs and midwives according to a care plan in a primary care setting, with the standard obstetrician-led antenatal shared care in a hospital setting (Tucker *et al.*, 1996). The total sample size was 1765, socio-demographic variables were well reported, and the groups were similar. The study groups were analysed by intention to treat and case mix adjustment was not reported. Low-risk women receiving midwife–GP shared care in the community were more likely to have a natural birth with fewer interventions of induction and augmentation. For this group, there were improvements in terms of antenatal continuity of carer and fewer non-attendances, day care episodes and admissions in the antenatal period. There was a small reduction in the number of routine clinic visits

for women in the GP–midwife group, with fewer routine visits for multiparous women. More Rhesus-positive women in the midwife–GP group failed to have an antibody check-up and more women with anaemia on testing in the obstetrician group failed to receive treatment. Fewer women in the midwife–GP group developed pregnancy-induced hypertension, transient hypertension, proteinuria or pre-eclampsia. There was no difference in Caesarean section rates. Satisfaction outcomes recorded were: overall satisfaction; acceptability of style and relationship with staff; experience attending clinics; information acquisition; service access and provision. Both study groups reported they were happy with care, but women in the midwife–GP group reported a better relationship with their general practitioner and a stronger preference to see the same person at each antenatal visit.

Substitution of nurse aides as birth attendants for nurses and hospital physicians

One study examined the substitution of nurse aides for nurses and hospital physicians as birth attendants. This was a retrospective cohort study carried out in Zimbabwe in a missionary hospital that compared births attended by nurse aides and births attended by trained medical and nursing staff (Manungo *et al.*, 1996). The cases were of unknown or mixed-risk status, the total sample size was 1459 cases, and neither the socio-demographic variables nor the baseline clinical characteristics were reported. Exclusion criteria were not stated, no gaps in data collection were reported and case mix adjustment was not described. Despite its poor methodological quality and reporting, this study was important because it presented an answer to the problem of an acute shortage of staff trained in attending births on a scale not seen in the Western world, and showed how a substitution policy could be made to work. The study found that for higher-risk women a referral system between newly trained nurse aides and qualified staff worked well, as supported by the low rate of perinatal mortality among deliveries attended by nurse aides.

Substitution of neonatal nurse practitioners for resident medical staff

Two studies examined the substitution of neonatal nurse practitioners for resident medical staff. These studies compared cohorts of admissions in the USA under different care providers – neonatal nurse practitioners and resident medical staff training in paediatrics. The groups were followed up from admission through to discharge for a number of health outcomes for the infant.

The first retrospective cohort was of extremely low-birthweight infants and compared the outcomes of infants cared for by neonatal nurse practitioners and those cared for by paediatric residents (Karlłowicz and McMurray, 2000). Although there was no definition of risk provided within this group, infants with major malformations, chromosomal abnormalities or congenital infections were excluded. Neonatal nurse practitioners and residents functioned independently of each other with

no crossover, under the supervision of the same certified neonatologists. The total sample size was 230, basic demographic variables were reported, and the groups were similar except for ethnicity. Case mix adjustment was not reported. Neonatal nurse practitioners provided comparable standards of care to extremely low-birthweight infants. No significant differences were found in major clinical outcomes for infants under 1000 g at birth, regardless of assignment to neonatal nurse practitioners or paediatric residents.

The second study looked a sample of infants for differences in health outcomes and there was no risk status applied to this group (Bissinger *et al.*, 1997). The inclusion criteria were all critically ill neonates admitted to the unit within the first 24 hours of life and whose birthweights were between 500 and 1250 g. The exclusion criteria were infants admitted to the unit after the first 24 hours of life, infants who died within the first 24 hours of life, and infants with congenital cardiac, genetic or surgical conditions. The comparison was between the outcomes of neonates under the care of neonatal nurse practitioners and those of neonates under the care of medical house staff, as supervised by the same lead physician. The sample size was 70, patient characteristics were reported, and the groups were similar. No case mix adjustment was reported. Neonatal nurse practitioners provided comparable standards of care and there were no significant differences in the outcomes of care. The quality of care index was similar for both nurse practitioners and medical house staff.

These two cohort studies found that the substitution of nurses for doctors in neonatal intensive care units resulted in no differences in outcomes and nurse practitioners were able to provide infants with comparable care to that of medical staff.

5.3.3 Others—doctor

Five articles pertained to assessing care provided by hospitalists – this is a US workforce category comprising physicians who provide only inpatient services. One article was a literature review focusing on studies that compared hospitalists with an appropriate non-hospitalist control group on resource use and/or clinical outcomes (Wachter and Goldman, 2002). The review included 19 published cohort studies (12 articles and 7 abstracts, including one identified by the scoping exercise (Davis *et al.*, 2000)), some of which made adjustment for case mix. Of these, 15 found significant decreases in both hospital costs (average decrease 13.4 per cent) and length of stay (average decrease 16.6 per cent). Two studies found a decrease in average length of stay but not in hospital costs and the remaining two studies found no reductions in these outcomes. Several studies found improved outcomes, such as inpatient mortality and re-admission rates, but these results were inconsistent. Additionally, the data sources were limited and all of the studies found were non-experimental, hence overall the review

concludes that there is insufficient evidence to support that hospitalists improve quality.

A prospective study from 1997 to 1999 of the costs and outcomes in patients on an academic general medicine service concluded that hospitalist care, when compared to care by traditional academic internists, was associated with appreciably lower costs and 30-day mortality (adjusted RR = 0.65) in the second but not the first year of hospitalists' experience (Meltzer *et al.*, 2002). However, the study included only two hospitalists and 58 non-hospitalist physicians and, therefore, generalisability of findings to other settings is very limited. A retrospective cohort study (Auerbach *et al.*, 2002) compared care provided by 5 hospitalists, 112 community physicians and 20 rotating medical staff in a community-based teaching hospital. Findings were similar to the Meltzer study (2002): hospitalist service produced reductions in length of stay and costs that were statistically significant in the second year of use; over the two years of this study, patients of hospitalists had lower hospital mortality risk (adjusted relative hazard = 0.71) and at 30 and 60 days of follow-up.

Another prospective cohort study on costs and length of stay by paediatric patients with asthma, bronchitis, gastroenteritis and pneumonia using a hospitalist service (n = 5) or primary care physicians (Wells *et al.*, 2001) was also of limited generalisability because it was conducted in a single, private, non-profit children's hospital. All physicians were general paediatricians without subspecialty training. The total number of patients in the study sample was 181, of whom 90 used the hospitalist service. Results indicated that, while hospitalists cared for patients of substantially lower socioeconomic status, they delivered care more economically for patients with asthma with no significant differences in emergency re-admission or 12-month re-hospitalisation rates.

Finally, a retrospective cohort study of the effect of varying levels of house staff (interns/residents) experience in teaching hospitals examined administrative records of 240,467 patients (Rich *et al.*, 1993). There were no significant effects of house staff experience on mortality or surgical complications; for the 25 study diagnoses combined, increased experience in teaching hospitals was associated with increased LOS relative to non-teaching hospitals.

A single-centre 26-week case study was carried out to assess the feasibility of community pharmacist management of minor conditions in patients seeking GP appointments or telephone requests for prescriptions (Whittington *et al.*, 2001). This 'care at the chemist scheme' examined data collected over a six-month period on 576 patients and found that only 21 were referred back to the practice and 33 re-consulted for the same minor condition during the following two-week period. This scheme resulted in a significant shift in workload away from the GP. More rigorous experimental evaluation of this scheme would appear to be worthwhile.

A simple before-and-after study using routine data was carried out at the level II Trauma Center in the Hurley Medical Center in the USA to evaluate the impact of using physician assistants instead of surgical residents (Miller *et al.*, 1998). Surgical and trauma physician assistants were introduced in 1995 and the complication rates associated with central venous and pulmonary artery catheter placements and other intervention procedures were compared with the previous period. Data collected indicated no reduction in quality of care and possibly a decreased length of stay. However, the study design was inadequate to make valid estimates of either the clinical impact or the cost implications of introducing physician assistants in this context. The potential benefits however make this a promising area for future investigation.

5.3.4 Substitution within professional groups

A significant proportion of patients attending A&E can be categorised as 'non-urgent' or 'semi-urgent'. In this randomised controlled trial the care of these patients managed by A&E staff is compared with that given by general practitioners (Murphy *et al.*, 1996). This study included 4684 patients and was based in a busy inner city hospital which employed three local GPs on a sessional basis. GPs investigated fewer patients, had lower referral rates to other hospital services, admitted fewer patients and prescribed more frequently. There was no difference between the two groups on re-attendance rates within 30 days, patient satisfaction, or health status within one month. This study suggests that GPs working as an integral part of an A&E department can manage a large percentage of A&E attenders safely and using fewer resources than do usual A&E staff.

In the USA, hospitals have introduced unlicensed assistive personnel (UAP) as a clinical support to RNs. This is similar to the health care assistant' (HCA) role in the UK. A before-and-after study compared outcomes and patient satisfaction following a change in patient care delivery using UAP as nurse extenders in a 41-bed short-stay medical–surgical observation unit in a small US teaching hospital (Badovinac *et al.*, 1999). This small study examined 40 patients discharged home who had been cared for by 15 RNs and 9 UAP. Patient satisfaction scores after the implementation of the UAP scheme were higher and patient fall rates did not change in the two years before compared to the two years after implementation. Patients, RNs and UAP appeared satisfied in the performance of UAP in taking over some of the RN tasks. Because of the small size of the study, the potential for bias given that it was poorly controlled, and the inadequate collection of clinical data, this study is insufficient to make any sensible judgments about the substitution of UAP (or HCAs) for RNs.

Thus there is now substantial evidence from many studies of substitution that non-physicians can assume some of the

responsibilities of physicians with similar and in some cases better patient outcomes. This is true in primary and secondary care.

This raises several questions, however, some of which were recently summarised by Cooper and Aitken (2001). To what extent can non-physicians effectively (and without compromising quality of care) replace physicians at the more complex end of the spectrum of clinical work and without physician supervision? Thus more research is needed to assess the extent to which substitution can be effective in areas of greater complexity and under less supervision.

5.4 Skill mix and health outcome

The main aims of these studies were to investigate the impact of different skill mix in a health care service delivery system/team on patient health outcomes. Within this scoping exercise, skill mix has been defined as the proportion of a professional group to the overall workforce (for example, the proportion of registered nurses to overall nursing personnel), or the different types (mix) of the workforce.

There were no systematic reviews in this area. One non-systematic review (McKenna, 1995) mentioned 65 studies on the relationship between staffing skill mix and quality of care. It found 38 studies to support the first assumption, 'more qualified staff is a highly efficient and highly effective way to run a health service'; 16 studies for the second assumption, 'more unqualified staff is often an inefficient and ineffective way to run a health service'; and 11 studies for the third assumption, 'more qualified staff is often an efficient and ineffective way to run a health service'.

However, this review did not have a systematic search strategy and analysis; it did not mention the study design of the included studies, nor did it appraise their quality. In addition, only for the first assumption did the review look at the health outcome related to skill mix (i.e. patient satisfaction, length of stay, and mortality). Thus it is difficult to assess the reliability of its conclusion that there are 'sufficient studies available which can be used to support the retention of high numbers of qualified nurses'.

Another non-systematic review (Krainovich-Miller *et al.*, 1997) studied the role of unlicensed assistive personnel (UAP) by summarising the results from two reviews and three primary studies conducted between 1988 and 1997. The two reviews included 72 studies; most of them were based on anecdotal 'evidence' and theoretical statements; others are fraught with methodological limitations such as mismatched groups, small convenience sample sizes, and unreliable measurement tools (such as untested questionnaires).

They had inconsistent results of the UAP's impact on health care quality. Two studies showed (one is a retrospective comparative study with a convenience sample, and the other is an experimental before-

and-after study with a random sample) that it was possible for UAP to deliver the same quality of care to patients (e.g. reduced length of stay, number of falls) at decreased cost.

However, we are not able to come to any conclusions on the effectiveness of any extant UAP skill mix model based on this evidence. For the analysis, the studies will be grouped according to different single outcomes; some studies examined more than one health outcome, therefore some of the studies may be quoted more than once.

5.4.1 Mortality

Three studies examined the proportion of RNs. Two of them (Blegen *et al.*, 1998; Tourangeau *et al.*, 2002) found that a higher proportion of RNs was associated with lower mortality. Both studies adjusted for severity of illness, and the most recent study (Tourangeau *et al.*, 2002) adjusted for patient socioeconomic status and staff characteristics as well. Another (Needleman *et al.*, 2002) found that proportion of RN hours was not related to mortality. This national, comprehensive retrospective cohort study on nurse staffing level and skill mix and made adjustment not only for patient demographics, comorbidity and severity of illness, but also for patient socioeconomic status, and hospital characteristics. The results from this study are more reliable and generalisable than those of the other studies.

A recent study in the USA used a cross-sectional analysis of routine administrative (and survey) data for a large number of general, orthopaedic and vascular surgery patients from 168 hospitals in Pennsylvania (Aiken *et al.*, 2003). This found that there was a statistically significant correlation between the proportion of RNs holding Bachelor degrees and a decrease in 30-day mortality and failure to rescue. So a 10 per cent rise in RNs educated to degree level was associated with a 5 per cent decline in mortality after adjustment for the type of hospital, patient case mix and nursing levels and experience. This suggests that nurses' level of educational preparation may be more important than their years of experience.

One study (Robertson and Hassan, 1999) examined respiratory therapists (RESPTH) and respiratory therapy technicians (RESPTTE). After adjusting for severity of illness and hospital characteristics, the inverse relationship between RESPTTE staffing intensity and mortality is greater than that of the RESPTH staffing intensity and mortality in both year 1989 and 1991, while the opposite case was found in 1990. The study only compared separately the impact of RESPTH or RESPTTE staffing level on mortality; strictly speaking, it did not examine the skill mix of two professionals. However, the authors speculated that as the acuity of inpatients grows, the importance of respiratory therapists in influencing outcomes of inpatients with lung disease will increase.

Therefore, as for the relationship between proportion of RNs and mortality, one strong study did not find any significant relationship, while two less strong studies found significant inverse relationship. The only study on RESPTH or RESPTTE found inconclusive results on the impact of the staffing intensity on mortality. There is one study that suggests that the importance of the educational level of nurses is important.

5.4.2 Length of stay (LOS)

One study (Needleman *et al.*, 2002) found significant inverse relationship between the proportion of RN hours and LOS among medical patients, but not for surgical patients. As mentioned before, this study was a well-adjusted national research with a very large sample size.

Another study (Barkell *et al.*, 2002) on RNs and patient care associates (PCAs) found no significant effect on LOS if increasing the proportion of RNs while decreasing the total number of nursing staff; however, it is not clear which factor (the skill mix, staffing level or both) was important. Furthermore, it is a retrospective convenience sampling study conducted in one hospital without case mix adjustment, so this may not be reliable.

Therefore, as for the relationship between the proportion of RNs and LOS, one strong study found inverse relationship for medical patients, but not for surgical patients. A poor study found no relationship.

5.4.3 Adverse events

Of these 11 studies, seven found a consistent inverse relationship between Registered and Licensed Nurses (RN:LN proportion) and adverse events, such as atelectasis (Unruh, 2003), decubitus ulcers (Unruh, 2003), falls (Unruh, 2003; Blegen *et al.*, 1998; Blegen and Vaughn, 1998), pneumonia (Unruh, 2003; Needleman *et al.*, 2002; Cho *et al.*, 2003), infections (Unruh, 2003; Needleman *et al.*, 2002; Blegen *et al.*, 1998), medication errors (Bond *et al.*, 2001), and pressure ulcers (American Nurses' Association (ANA), 1997). All these studies were adjusted for the severity of illness, and two studies (Needleman *et al.*, 2002; Cho *et al.*, 2003) also adjusted for hospital characteristics.

One study (Blegen and Vaughn, 1998) detected a nonlinear relationship between skill mix and outcome: units with higher proportions of RN care (up to 85 per cent) had lower rates of medication errors per 10,000 doses; but units with RN proportions greater than 85 per cent had higher rates of medication errors per 10,000 doses. Similar trends were apparent for the effect of RN proportion on medication errors per 1,000 patient days. This cross-sectional study only adjusted for severity of illness, not for hospital characteristics, which may be an important weakness.

Another study (Anderson *et al.*, 1998) first grouped the nursing homes to the best or worst health outcomes, and examined the difference of skill mix of each group; then it compared the health outcomes of groups with highest and lowest RN staffing levels. After adjusting for both patient demographics, severity of illness and nursing home characteristics, it concluded that a higher proportion of RN staffing can improve overall quality of care (significant lower rate of adverse outcomes such as physical aggression, other disruptive behaviour, geriatric-chair restraints, decubitus ulcer, urinary tract infection, and fracture) in nursing homes.

Three studies (Barkell *et al.*, 2002; Burnes Bolton *et al.*, 2001; Luckenbill Brett and Tonges, 1990) did not find any relationship between higher proportion of RNs and adverse outcomes. Only one study (Barkell *et al.*, 2002) did case mix adjustment but it was in other respects badly designed.

Therefore, as for the relationship between the proportion of nursing staff who were RNs and adverse events, a total of seven studies incorporating good risk adjustments and one poorer-quality study found an inverse relationship (including the strongest (Needleman *et al.*, 2002; Anderson *et al.*, 1998) in nursing homes). The other five studies made limited adjustments for patient characteristics and the study designs were of poorer quality; this is one possible explanation why no relationship was found between RNs and adverse events in four of these studies and a nonlinear relationship in the fifth.

5.4.4 Patient satisfaction

Three studies found no change in patient satisfaction with a lower proportion of RNs. One study (Luckenbill Brett and Tonges, 1990) is an eight-month before-and-after study evaluating the effect of the Professional Advanced Care Team (ProACT) model, which had similar problems to one of the studies mentioned earlier (Barkell, 2002): it is not clear whether the associations found were a consequence of fewer RNs or the other factors (the new type of nursing management), and since both of the studies were in a single setting with convenience samples, the results were even less accountable.

Another study (Pratt *et al.*, 1993) is a three-month retrospective cohort study comparing the RN and enrolled nurse (EN) models in two wards of one hospital. In addition to the short study time, the survey method for measuring patient satisfaction was too simplistic and untested.

The last study (Pearson *et al.*, 1992) examined much broader aspects of the workforce than skill mix, including the leadership style of the director of nursing. It concluded roughly that different skill mix models did not significantly influence patient satisfaction.

Therefore, as for the relationship between the proportion of RNs (or different skill mix models) and patient satisfaction, four poor-quality studies all found no relationship.

5.4.5 Pain

One study (Barkell *et al.*, 2002) found the pain score increased as the total number of nursing staff decreased with a commensurate increase in the proportion of RNs; however, while statistically significant, this increase may not be clinically significant, as the main pain scores remained less than 3, which indicates satisfactory pain control and does not limit the patient's ability. The study had other limitations such as a single-setting, retrospective design. If there really is an association, it is difficult to tell whether the higher proportion of RNs related to increased pain or the decreased total staff numbers.

Another study (Huston, 2001) compared different types of pain management models in two hospitals. It did not find a correlation between RN proportion and pain scale scores, but it found that a higher proportion of UAP was associated with increased pain scale scores. This study only adjusted for patient age.

Finally, a prospective study analysed the impact of nursing grade on the quality and outcome of nursing care (Carr-Hill *et al.*, 1995). An opportunistic sample from 15 wards at seven sites was used to investigate this relationship and the results indicate that more highly qualified nurses produced better outcomes for patients in terms of QUALPACs (Quality of patient care scale) and pain control. No adjustments were made for patient or hospital characteristics.

In summary, for the relationship between skill mix and pain, one poor-quality study found that a higher proportion of RNs related to increased pain; another poor-quality study found that a higher proportion of UAP was associated with more pain, but no relationship between RN proportion and pain. However, a larger study found that as the ratio of qualified and further trained staff increased the quality of nursing care also increased.

5.5 Volume of activity

Six reviews and 19 primary studies examined the relationship between volume and health outcome. Volume is defined as either the extent of an institution's activity (VIA) or that of individual health professionals (VHP). All reviews (Shackley *et al.*, 2000; Hillner *et al.*, 2000; Finlayson and Birkmeyer, 2003; NHS Centre for Reviews and Dissemination, 1995; Gandjour *et al.*, 2003; Halm *et al.*, 2002) investigated both VIA–outcome and VHP–outcome relationship.

The largest review (NHS Centre for Reviews and Dissemination, 1995) analysed 215 primary studies (184 retrospective cohort studies, 13 prospective cohort studies, eight before-and-after studies, four cross-sectional studies, two randomised controlled trials, two case–control studies, one controlled trial, one case review), and covered 5,351,888 patients.

Among the 28 procedures included in the review, eight investigated both VIA and VHP; six found positive (higher volume related to better health outcome) VIA–outcome relationship (cardiac catheterisation, abdominal aortic aneurysms, gastric surgery, cholecystectomy, intestinal operations (excluding cancer), colorectal cancer); two found no VIA–outcome relationship (acute myocardial infarction (AMI), malignant teratoma); three found positive VHP–outcome relationship (AMI, intestinal operations (excluding cancer), colorectal cancer); and five found no VHP–outcome relationship (cardiac catheterisation, abdominal aortic aneurysms (AAA), gastric surgery, cholecystectomy, stomach cancer).

Of 14 studies that investigated VIA, seven found positive VIA–outcome relationship (coronary-artery bypass grafting (CABG) surgery, paediatric heart surgery, amputation of lower limb (no trauma), knee replacement, neonatal care, AIDS, malignant teratoma); one found negative VIA–outcome relationship (non-surgical gall bladder); six found no VIA–outcome relationship (non-surgical ulcer, hip fracture, paediatric intensive care, adult intensive care, prostatectomy, trauma care).

Of six studies that investigated VHP, three found positive VHP–volume relationship (PTCA, cataract surgery, and pancreatic cancer), one found a negative VHP–outcome relationship (oesophageal cancer), one found inconsistent relationship (breast cancer), and one found no VHP–volume relationship (laparotomy with colorectal resection).

This review gave full details of the methods and stratified the results by case mix adjustment. Because the quality of those primary studies is variable, one should be cautious when trying to summarise the results.

One of the most recent reviews examined 135 studies from 1980 to 2000 (Halm *et al.*, 2002). Half of the studies had been published since 1998. This confirmed the findings of the earlier York review (Ferguson *et al.*, 1997) that though there was evidence supporting a general proposition of a positive relationship between outcomes and volume, this varied greatly. The strongest associations were for AIDS treatment, surgery for pancreatic cancer, oesophageal cancer, abdominal aortic aneurysm and paediatric cardiac procedures. This was less for procedures such as CABG, angioplasty, carotid endarterectomy, other cancer surgery and orthopaedics. Methodological shortcomings were highlighted, in particular the lack of good case mix. Very few studies examine both clinician and hospital volume and so the relative importance of each is unclear.

The most recently published systematic review also examined studies published up to 2000 (but with no language restrictions) (Gandjour *et al.*, 2003). In this review the best study for each diagnosis and intervention was identified. This also found that 50 per cent of these had been published since 1998. 76 studies met the selection criteria and just over half of those which examined physician volume found a

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negative relationship with mortality rate (RR = 0.87; 95 per cent CI: 0.81, 0.94).

Another systematic review (Shackley *et al.*, 2000) considered the peripheral vascular surgery and examined 36 primary studies (31 retrospective studies, two prospective studies – others' study designs are not reported). For carotid endarterectomy, it found positive VHP–outcome relationship, but no volume–outcome relationship. For abdominal aortic aneurysm repair (AAA), it found positive VIA and VHP–outcome relationship for unruptured AAA, but no volume–outcome relationship for those that had ruptured. For other vascular interventions there were insufficient studies to draw meaningful conclusions. The summarised results were based on primary studies which made adjustment for patient demographics, comorbidity, and severity of illness.

One non-systematic review (Hillner *et al.*, 2000) was on cancer care. It found that for cancers treated with technologically complex surgical procedures (non-small-cell lung cancer, pancreatic, oesophageal, and gastric cancer), an extensive, consistent literature supported a positive volume–outcome relationship. For cancers primarily treated with low-risk surgery (colon, breast, prostate, and ovarian cancer), an association with hospital and surgeon volume varied; but for breast cancer and other non-surgical cancers (lymphomas, testicular cancer, leukaemia), all reports showed a positive association between hospital volume and long-term health outcomes. Although it only included primary studies that were stratified by or adjusted for clinical stages, it did not report in detail on the other risk adjustment for each study. In addition, the included studies were all retrospective using data mainly collected in the 1980s. The focus of the review was not only on the volume issue. The quality of each primary study was not considered.

Another non-systematic review (Finlayson and Birkmeyer, 2003) investigated the VIA/VHP and health outcome in colorectal surgery and found that for colon cancer, high-volume hospitals/surgeons were associated with lower mortality rates; for rectal cancer surgery, only high VHP related to better results, including lower rate of recurrence and mortality. Most of the included studies used administrative data; however, the review did not report the degree of adjustments for case mix, nor did it summarise the results based on the quality of the individual studies. So the evidence from this review is not so robust.

Seven non-experimental studies included both VIA and VHP (Solomon *et al.*, 2002; Vakili *et al.*, 2001; Katz *et al.*, 2001; Katz *et al.*, 2003; Begg *et al.*, 2002; Bachmann *et al.*, 2002; Bachmann *et al.*, 2003).

Three primary studies (Solomon *et al.*, 2002; Katz *et al.*, 2001; Katz *et al.*, 2003) on total hip replacement all used different cut-off points of volume of activity for surgeons and hospitals. After adjusting for demographics, comorbidity, severity/history of illness, hospital-level characteristics and/or patient socioeconomic status, two studies (Solomon *et al.*, 2002; Katz *et al.*, 2001) found both VIA and VHP to be

inversely related to dislocation rate or 90-day mortality. In aggregate the effect of VHP was dominant. Katz *et al.* (2001) also found that as for the revision procedures (a new hip replacement for a patient who had previously had the same operation on the same hip), hospitals with more than 50 procedures were related with a lower rate of dislocation, and greater surgeon volume was associated with lower mortality. The later study by Katz *et al.* (2003) did not find any significant volume–outcome (Harris hip score) relationship, except a positive relationship between volume and patient satisfaction.

One study (Vakili *et al.*, 2001) focused on angioplasty, with the adjustment for patient demographics, comorbidity, history of illness, and time to treatment; it found that both VIA and VHP had an inverse relationship with mortality rate, and also indicated that an interaction between hospital and physician volume and in-hospital mortality exists such that those AMI patients treated in high-volume hospitals by high-volume physicians have a 49 per cent lower in-hospital mortality rate than those treated by low-volume physicians in low-volume hospitals.

Two UK studies were retrieved which explored the relationship between the volume of activity and the care of cancer patients (Bachmann *et al.*, 2002; Bachmann *et al.*, 2003). In a prospective study of 23 acute care hospitals in England and Wales (Bachman *et al.*, 2003) patients with pancreatic cancer managed by higher-volume hospitals survived significantly longer (adjusted hazards ratio = 0.88). Patients of high-volume doctors were more likely to undergo various tests and treatments but this had little effect on the adjusted hazards ratio. Bachman *et al.* have also examined the volume–outcome relationships in patients with oesophageal and gastric cancers (Bachmann *et al.*, 2002). For oesophageal cancer the risk of mortality decreased by approximately 8 per cent for each increase of 10 patients in doctors' annual caseload and for gastric cancer, the mortality risk decreased by 7 per cent for each increase of 10 patients in hospitals' annual caseloads. The last study (Begg *et al.*, 2002) was on radical prostatectomy; after adjusting for patient demographics and comorbidity, it found no relation between hospital/surgeon volume and mortality, but an inverse relationship with rates of urinary complications; increased hospital and surgeon volumes were related to decreased rates of post-operative and late urinary complications.

Three primary studies (Tucker and the UK Neonatal Staffing Study Group, 2002; Tilford *et al.*, 2000; Birkmeyer *et al.*, 2002) solely explored the relationship between VIA and health outcome. Birkmeyer *et al.* (2002) examined colectomy, gastrectomy, esophagectomy, pancreatic resection, nephrectomy, cystectomy, lobectomy in pulmonary resection, pneumonectomy, CABG, heart-valve replacement, carotid endarterectomy, lower-extremity bypass, elective repair of abdominal aortic aneurysm. It used a variety of thresholds for the hospital procedure volume. It found an inverse relationship between hospital volume and in-hospital mortality, 30-day mortality or complication. Case mix adjustments were done for patient demographics,

comorbidity, and severity of illness by multivariate logistic regression models. Adjustments were also made for patient socioeconomic status. All the studies were observational retrospective cohort studies done in the USA, using patients' data from a Medicare-linked database.

One study on neonatal intensive care (Tucker and the UK Neonatal Staffing Study Group, 2002) defined the unit patient volume as the number of very low-birthweight babies (less than 1500 g) admitted per year, and set the volume at: less than 35, 35–57, and more than 57; this cross-sectional study found no association between unit volume and in-hospital mortality, cerebral damage, and nosocomial bacteraemia. One study (Tilford *et al.*, 2000) on paediatric intensive care found strong inverse association between unit volume and mortality and LOS. Both of them were adjusted for patient demographics, comorbidity, and severity of illness.

Four primary studies (Klein *et al.*, 2002; Brown *et al.*, 2001; Margulies *et al.*, 2001; Tu *et al.*, 2001a) investigated the relationship between VHP and health outcome.

One retrospective New Zealand study on maternity care (Klein *et al.*, 2002) defined physician volume as annual number of deliveries performed, and set a general volume cut-off point at 20. It adjusted for demographics and case mix and found no VHP–outcome relationship.

The study on intensive trauma care (Margulies *et al.*, 2001) found no correlation between physician volume and health outcomes. It adjusted for patient demographics, comorbidity, stage of illness, and hospital characteristics in a logistic regression model, but it did not report the logistic analysis on the relationship between volume and LOS.

The study (Tu *et al.*, 2001a) on acute myocardial infarction (AMI) defined the surgeon volume as: 1–5, 6–13, 14–24, and more than 24 procedures per year. After adjusting for patient demographics, comorbidity, severity of illness, and hospital/physician characteristics, it suggested that there was a strong inverse association between surgeon volume and mortality.

One cross-sectional study (Brown *et al.*, 2001) on off-pump coronary artery bypass procedure set the cut-off point at 100, and found an inverse relationship between hospital volume and mortality and complications. It was well adjusted for patient demographics, comorbidity, and severity of illness.

According to the literature (six reviews, 13 primary studies) on volume and health outcome, three comprehensive systematic reviews and two other less strong reviews found positive VIA/VHP–outcome relationship for some procedures.

The reviews and the subsequent primary studies confirm that there is a stronger relationship of volume with certain procedures such as abdominal aortic aneurysms (AAA), gastric cancer surgery, pancreatic

cancer and AMI. For trauma care, however, no VIA–outcome relationship or VHP–outcome relationship was found.

These studies are difficult to interpret because of the variability in quality (especially case mix adjustment) and the volume cut-offs used. Given the higher degree of concentration of UK health services compared to the USA, many of these cut-offs are well below volumes routinely achieved in the UK but this is not true of all procedures or at the physician level.

Most studies were observational, retrospective cross-sectional studies based on administrative data. Relationships found in cross-sectional studies do not necessarily translate into the anticipated outcomes when volume changes are made prospectively.

5.6 Specialisation of the workforce

On the topic of ‘specialisation’, 55 papers were reviewed. This theme focused on assessing the impact of health care workforce specialisation on patient outcomes, within professional group (for example, general practitioner versus cardiologist) and between group (for example, acute nurse practitioner versus residents) differences.

This literature is largely from the USA (35 papers); a smaller set of articles is from the UK (12 papers), a single paper from each of Australia, Netherlands, Finland, and Portugal, and two from Canada and Italy.

The majority of the studies pertain to medical practice and various physician specialities, especially the US studies. While a variety of medical conditions and health outcomes were studied, cardiovascular conditions were the most frequently studied.

5.6.1 Cardiovascular

Among these, seven studies concerned the effect of specialisation on patients with acute myocardial infarction (AMI). Three of these studies used a database containing all such admissions in Pennsylvania in the 1990s (Casale *et al.*, 1998; Jollis *et al.*, 1996; Nash *et al.*, 1999). The main outcome of interest was in-hospital mortality; two studies yielded almost identical odds ratios favouring care by cardiologists (Nash, 0.893; Casale, 0.83) over primary care physicians. Casale also reported outcomes for those treated by non-specialist physicians with a high volume of AMI patients. The odds ratio for this group fell between that of cardiologists and primary care physicians (0.89), indicating a type of specialisation dose–response.

An earlier study of Medicare patients hospitalised for acute myocardial infarction in four states (Alabama, Connecticut, Iowa, Wisconsin) during a seven-month period in 1992 measured survival up to one year after MI (Jollis *et al.*, 1996). After adjustments for patient and hospital

characteristics, it was found that patients treated by cardiologists were 12 per cent less likely to die within one year. All three studies used a retrospective cohort design.

A more recent study (Ayanian *et al.*, 2002) using the Cooperative Cardiovascular Project data, examined the relationship between ambulatory care and two-year mortality among elderly patients after MI. Care provided in seven states by cardiologists, internists, and family practitioners for Medicare patients, 65–84 years of age, who were hospitalised with MI in 1994–1995 was assessed by a telephone survey 18 months after discharge. Hospital and medical administrative data were examined for service utilisation analyses. Ambulatory care by cardiologists was associated with a lower mortality among elderly patients; the mortality rate was 14.6 per cent for this matched cohort compared to 18.3 per cent for those treated by an internist or family practitioner. An earlier study by the same researchers (Ayanian *et al.*, 1997) of Medicare beneficiaries aged between 65 and 79 years who were treated for AMI at 285 hospitals in Texas during 1990 indicated that adjusted one-year mortality did not differ significantly between patients treated by generalists compared to those treated by cardiologists (OR = 1.01). However, patients admitted to hospitals offering coronary angioplasty and bypass surgery had much lower adjusted one-year mortality than patients admitted to other hospitals (OR = 0.68). Cardiologists were more likely to treat patients in hospitals with better outcomes.

Another study using data on California patients, also from the Cooperative Cardiovascular Project (Frances *et al.*, 1999), examined whether during hospitalisation, cardiologists are more likely to provide recommended therapies to elderly patients with AMI than are medical subspecialists, general internists, or family practitioners. The study concluded that good candidates for aspirin were more likely to receive it if treated by a cardiologist (87 per cent) than by an internist (84 per cent), family practitioner (81 per cent) or medical subspecialist (73 per cent). Cardiologists were more likely to treat with thrombolytic therapy (51 per cent) compared to general internists (40 per cent), medical sub-specialists (29 per cent), or family practitioners (27 per cent). Interestingly, 30-day mortality was similar across physician specialties. However, one-year mortality rates were greater for patients treated by family practitioners (OR = 1.3) medical sub-specialists (OR = 1.2) or general internists (OR = 1.1) compared to patients treated by cardiologists.

A fourth study using AMI data from the Cooperative Cardiovascular database (Chen *et al.*, 2000) assessed the extent to which the association between physician specialty and 30-day and one-year mortality was mediated by differences in the use of guideline-supported therapies or differences in the clinical characteristics of the patients. Cardiologists had the highest use of guideline-supported therapies. The one-year survival rates favoured cardiologists relative to internists (RR = 0.97) and excess mortality associated with general

practitioners (RR = 1.05). However, when these results were adjusted for the use of guideline-supported therapies, differences in one-year patient survival were not significant.

Three studies examined congestive heart failure (CHF) in the USA (Philbin *et al.*, 1999; Philbin and Jenkins, 2000) and Portugal (Azevedo *et al.*, 2002). The earliest US study used a prospective cohort design and followed 2454 patients for six months post discharge. All outcomes were severity adjusted. The findings indicated that in the 10 acute care community hospitals, the clinical practices of cardiologists were more compatible with published treatment guidelines than the practices of other physicians. Lower CHF re-admission and better quality of life measures were the benefits of cardiology specialty care rather than lower mortality rates or shorter length of stay. No differences in adjusted mortality rates were observed between patients treated by cardiologists and non-cardiologists. The second US study examined administrative data for 44,926 patients six months post discharge (Philbin and Jenkins, 2000). The aim of the study was to investigate the demographic and clinical differences between patients of cardiologists and patients of other types of physicians (internists, family physicians and 'other' physicians). After adjustments for patient and hospital characteristics, the length of stay was similar for cardiology (OR = 9.4) and internal medicine patients (OR = 9.5), but lower for family practice patients (OR = 8.6) and highest among other physicians' patients (OR = 11.7). The adjusted odds ratio for death and re-admission and a composite measure (in-hospital mortality and re-admission) were equivalent to cardiology patients for the remaining three groups.

Azevedo *et al.* (2002) assessed outcomes one month after hospitalisation and survival over the longer term (just over one year) using a prospective cohort design, following up 339 patients. The study took into account several demographic and clinical patient characteristics. The risk of dying or being re-admitted during the first month after discharge was significantly lower in patients managed by a specialised heart failure clinic (adjusted OR = 0.23) which provided ambulatory care by a multidisciplinary medical staff, compared to usual care by general practitioners.

Vascular surgery was another area of specialisation for which four studies were reviewed. Three studies examined outcomes for patients with unruptured abdominal aortic aneurysm. A prospective study using the EUROSTAR database (Laheij *et al.*, 2002) determined that the outcomes of patients treated by a highly experienced team of vascular surgeons and intervention radiologists from 16 European countries were significantly better than outcomes (death or secondary intervention) of patients who underwent treatment by a relatively inexperienced team. Post-operative mortality was 40 per cent lower in patients treated by the most experienced specialist teams compared with the least. A retrospective study of coil embolisation in the US (Singh *et al.*, 2002) indicated similar results; the odds of complication were lower with

increasing experience for the three physicians under study. A 30 per cent reduction in the OR for complication was reported for every five cases treated. However, this was a small study (patient $n = 94$; neuroradiologist $n = 3$) in one university medical centre, covering a seven-year period; history and maturation were clearly threats to validity. A much larger Canadian retrospective cohort study (Tu *et al.*, 2001b) of elective AAA indicated that treatment by vascular or cardiac surgeons led to significantly lower 30-day adjusted mortality rates (3.5 and 4.0 per cent, respectively) than repair by general surgeons (6.2 per cent).

A fourth study on early outcomes of major lower-limb amputations for vascular disease (Campbell *et al.*, 2001) also examined attempted revascularisation and seniority of surgeon. The study reported no differences between consultants, registrars, and senior house officers for any of the outcome measures: amputation level, revision, complications and death.

A prospective cohort study supplemented by a questionnaire-based survey of 10,880 admissions at 29 institutions examined the effect on ischaemic stroke outcomes in patients admitted to academic medical centres (Gillum and Claiborne Johnston, 2001). In-hospital deaths were less frequent and LOS reduced at hospitals with a vascular neurologist (OR = 0.51; 95% CI = 0.36 to 0.74; $p < 0.0001$). This study reported no adjustments for patient or hospital characteristics.

5.6.2 Emergency care

Another eight studies on specialisation pertained to emergency care, including trauma care and ambulance services. Among these is a retrospective study of one hospital in New York State, before and after achieving American College of Surgeons Level I trauma verification (DiRusso *et al.*, 2001). Trauma system improvement appears to have a positive effect on survival and patient care, as indicated by the analysis using risk models to compare the two years under study. A five-year study of four Scottish hospitals (Wyatt *et al.*, 1999) compares the survival rate of trauma patients treated by A&E consultants and by junior doctors. The findings of this large study (patient $n = 10,968$) indicate that patients treated by A&E consultants had significantly higher survival rates than the group treated by the junior doctors, survival rates that were higher than the UK average.

Two studies examined survival from out-of-hospital cardiac arrest (Soo *et al.*, 1999; Suominen *et al.*, 1997). Soo examined outcomes when attended by various teams of paramedic or technician crews or combinations of technicians backed up by paramedics, medical personnel, or other health professionals. Results indicated that resuscitation by paramedic crews resulted in better rates of survival to both hospital admission and discharge compared to technician-only crew. The data for this retrospective study came from a number of administrative sources in Nottingham and 1547 patients were included

in a logistic regression model. The crude survival rates to admission varied between 6.9 per cent and 24.3 per cent; adjusted odds ratios favoured treatment by a trained paramedic crew with medical back-up (13.82 additional survivors relative to a technician crew) or with other health professional backup (12.38 additional survivors to admission). Resuscitation by a paramedic crew without back-up resulted in 6.94 additional survivors to admission and another 3.55 survivors to discharge. While the paper did not discuss limitations to the study, history and maturation are important threats to validity; the number of ambulance crews had increased from 22 to 116 during the period under study.

Suominen *et al.* (1997) studied paediatric cardiac arrest patients (under 16 years of age) in an emergency system based on physician care units during 1985 to 1994, and compared the outcomes to those from the literature about systems based on paramedics. The retrospective cohort analysis included 100 pre-hospital cardiac arrest patient records; two physician-staffed emergency care units saw patients. Sudden Infant Death Syndrome (SIDS) was the most common cause of arrest. Of the 50 patients who had received CPR (the other 50 were declared dead on the scene), resuscitation was successful in 13 patients and eight were ultimately discharged. The study concluded that the overall rate of survival was equally poor as reported from systems with paramedics. The only difference between physician and paramedic-staffed units was the ability of physicians to refrain from resuscitation when prognosis is poor.

Outcomes and costs of primary care problems in patients who attended A&E departments in a 12-month period at King's College Hospital, London (Dale *et al.*, 1996) compared general practitioners, senior house officers, and registrars. The inner city A&E department was visited by 4641 patients presenting primary care problems. A sub-sample of patients was followed up for information on patient satisfaction, use of general practice, and recovery. A three-month follow-up of clinical care outcomes was undertaken through a survey of practices near the hospital that had provided care to a sub-sample of those discharged to community care. The study concluded that management of patients with primary care needs in an A&E department by general practitioners (employed on a sessional basis) reduced costs with no apparent detrimental effect on outcome. Elaborate modelling of costs was based on numerous cost estimates of investigation, treatment and referral as well as hospital administrative costs. Including cost of admission, the average costs per case were £58.25, £44.68, and £32.30, for senior house officers, registrars, and general practitioners, respectively. The authors acknowledge the important limitations of hospital costing information and the large disparities between hospitals in their cost estimates for the same procedure. This would greatly limit the generalisability of the results. Hidden costs due to methods of estimation may have important implications on overall study results.

One ambulatory care study examined the effect of interns' care in a walk-in clinic on patient functional status, symptom resolution and visit costs, relative to staff physicians (Jackson *et al.*, 1999). Follow-up data at two weeks and three months were collected. There was no difference between the groups in visit costs, subspecialty referrals, health care utilisation, or hospitalisation rates.

Finally, two studies were found on the transportation methods of critically ill patients in the ICU (Bellingan *et al.*, 2000; Stearley, 1998). One study at the University College of London Hospitals (UCLH) in 1996–1997 found specialist teams consisting of doctor, nurse, driver and medical physics technician trained in transfer of ICU patients had fewer deaths within six hours of admission and up to 12 hours after admission when compared to the standard emergency ambulance team (Bellingan, 2000). The study did not control for transport from other ICUs or medical patients, both of which may alter results. The second study found that in the transfer and monitoring of critically ill patients a specialty-trained ICU nursing staff could substantially reduce the rates of complications and adverse events (Stearley, 1998). When compared with US national overall complication rates for intra-hospital transportation of patients, complication rates of the hospital studied were much lower. National complication rates were compared to the specific hospital in the study; however, no attempt was made to match patients or make the two samples similar in characteristics. Hence, it was difficult to determine the specific areas in which nurses made a difference.

5.6.3 Cancer

A small number of articles were retrieved that investigated the effect of specialisation on cancer patients, two of which were systematic reviews. The first was a UK review, which was undertaken to determine whether teams (doctors, clinical nurse specialists, social workers, chaplains, therapists and psychologists or psychiatrists) providing specialist palliative care improve the health outcomes of patients with advanced cancer when compared to conventional services (Hearn and Higginson, 1998). A comprehensive search strategy was used and 18 studies – five RCTs and 13 observational or comparative studies – were included in the final analysis. The studies were not combined and there was only a limited discussion of the study differences. However, four out of the five RCTs and the majority of the other studies indicated that the specialist co-ordinated approach resulted in similar or improved outcomes for patients.

The second article focused on randomised controlled trials, and retrospective and prospective cohort studies that compared clinicians or centres grouped according to specialisation to determine whether cancer patients had better outcomes when cared for by specialist centres and clinicians (Grilli *et al.*, 1998). An adjustment score was given to the 46 studies based on the number and type of patient characteristics

considered in adjusting for case mix. Generally patients had a lower risk of long-term mortality when treated by specialised centres/clinicians although the results from two of the studies differed. Five studies that focused on breast cancer care all had an adjustment score of 2 or more and lower five-year mortality was reported when treated in specialist centres or by specialised clinicians (OR = 0.82, 95% CI: 0.77, 0.88). For haematological cancer four studies (one of which dealt with three types of tumour) were found and five of the six treatment arms showed lower mortality when treated in specialised situations. Six out of the seven studies focusing on ovarian cancer showed lower mortality when treated in specialised situations. Within the literature on other solid tumours, two studies reported statistically significant lower mortality for colorectal cancer and prostate cancer in teaching versus non-teaching hospitals. Lung cancer (one study, two histological types) results differed according to histology. Testicular cancer (one study) showed an advantage only for the availability of on-staff urologists and not for oncologists. Few studies focused on types of neurological tumours, sarcomas, or childhood cancers. The limitations of the review include the possibility of publication bias due to outcome-dependent publication and the influence of methodological flaws on the results – for example, the lack of comparability of patients seen at specialised and non-specialised centres and the use of observational studies resulting in an over-estimate of effect size. Additionally, as the primary studies were limited to those published in English, some relevant studies may have been omitted. Hence, the authors correctly advise caution in the interpretation of the results in the light of the overall limited quality of evidence identified.

A prospective study, following 3701 patients who were screened for colorectal cancer was retrieved and there were no significant differences between board-certified gastroenterologists performing sigmoidoscopies and trained non-physician endoscopists (Wallace *et al.*, 1999). Non-physicians detected neo-plastic polyps in a greater proportion of patients than physicians, but this difference was not significant after adjustments were made for patient characteristics. The final study pertaining to cancer care explored whether immediate surgical outcomes and long-term survival after supervised rectal cancer surgery by trainees were being compromised (Tytherleigh *et al.*, 2002). The study followed a total of 205 consecutive patients who had undergone elective rectal resection of their rectal cancer between 1995 and 1999, under the care of six consultant surgeons. There were no significant differences in post-operative morbidity and mortality between operations performed by consultants and surgical specialist registrars. Patients were controlled for age, gender (but differences were not significant in the survival analysis), tumour stage, and type of operation performed and whether they had a de-functioning stoma. The study findings indicate that in the selected patients outcomes were not compromised by supervised surgical specialist registrar resections of rectal cancer.

5.6.4 Common medical conditions

While many studies examined care for various disease categories by primary care providers compared to specialists, four studies were identified that compared primary care with the specialist care for general common medical problems: one in ambulatory care (Franks and Fiscella, 1998), one in a nursing home (Bellelli *et al.*, 2001) and two in hospitals (Rudy *et al.*, 1998; McGann *et al.*, 1995). Franks and Fiscella used data from the 1987 National Medical Expenditure Survey on a sample, reporting as their personal physician either a primary care physician (GP, FP, internist, or ob/gyn) or a specialist, to examine total annual health care expenditures and five-year mortality experience. The study reported appreciable socio-demographic and health differences between the patients who consulted primary care providers or specialists; after controlling for these differences, including health insurance status and health perceptions, respondents reporting using a primary care physician compared to those using a specialist had 33 per cent lower annual adjusted health care expenditures and lower adjusted mortality (hazards ratio = 0.81). The self-reported information on morbidity presents the usual data validity and reliability problem; case mix adjustment between physician groups was based on this self-reported information. Also, respondents who reported seeing 'other doctors' were included in the specialist group, blurring the definition of specialist. This study, however, provides some insight into the integration of primary and specialist care in the US system, which has increasingly moved to a managed-care delivery model.

McGann *et al.* (1995) examined the relationship between cost and specialty training of the ten most common Diagnostic Related Groups (DRGs) in patients 65 and older, using the Medis Groups Comparative Database for 29 hospitals in Pennsylvania. The physician groups of interest were general/family practitioners compared to general internists and internal medicine sub-specialists. There were no differences in mortality or hospital charges for patients of family physicians and internists, after adjusting for patient and hospital characteristics. Slightly higher morbidity was reported for patients of internists (OR = 1.07) and a small difference in LOS (10.80 versus 10.54 days for internists and family practitioners, respectively). Weaknesses in study design, including the validity of the measures for morbidity and severity of illness drawn from the quality assurance database, raise some questions about the strength of the conclusions. The authors conclude that savings to the health care system attributable to family practitioners in other studies may occur predominantly outside the hospital.

An Italian nursing home study was retrieved which investigated whether the use of different kinds of physicians led to different outcomes at night and during holidays (Bellelli *et al.*, 2001). Data were collected from ten non-profit nursing home facilities, with 352 nursing home residents. A semi-structured form was used to record all adverse clinical events, and medical and administrative charts were also reviewed. The

hospitalisation rate of NHS physicians was about twice that of the temporary physicians and six times that of the staff physicians. Staff physicians' diagnoses and management were appropriate in the majority of cases; NHS diagnoses and management were doubtful or incorrect in about one-third of all cases. However, no adjustments were made for patient or hospital characteristics.

5.6.5 Chronic conditions

An additional nine studies were found that investigated the effect of specialisation on a variety of conditions including: musculoskeletal and rheumatic conditions, chronic obstructive pulmonary disease, asthma, gastrointestinal diseases, liver disease, laparoscopic donor nephrectomy, ischaemic stroke and rhegmatogenous retinal detachments.

A critical review of the literature for patients with musculoskeletal and rheumatic conditions was found that compared the outcomes of care provided by generalists with those of care provided by specialists (Solomon *et al.*, 1997). One randomised controlled trial, four prospective cohorts, eight retrospective cohorts and three physician surveys published in English were identified by searching MEDLINE and by contacting experts in the field. Generalist care was reported to be as effective as specialist care and less expensive, but also less satisfying for patients with lower-back pain. No clear variations in clinical outcomes were identified for patients with acute arthritis. For work-related injuries, osteoarthritis and rheumatoid arthritis specialists appeared to provide better outcomes than generalists. However, all of the studies had methodological limitations, in terms of study design, cohort selection, outcome definition and sample size calculations. As the authors failed to report the methods by which decisions were made on the relevance and quality of the primary studies it is difficult to generalise the results and draw any firm conclusions from this review.

A prospective comparative study also focused on the relative costs and effectiveness of specialist and general internist ambulatory care for patients with two chronic musculoskeletal conditions (knee osteoarthritis and chronic low-back pain) (Anderson *et al.*, 2002). Among the 398 patients across four sites in Boston, with adjustments for patient characteristics, specialist-only care was associated with improvements in functional status at slightly higher costs compared to non-specialty care. Co-care was substantially more costly and was associated with little improvement in functional status.

One prospective study on COPD compared survival of patients treated by pulmonologists and generalists in five academic medical centres (Regueiro *et al.*, 1998). There was no evidence of a survival advantage for patients cared for by pulmonologists.

Physician specialty (generalists, experienced generalists, pulmonologists and allergists) and treatment and outcomes of patients

with asthma in managed-care plans were explored in the study (Wu *et al.*, 2001). Data for the 1954 patients, with their corresponding 1078 physicians, were obtained from mailed, self-administered patient and physician surveys. After controlling for baseline patient characteristics the results indicate those with self-reported expertise in treating asthma achieved better outcomes for patients when assessed one year later. However, the findings can only be generalisable to adults treated in managed health care settings but not the whole population because the study population consisted of mainly white adults insured through plans affiliated with prominent US companies.

Some health maintenance organisations (HMOs) limit access by their members to specialists to lower costs, hence a study was undertaken to explore whether this policy affects the outcome of children with appendicitis (Alexander *et al.*, 2001). At a single medical centre children were either treated by Group A (six general surgeons each with more than five years of experience) or Group B (three paediatric surgeons with a minimum of two years of experience). In patients with simple acute appendicitis, there were no significant outcome differences between Groups A and B. In patients with gangrenous or perforated appendicitis, there were significant differences for complications (Group A, 9 of 27 versus Group B, 3 of 34, $p = 0.025$); re-admissions (Group A, 6 of 27 versus Group B, 0 of 34, $p = 0.001$); second operation (Group A, 6 of 27 versus Group B, 2 of 34, $p = 0.001$); and mean total length of stay in days (Group A, 8.6 of 27 versus Group B, 5.4 of 34, $p = 0.05$). No adjustments were made for patient or hospital characteristics.

A Canadian study at four university teaching hospitals in Quebec was found that investigated the outcome differences in the management of fistulas complicating diverticulitis between patients under the care of specialists (colorectal surgeons) and general surgeons (Di Carlo *et al.*, 2001). As there were no significant differences in patient demographics, pre-operative comorbidities, or the number of pre-operative diagnostic investigations between the two groups, no adjustments were made for patient characteristics. Compared to the patients treated by specialists (CS), general surgeon (GS) patients had: longer pre-operative lengths of stay (median CS 3 (range, 1–28) days versus GS 8 (range 0–29) days; $p < 0.001$); longer post-operative lengths of stay (median CS 11 (range, 5–40) days versus GS 14 (range 2–80) days; $p = 0.001$); and longer total lengths of stay (median CS 14 (range 6–62) days versus GS 24 (range 6–100) days; $p < 0.001$). The patients in the GS group experienced a higher rate of wound infections (CS 5.4 per cent versus GS 12.9 per cent) and a larger proportion of them experienced complications (CS 27 per cent versus GS 41.2 per cent). However, as patients in the GS group had a higher incidence of abscesses prior to surgery, which might impact the rate of wound infection and post-operative complications, the results are potentially biased.

One of the retrieved studies compared the length of hospital stay, cost of hospitalisation, and outcomes when generalists work together with

gastroenterologists or alone in the management of patients admitted to the hospital with decompensated cirrhosis (Bini *et al.*, 2001). This prospective cohort study was performed at one Veterans' Association (VA) teaching hospital site affiliated with New York University School of Medicine and involved 197 patients. Those patients who had a gastroenterologist (GI) consultation had a significantly shorter LOS (5.6 ± 3.5 versus 10.1 ± 5.8 days, $p < 0.001$) and a lower cost of hospitalisation ($\$6,004 \pm \$4,994$ versus $\$10,006 \pm \$6,183$, $p < 0.001$) than those patients managed by generalists alone. The 30-day incidence of re-admission (13.3 per cent versus 27.8 per cent, $p = 0.01$) and mortality (7.5 per cent versus 16.7 per cent, $p = 0.045$) were significantly lower in the GI consultation group. During the median follow-up period of 618 days (range 2–970), patients who had a GI consultation during hospitalisation had a significantly longer time to hospital re-admission ($p < 0.001$) and improved survival ($p = 0.02$). Adjustments were made for patient and hospital characteristics.

An observational study examined whether a trained laparoscopic team could improve patient outcomes of cholecystectomy (Kenyon *et al.*, 1997). Data from hospital records from 1990 to 1993 were used and although no complications were reported between the two groups, the risk of converting a laparoscopic procedure to an open procedure was significantly higher when the non-designated team performed the procedure.

The initial 70 sequential laparoscopic donor nephrectomy (LDN) procedures performed between October 1998 and March 2001 at institutions in the USA were investigated (Siqueira *et al.*, 2002). The procedures were stratified into two groups, those that were performed by one proficient laparoscopic surgeon and an inexperienced laparoscopic surgeon (resident, fellow or faculty) as the first assistant, and those performed by two proficient laparoscopic surgeons. Relatively few complications occurred in both groups, but there were significant differences in the total operative time and estimated blood loss between the two groups, with a decrease shown in the group with two proficient surgeons. However, it is unclear from the article if any adjustments were made for case mix and the generalisability of the results outside the study centre is questionable.

A national UK study was found which was designed to audit anatomical outcomes and complications relating to primary surgery for rhegmatogenous retinal detachments (Thompson *et al.*, 2002). The study population included 768 patients and 167 consultant ophthalmologists, and the clinical data were collected via a survey of all consultants who performed retinal detachment surgery in the National Health Service. There were significant differences in re-attachment rates between specialists and non-specialists, overall and for specific sub-groups of patients. Conversely, there was no significant difference between the overall complication rates between the two groups. However, as the majority of non-specialists performed fewer procedures

the lower success rate may be related to lack of quantity, as they may not have had sufficient practice to maintain clinical and surgical skills.

5.6.6 Nursing

A considerable number of articles were identified pertaining to nursing and specialisation. Three were literature reviews, covering: the extent to which nursing education is actually related to nursing practice; nursing specialty training in management of epilepsy; and the impact of unlicensed assistive personnel (UAP) on nursing care delivery.

A review of studies, although the number is unclear, examined the potential effects of specially trained epilepsy nurses working in primary care (Ridsdale, 2000). Six sources were searched and inclusion criteria discussed. This review concludes that where nurses have been trained in epilepsy care, there is level I evidence that running clinics in family practice is acceptable and satisfactory to patients. Where clinics have been set up in primary care, there is level I evidence that there has been an increase in the information and advice recorded as being provided to patients. This review also notes that there is little evidence on outcomes from clinics set up by epilepsy nurses and suggests trials with an adequate sample size and follow-up to identify whether such services will benefit patients.

A second systematic review was found, focusing on evidence from controlled trials investigating the effectiveness of specialist epilepsy nurses compared to routine care (Bradley, 2001). Specialist epilepsy care was defined as care received from a nurse specially trained to manage the problems of people with epilepsy. Routine care was defined as care received either in general practice or hospital, which does not involve the service of a specialist epilepsy nurse. Numerous databases were searched and three trials were included in the final analysis. The authors conclude that there was insufficient evidence to support the theory that specialist epilepsy nurses improve outcomes for people with epilepsy overall. Owing to the presence of clinical heterogeneity, no pooling of results was performed and there is a difficulty in generalising results because the definition of a specialist nurse was unclear from the studies.

The narrative review by Krapohl and Larson using a single bibliographic source (CINAHL 1988–1994) provides basic tabulation of studies dealing with the use of unlicensed support personnel and its impact in terms of nurse and patient satisfaction, cost and quality of care (Krapohl and Larson, 1996). No empirically strong evidence was found to confirm that nursing support personnel improved quality or increased nurse and patient satisfaction. No information was provided about the number of reviewers or method of appraisal, if any.

Over a 14-month period the effects of care activities performed by acute care nurse practitioners and physician assistants (ACNP/PAs) at two centres on the outcomes of their patients were compared with those

of resident physicians (Rudy *et al.*, 1998). There were no significant differences in the length of stay, in-hospital mortality, occurrence of a drug reaction or re-admissions between patients treated by ACNPs or PAs and those treated by residents. No adjustments were made for patient or hospital characteristics in the analysis of these outcomes.

Three RCTs were found which evaluated nurse specialisation. Dixon (2001) reported an RCT of standard, inpatient care for adults with diabetes, with and without the intervention of a diabetes specialist nursing (DSN) service in a single UK hospital (Davies *et al.*, 2001). Primary outcome measures were LOS and re-admissions; secondary outcome measures included diabetes-related quality of life and GP/community contacts upon discharge. Statistically significant results indicated lower LOS in the intervention group and cost per nursing input was £38.94. However, when the reduced LOS was taken into consideration, the intervention produced a mean saving of £436 per admission. Patients in the intervention group were more knowledgeable regarding their diabetes and more satisfied with their care. Re-admission rates and mean time to re-admission were similar in the intervention and control groups.

A continuum of nursing care for frail rural elderly people post discharge was the subject of a second RCT (Dellasega and Zerbe, 2000), comparing outcomes of intervention by advanced practice nurses (APNs) with those of no nursing care, RN-only care and both RN and APN care, post discharge. The small sample consisted of 140 elderly patients and 65 caregivers. The size of the sample is of concern because the initial consent rate was very low at 50 per cent for patients and 56 per cent for caregivers. The reasons provided for refusal were of even more concern: a belief that no follow-up care was necessary because needs would be met by informal caregivers at home. This has important implications regarding self-selection. The completion rate was 71 per cent for elderly people and 64 per cent for caregivers. Among the reasons for refusal to continue with the study was dissatisfaction with the research process, loss of contact, and death of the elderly person. Such loss to follow-up in a study that collected data at discharge and at two, four and six weeks after discharge has major limitations which were not broached in the analysis or discussed in the paper. The authors report that elderly patients in the APN-only group experienced fewer emergency room visits and hospital re-admissions, but this was not statistically significant. Caregivers receiving APN-only support reported significantly fewer work days missed relative to the RN-supported caregivers. The authors also report from the small focus group (four APNs) on the role of the APN in delivering post-discharge intervention for frail elderly hospital patients. Participants perceived their role as more comprehensive than autonomous and able to enhance continuity of care.

The final randomised controlled trial included 1859 patients from nine randomly selected health authorities in England (Jarman *et al.*, 2002). The study explored the effects of community-based nurses specialising

in Parkinson's disease on health outcomes and health care costs. Mortality did not differ between those who were attended by nurse specialists and those receiving standard care from their general practitioner (hazard ratio for nurse group versus control group 0.91; 95% CI 0.73 to 1.13). Scores on the global health question (patients' sense of well-being) were significantly better in patients attended by nurse specialists than in the control group (difference -0.23, -0.4 to -0.06). No adjustments were made for patient or hospital characteristics.

One non-experimental study was retrieved that investigated the effect of having a clinical nurse specialist (CNS) join the team on the LOS. The study was based in an orthopaedic and rehabilitation unit and found a reduction from 6.84 days to 4.87 days with a unit-based CNS (Wheeler, 2000). Conversely, this study also looked at the LOS on the orthopaedic unit, which gave a similar mean LOS for both groups (4.5 with a CNS and 4.72 without). This study also investigated complications but had such a low incidence rate (six (9 per cent) with CNS and 17 (26 per cent) without CNS) it could not be statistically analysed.

A retrospective cohort study examined the effect of concentrated staff nurse expertise (a nursing specialty unit) on patient outcomes of LOS and mortality (Czaplinski and Diers, 1998); 11,316 inpatients were followed and were analysed according to 16 different Diagnostic Related Groups (DRGs). In nine of the DRGs a significant reduction was found in the LOS of patients cared for on specialised nursing units. Also, in four of the DRGs the mortality rate was significantly lower for patients cared for on specialist units. Patients' age and differential intensive care unit use were used for risk adjustment. However, this study made no adjustments for physician speciality.

The catheter-related complication rates in patients who had infusion devices placed by infusion nurses were compared with complication rates of those placed by generalist nurses was explored in this study (Palefski and Stoddard, 2001) There were 639 patients treated by infusion nurses and 137 patients treated by generalists at three sites. Out of all vascular access devices (VADs) inserted by generalist nurses 36 per cent were removed because of a complication compared with 20 per cent of those inserted by infusion nurses ($p < 0.001$, RR = 0.55, and the risk difference = 16.1 per cent). A significantly lower incidence of leakage occurred with VADs inserted by infusion nurses (6.4 per cent versus 15.3 per cent, $p = 0.001$). Additionally, the incidence of infiltration was significantly lower with VADs inserted by the infusion nurses (7.5 per cent versus 13.9 per cent, $p = 0.028$). Since patients were not randomised to the two groups differences in patient and therapy characteristics were present. There were also differences in the settings as generalist nurses inserted VADs primarily in emergency room (42.5 per cent) and 'other' (33.9 per cent) settings, whereas the specialists worked primarily in medical or surgical settings (83.5 per cent). This could have had an impact on the number of leakages and

other complications due to the unsettled nature of inserting in the emergency room setting, patient stress, and the necessity of moving the patient to a ward.

One retrospective study aimed to identify incidents associated with nursing staff inexperience and estimate the effect on the quality of patient care (Morrison *et al.*, 2001). The authors reported that nursing staff inexperience could have a negative impact on the quality of care delivered to critically ill patients as shown by the occurrence and outcome of incidents. Specialised nurses detected incidents more often, and precipitated them less often than non-trained ICU nurses.

Findings in the next study found that specialisation of home care nurses made little difference to patient outcomes (Frank-Stromborg *et al.*, 2002). The difference in outcomes for cancer patients cared for by Oncology Certified Nurses and by RNs was studied. There was no difference with respect to pain management at and after admission, fatigue assessment at admission, and unplanned visits to care facilities. Results did however differ between fatigue assessment after admission and the adverse event of an infection.

Another study (Miller, 1997) undertaken to explore an alternative care model for nursing home patients receiving care in one hospital centre concludes that a gerontological nurse practitioner along with an attending physician resulted in a mean decrease in LOS for 17 common diagnostic categories, when compared to care by a physician's assistant and attending physician. The study uses mostly anecdotal information and data on LOS. The source of those data has not been identified. Conclusions include effectiveness of the gerontological nurse practitioner with patients and families, anticipation of discharge and long-term needs from a gerontological perspective and continuity of care.

The study by Silber *et al.* (2000) has the most rigorous design among this subset of studies; however, the purpose of this retrospective cohort study is to compare outcomes of anaesthesia performed or medically directed by anaesthesiologist and by a physician or staff nurse anaesthetist employed by the hospital, defined as undirected anaesthesia. The study involved 194,430 directed and 23,010 undirected patients among 245 hospitals. All Pennsylvania Medicare claims records for patients 65 and older were analysed for general and orthopaedic admissions between 1991 and 1994. Death, complications and failure to rescue were the outcomes of interest; 64 patient characteristics and 42 DRG-procedure categories were used to adjust the outcome models. Also 11 hospital variables were included in the three outcomes models to measure their significance to the results. Silber *et al.* found higher adjusted mortality and failure-to-rescue rates for patients who underwent operations without medical direction by an anaesthesiologist. However, adjusted complication rates were not related to medical direction.

Changing patterns of staffing in anaesthesia services at one US university hospital between 1992 and 1997, including the deployment of a certified RN anaesthetist (CRNA) were studied (Posner and Freund, 1999). Complications, adverse events and medical errors were the outcomes of interest, as measures of quality of anaesthesia care. This retrospective cohort study reported no statistically significant relationship between increased productivity and adverse events or errors. Over the six years of changing staffing patterns and increasing productivity, most quality of anaesthesia care indicators did not appear to decrease. However, the quality measures were aggregated and could not be attributed only to the anaesthesiologist compared to attending resident or attending CRNA care teams. There were no case mix adjustments made and concurrent efforts in continuous quality improvement (CQI) – history and maturation as threats to validity of research design – were not addressed.

In summary, this review indicates that there were few experimental and quasi-experimental studies, on the relative effectiveness of medical workforce specialisation. This may be due to the immutable position of traditional boundaries between medical specialties, or the reluctance of health care authorities/researchers to deny medical intervention in an RCT, even if the effect of that intervention is unknown, or both. Clearly, as some nursing services have been studied as RCTs, this does not seem to be an issue where nursing care is concerned. Available studies, mostly retrospective (and a few prospective) cohort design, provide some evidence on the benefits of health workforce specialisation for specific patient groups, in particular in the treatment of coronary disease, cancer and in emergency care. Generalisability of findings from these studies is rather limited.

5.7 Operation of the workforce

The research identified in this area focuses on the relationship between collaboration, co-ordination and communication, and patient outcomes.

5.7.1 Collaboration

Two reviews (Mitchell *et al.*, 2002; Zwarenstein and Bryant, 2000) and four primary studies (Mitchell *et al.*, 1989; Baggs *et al.*, 1999; Knaus *et al.*, 1986; Macpherson *et al.*, 1994) were found that investigated the effect of collaboration among hospital staff on patient outcomes.

Collaboration has been defined in one primary study as ‘physicians and nurses working together, sharing responsibility for solving problems, and making decisions to formulate and carry out plans for patient care’ (Baggs *et al.*, 1999). One review investigated the effect of ‘formal liaison’ on patient outcome (Mitchell *et al.*, 2002); it used this term interchangeably with ‘collaboration’, but it also defined it as formalised cooperation. From the literature identified in this scoping study it appears that when investigating collaboration it is often that of

perceived collaboration by the practitioners involved. Co-ordination on the other hand is investigated through the implementation of strategies (such as periodic meetings) that are employed to create greater collaboration.

One of the reviews investigated the effect of formal liaison on patient outcomes (Mitchell *et al.*, 2002) and included seven experimental primary studies. This gave a total of 963 patients in the intervention group and 899 in the control. The origins of the primary studies were not stated. There were differences in the illness groups, settings and analyses used which prevented statistical pooling; however, the findings were synthesised qualitatively. The review found greater patient satisfaction when collaboration was present in all four studies that measured this outcome. No effect was found for collaboration on the patients' physical and functional activities, or re-admission rate. The primary studies were reported as being of adequate quality. This review is restricted in its contribution to the evidence base because each of the primary studies used different patient groups, which may vary in their sensitivity to the effects of collaboration. The variation also makes combining the findings of each study unpractical.

The second review (Zwarenstein and Bryant, 2000) investigated the effect of collaboration between doctors and nurses on patient outcomes. This review included two studies. One was an RCT of 1102 patients in the USA and the other was a controlled before-and-after study including 843 patients based in Thailand. Both studies found a shorter LOS in the presence of collaboration. However, the Thai study only found this relationship with the exclusion of inpatient deaths. There was no statistical difference in mortality rates found in either of the studies.

All of the primary studies investigating collaboration of the workforce have been performed in the intensive care setting, and measure patient mortality, in addition to other patient outcomes.

One cross-sectional study (Mitchell *et al.*, 1989) used standardised mortality ratios and found a significant decrease in the expected mortality rates in an ICU with reported collaboration ($\chi^2 = 7.905$, $df 1$, $0.001 < p < 0.005$). Patient mean satisfaction ratings were also greater in the presence of collaboration. No relationship was found between collaboration and the mean rate of occurrence of complications. The study surveyed 42 nurses (82 per cent of all those in the unit) and 23 physicians (85 per cent of those assigned to the unit) in one US hospital. Adjustments were made for patient status using the APACHE II tool and for hospital characteristics such as size, type and purpose. Specialisations, expertise, formalisation of procedures at the unit level were also measured. The study used an historical control for which data on organisational characteristics (such as collaboration) were unavailable, thus limiting the applicability of its findings.

A larger prospective observational study (Knaus *et al.*, 1986) was performed in 13 hospitals across and within several states in North

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America. This study found significantly lower mortality rates than expected ($p < 0.0001$) in hospitals with a high degree of collaboration and significantly higher rates of mortality than expected in those where collaboration was considered poor. Patients in the study were stratified for individual risk of death using diagnosis, treatment and APACHE II scores. The study categorised ICUs into three levels relating to intensity of physician and nurse staffing as a means of reducing its confounding effect on the findings. Information on the nature and practice of the ICUs was obtained from the units' director; the findings are hence based on their perception of collaboration among their staff rather than the direct opinions of those working on the unit. A further limitation of this study is that the only measure of patient outcome is inpatient mortality. Collaboration may not affect mortality; however, it may influence other patient outcomes. Inpatient mortality is also a poor proxy for long-term mortality. The study did, however, perform a preliminary comparison of patient mortality with that reported six months post discharge. No differences in mortality rates were found in the nine (of 13) hospitals investigated.

Another cross-sectional study looked at three ICUs (medical, surgical and mixed) in one area of New York (Baggs *et al.*, 1999). The study used self-reported questionnaires to investigate collaboration by nurses and physicians and the subsequent effect on mortality and re-admission rates. Nurses' reports of collaboration were positively associated with reduced mortality and re-admission in medical ICUs ($p = 0.037$). Collaboration reported by nurses in surgical and mixed ICUs and collaboration reported by resident and attending physicians did not show a statistically significant relationship with mortality or re-admission rates. The APACHE III tool was used to adjust for the severity of illness. However, there may be differences, other than severity of illness, in the three ICUs that may influence the effect of collaboration on patient outcomes, such as availability of facilities. The response rates among physicians were poor; there were no responses by resident physicians in the mixed ICUs and no responses from attending physicians in the medical ICU.

The final primary study investigated the effect of co-management (Macpherson *et al.*, 1994) as a proxy for improved collaboration. A before-and-after design was used to compare mortality rates and LOS before and after explicit mechanisms of collaboration were employed, namely the introduction of an internist to co-manage the ICU. The study found no statistically significant difference in inpatient mortality rates for patients undergoing surgery, but a significant decrease in the post-operative length of stay (18.1 days before versus 12.1 days after, $p = 0.05$). Adjustments were made for comorbidities using the Charlson comorbidity index. The study included 86 patients pre-intervention and 79 patients post-intervention. One question that arises from this study is whether the findings are a result of a skilled internist, perhaps in addition to an improvement in collaboration among the ICU team, or

whether the increased availability of another member of staff has caused the improvement in patient outcomes.

5.7.2 Co-ordination and communication

Two primary studies were found that investigated the effect of co-ordination among hospital staff on patient outcomes (Young *et al.*, 1997; Doran *et al.*, 2002).

One cross-sectional study conducted in the USA in 1997 was based in 20 surgical units and was included in the National Veterans Affairs Surgical Risk Study (Young *et al.*, 1997). This study uses risk-adjusted mortality and morbidity rates to divide the units into high and low outliers. It concludes that low outliers (those units with low mortality/morbidity rates) show higher levels of interaction among different types of surgical staff at administrative and patient care levels, have opportunities for one-to-one discussions and group meetings among staff, and have mechanisms in place for training staff and standardising work processes. High outliers, on the other hand, show communication and collaboration among surgical staff as weak, few structures or processes in place to manage the interdependencies that exist among different types of surgical staff, poor opportunities for staff training and standardised work processes. Mortality and morbidity rates were only investigated at 30 post-operative days; hence long-term effects of co-ordination were not investigated.

The second study investigated the effect of co-ordination on therapeutic self-care, mood disturbance and functional status. This was a Canadian cross-sectional study, which included 26 medical/surgical units. Nurses were asked to complete the Lyon's Role Tension Scale which measures perceived co-ordination and communication (Doran *et al.*, 2002). Patients on the units were also required to complete surveys that measured therapeutic self-care and functional status, which were developed by the authors. Mood disturbance was measured using the Sunderland Linear Analogue Assessment Scale. The study reported no relationship between staff co-ordination and therapeutic self-care. The other patient outcomes were based on a conceptual model that assumes co-ordination affects the quality of the nurses' role, which in turn affects mood disturbance and functional status. Patients were stratified according to their condition; however, no further adjustments were reported. The response rate from the nurses was 35 per cent (254 nurses), which reduces the strength of the findings.

5.8 Well-being of the workforce

The scoping study has identified research performed in the following areas: job satisfaction, stress and burnout. The findings for each of the above features are discussed below.

5.8.1 Job satisfaction

Three primary studies (Weisman and Nathanson, 1985; Tzeng *et al.*, 2002; Goodell *et al.*, 1994) were found that investigated the relationship between job satisfaction and patient outcomes.

Two of these were cross-sectional studies from the USA (Goodell *et al.*, 1994; Tzeng *et al.*, 2002). The earlier was a pilot study (Goodell *et al.*, 1994) which surveyed 33 nurses and 168 patients in an urban Midwest teaching hospital. No statistically significant relationship was found. However, there was no control for the number of days cared for by the same nurse and the information given in the report was limited.

The second cross-sectional study was based in 17 different units within one centre in the Midwest of the USA in 2002 (Tzeng *et al.*, 2002). This study found a significant correlation between nurse job satisfaction and patient satisfaction with home care and follow-up ($p < 0.01$), but no significant relationship between job satisfaction and inpatient satisfaction with nursing care. The study had a 28 per cent (146) response rate for nurses and a 36 per cent (124) response rate for patients. It is unclear from both studies whether adjustments for patient and hospital characteristics were made. It is also difficult to assess the direction of causality (if any) from a cross-sectional design.

The final study found in this area was a longitudinal study of 77 county health departments in Maryland in 1985 (Weisman and Nathanson, 1985). They surveyed 344 RNs and interviewed 2900 women who were unmarried, under 20 and making their first visit for contraception. They found that higher job satisfaction levels were associated with higher patient satisfaction levels ($p < 0.001$). Adjustments were made for nurses' mean age, the percentage of nursing staff with teenage children, degree of autonomy exercised by the clinic, staff conflict and nursing influence. Staff satisfaction was presumed to reflect the climate in which provider–patient interactions take place; however, patient satisfaction may influence the level of staff satisfaction and both factors could be mutually reinforcing.

5.8.2 Stress and burnout

Two studies were found that investigated the effect of professional stress and burnout on patient outcomes (Dugan *et al.*, 1996; Leiter *et al.*, 1998).

A cross-sectional study from the USA investigated the effect of stress and burnout in nurses on medication errors and patient falls (Dugan *et al.*, 1996). The study included 19 hospital units and 601 nurses. A significant linear relationship was found between nurse stress and medication errors and patient falls ($p < 0.05$). The survey response rates by nurses reduced over time; however, the relationship between stress scores and patient incidents remained consistent. This study did not make adjustments for the effects of potential confounding variables.

The second cross-sectional study, conducted in Canada in 1998 (Leiter *et al.*, 1998) included 16 inpatient units from two hospital sites, consisting of 605 patients and 711 nurses. An inverse relationship between nurse stress and patient satisfaction was found. Again, no adjustments were made for confounders. The patient response rate to the satisfaction survey was 58 per cent.

The inferences of both studies are based on a causal relationship and may therefore be unreliable. In addition, the survey follow-up in both studies was poor.

5.9 Human resources

Within the area of human resources four studies were retrieved, which examined turnover and time and day of admission and the relationship with patient outcomes. A summary of the findings for each category is detailed below.

5.9.1 Time and day of admission

Two studies were retrieved that explored the relationship between weekend and weekday admissions and the subsequent effect on patient outcomes. This is considered by some to be a proxy for workforce ratios, because fewer people work in hospitals on weekends than on weekdays and they may be less experienced or qualified.

One of the studies was a ten-year Canadian observational study, which assessed 3,789,917 hospital admissions to investigate differences in aggregate mortality among patients admitted on weekends and those admitted on weekdays, using three specified conditions that were thought to be sensitive to the consequences of lower staffing and three control outcomes (Bell and Redelmeier, 2001). They also considered the 100 most frequent causes of death. Of the pre-specified conditions the mortality rate among patients admitted on a weekend was statistically higher than that among patients admitted on a weekday. The control outcomes were equivalent for both groups. For 23 of the 100 most frequent causes of death, admission on a weekend was associated with a significant increase in mortality. Conversely, weekend admission was not associated with a significantly reduced mortality rate for any of the conditions. Adjustments were made for patient characteristics but excluded the severity of illness.

The second study focused on the day of admission, defining weekends as Saturdays and Sundays and weekdays as Tuesday to Thursday, and its impact on medication errors and falls (Weinberg *et al.*, 2002). The study was based at a university-affiliated nursing facility with 31 patients in Atlanta and found that the rate of falls was 0.19 per cent on weekdays and 0.77 per cent on weekends ($p < 0.05$). Only two medication errors occurred and both of those were at the weekend. Overall, the number of licensed practical nurses and certified nursing

assistants was statistically greater on weekdays than on weekends. This study made no adjustments for case mix.

5.9.2 Turnover

Two studies were found that examined the relationship between turnover rates in nursing homes and resident outcomes. One study focused on nursing personnel turnover and mortality (Halbur and Fears, 1986). This cross-sectional study found that nursing aides contributed disproportionately to turnover rates among nursing personnel, with their average being approximately double that for registered nurses. The log RN, log LPN and log NA turnover rates were not statistically significantly correlated with mortality. No adjustments for case mix were made. A second study considered turnover rates of directors of nursing, RNs, LPNs, aides, therapists, physicians, volunteers and administrators, and their impact on infection rates (Zimmerman *et al.*, 2002). Higher RN turnover was significantly related to higher infection rates and higher rates of hospitalisation for infections. No adjustments were made for patient and hospital characteristics, but it was reported that the adjusted point estimates did not differ substantially from the unadjusted ones.

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Addendum

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