Transforming Health Care Delivery with Especial Reference to Regions with Declining and Ageing Populations

Discussion Paper

Alan Maynard
University of York

Introduction

The purpose of this discussion paper is threefold:

- to analysis the role of non doctor inputs into the provision of primary care;
- to examine the role of information technology in supporting such change;
- to examine the transition to more flexible structures, especially in out-patient primary care.

The paper is in four sections. The first section examines the market for health care from an international perspective and focuses on common problems in the delivery of care to patients. The second section reviews evaluation methods and the international literature on the substitution of nurses for doctors in primary and secondary care. A brief third section draws together the conclusions from the literature about the clinical and cost effectiveness of the substitution of doctors by nurses and capital (e.g. investments in information technology), and examines the affordability of such a transition. A final section offers some policy conclusions.

1. Common problems in health care delivery

For decades the policy debate has focused on the funding of health care with arguments about the costs and benefits of private insurance, user charges, social insurance and tax based schemes. This debate has often been poorly evidenced and highly ideological (1), (2).

The policy issue of primary importance is not how health care systems are funded but whether they improve the health of patients. This focus has been secondary for decades. What taxpayers and insurance payers need is an assurance that their funds create value for money and that there is a high level of consumer protection for patients. Currently this assurance does not exist in any health care system.

In order to put the issue of nurse-doctor substitution in context, it is necessary first to examine the failures of health care provision systems. These failures are common to public and private health care systems (3). It does not matter if the payer is the State, the sickness fund, the private insurer or the patient. All these parties have been passive purchasers of health care questioning poorly both its cost and its quality.

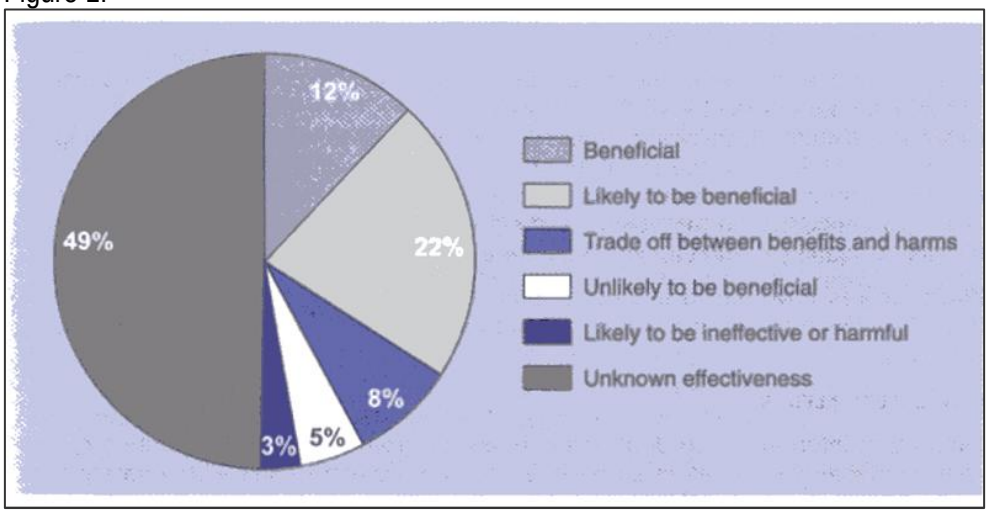
There are five related issues that characterise the failure of health care markets to deliver high quality care to patients, which are discussed in the sections below:

- the evidence base about the clinical and cost effectiveness of much of medicine is absent;
- there are large variations in clinical practice i.e. physicians deliver different; volumes and types of care to patients with similar health care needs and with similar personal characteristics;
- medical errors: health care is not safe;
- health care systems fail to deliver to patients what is known to be appropriate, effective and efficient;
- performance is poorly measured and evaluated with a focus on health care inputs and processes, rather than measurement and management of patient outcomes i.e. whether health care inputs and process improve the length and quality of patient's lives.

1.1 The incomplete evidence base about medicine

What works in medicine i.e. which interventions used by physicians have an evidence base derived from well designed and reported randomised clinical trials (RCTs)? The Evidence Centre of the British Medical Journal publishes on a regular and revised basis a "Clinical Evidence Handbook" which claims to provide "the best available evidence for effective health care" (www.clinicalevidence,bmj,com). In each printed edition of this handbook is a pie chart as in figure 1.

Figure 1:

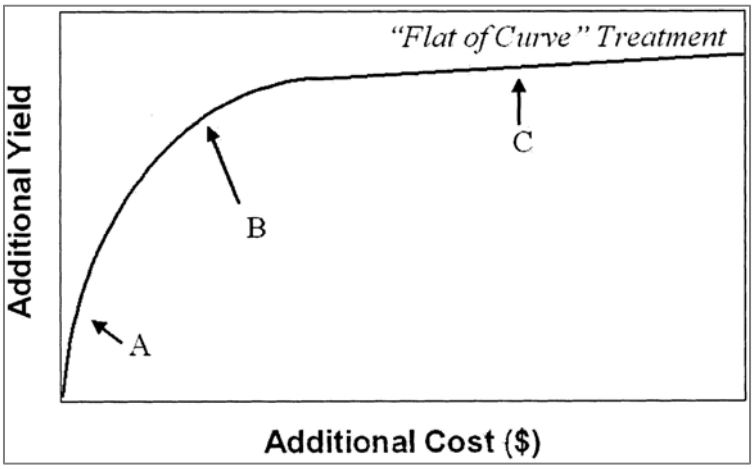


Source: BMJ Publishing, December 2008

This chart shows that 12 per cent of medical interventions are beneficial with a robust evidence base. A further 22 per cent are likely to be beneficial. Then there are three small categories with 8 per cent of therapies having a trade off between benefits and harms, 5 per cent being unlikely to be beneficial but in use and 3 per cent likely to be ineffective or harmful. The largest "slice" of this pie chart is that on the left of figure one: 49 per cent of medical therapies available to physicians and used by them have no evidence base.

Data such as these have initiated a debate about whether there are sharply diminishing returns to investing in health care. In terms of figure 2, the pertinent policy issue is are you investing at A,B, or C? At A investments create a high return. At B the returns are reasonable but falling. At C you spend more on health care but get no benefit. This is what has been termed "flat of the curve medicine".

Figure 2:



For several decades researchers in the Cochrane Collaboration have been reviewing evidence about what works in medicine and seeking to keep the knowledge base up to date to inform clinical decision making and consumer choice (www.cochrane.org). This international collaborative effort is identifying what works and those therapies that have no evidence base, many of which could not now be tested in clinical trials because of ethical constraints.

The physician Professor Archie Cochrane, after whom this Collaboration is named, was very sceptical about what worked in medicine. Thirty years ago he likened health care to a crematorium:
"I once asked a worker at a crematorium, who had a curiously contented look on his face, what he found so satisfying about his work. He replied that what fascinated him was the way in which so much went in but so little came out. I thought of advising him to get a job in the NHS, it might increase his job satisfaction, but decided against it. He probably gets his kicks from the visual demonstration between input and output. A more statistical demonstration might not have worked so well" (4).

As demonstrated in figure 1, relative ignorance about the clinical effectiveness of many medical therapies remains. Furthermore, there is even greater ignorance about their cost effectiveness. As argued over a decade ago, what is clinically effective may not be cost effective but what is cost effective is always clinically effective (5). As will be shown, this distinction is one that affects the policy debate about nurse-doctor substitution.

1.2 Clinical practice variations

There is a substantial international literature on clinical practice variations i.e. differences in how patients with similar health needs and personal characteristics receive very different levels of health care. To vary is human but this literature shows that high spending regions and practitioners may provide no better outcomes for patients than safe, conservative low spending practitioners.

Some of the best evidence about clinical practice variations comes from research by physicians such Wennberg, Fisher, Goodman and colleagues at the Dartmouth Medical School in the USA (www.dms.dartmouth.edu). Their primary focus for the last three decades has been the analysis of differences in spending and activity for Medicare patients across the USA.

For instance, table 1 shows the reimbursement rate for non-capitated Medicare enrollee in 2006. Similar patients across the USA received very different level of expenditure (6).

Table 1: Reimbursement rate for non-capitated Medicare per enrollee, 2006

Hospital referral region	Medicare spending 2006 ($)	Spending growth 1992-2006 ($)	Annual growth rate 1992-2006 (%)
Manhattan NY	12114	4979	3.9
Los Angeles	10810	3707	3.0
Philadelphia	9665	3495	3.2
Boston	9526	3204	3.0
Nashville	8355	3048	3.3
Phoenix AZ	7890	2748	3.1
Atlanta	7363	2004	2.3
Seattle	7218	2379	2.9
Minneapolis	6705	2967	4.3

Source: Fisher et al, New England Journal of Medicine, February 26th, 2009, page 851

In earlier analysis of these variations Fisher concluded that differences were due to volume effects rather than illness differences, socio economic status or the price of services. Furthermore despite these volume differences:

"Residents in high spending regions received 60% more care but did not have lower mortality rates, better functional status or higher satisfaction".((7)

Fisher has argued that the US Medicare programme offers potential savings of thirty per cent of expenditure if high spenders reduced their activity and provided the safe practices of conservative treatment regions.

Similar work in the UK over 30 years has shown similar differences and highlighted the potential for savings and reinvestment (e.g.(8), (9) and www.instutute.nhs.uk). In both the USA and the UK policy change has not reflected the results of this research. If it did significant resource would be made available to invest in cost effective health care. In the context of reform of doctor-nurse ratios in the delivery of health care, these funds if freed could "oil" the wheels of change. In the USA the Dartmouth group have emphasised that reduction of wasteful and unnecessary practice

variations could help fund President Obama's drive to extend insurance cover across the population. (7)

Wennberg, himself a physician, argued over 30 years ago that a primary cause of clinical practice variation was physician behaviour:
"the amount and cost of hospital treatment in a community have more to do with the number of physicians there, their medical specialties and the procedures they prefer that the health of patients" (10).

The failure to recognise the waste inherent in clinical practice variations is ubiquitous. Its mitigation could free considerable resource to fund the delivery of cost effective care.

1.3 Medical errors and patient safety

Another source of inefficiency is medical errors. International interest in this was re-awaken by a US-Institute of Medicine (IOM) report in 1999 (11) and the consequent evangelical marketing of improved safety by the US-Institute for Health Improvement (www.ihi.org).

The IOM report concluded that medical errors killed more Americans each year than breast cancer, motor vehicle accidents and HIV-AIDS and that, for instance, medication errors alone killed three times as many people than the bombing of the Twin Towers on 9/11. In the UK two independent studies of hospitals have concluded that the errors rates are about ten per cent i.e. one in ten admitted patients may be affected by an error.(12, 13)

In addition to medication errors involving the administration of the wrong drug and the wrong dose to patients, patients are damaged by surgeons cutting the wrong limb and organ and using the wrong technique as in Bristol in England when a paediatric surgeon caused the death of 29 children. Nurses, physicians and all clinical staff damage patients due to poor personal hygiene, especially poor hand washing. Many of these "low hanging fruits" can be harvested by simple and cheap improvements in patient care by improving the measurement of such "never" events and making individual and team performance more transparent. This would free up funding for investing in cost effective health care in the primary and secondary sectors.

1.4 The failure to deliver appropriate and efficient care

Although much of medical care is of uncertain clinical effectiveness, some interventions, as shown in figure one, are known to be effective. Sadly the delivery of these clinically effective interventions is often poor, creating avoidable morbidity and mortality.

This is particularly the case with the control of chronic diseases. Typically as populations age, older people exhibit multiple chronic health problems e.g. high blood pressure, diabetes, heart failure and cancer. Many aspects of these conditions can be controlled by careful monitoring of disease progression and with pharmaceutical interventions, many of which are cheap and out of patent. Sadly throughout the world although protocols and clinical guidelines exist detailing from the evidence base the need to monitor and intervene in a timely fashion, health care systems public and private fail to deliver this appropriate and efficient care to patients.

For instance as smokers age they may acquire chronic obstructive pulmonary disease (COPD) and with minor infections may have severe breathing difficulties and become expensive emergency admissions to hospital. Such patient may be admitted many times a year at great cost to the sick fund and taxpayer, and with poor quality of life for the patient. Regular monitoring of these patients in their homes can prevent hospital admissions and save money. For instance a daily telephone call to ensure all is well and if it is not to send community nurse to the patient's home to administer antibiotics may be clinically and cost effective.

Although there are many interventions for chronic disease that are known to be effective and efficient, patients do not receive them. In the USA a Rand Corporation study showed that Americans get only 55 per cent of the care they need (14). This failure to provide timely interventions in the community wastes considerable resource and imposes illness and premature death on patients.

This is recognised internationally and slowly better policy responses are emerging. For instance the British introduced new fee for service incentives to deliver better chronic care for patients in primary care: the quality outcomes framework (QOF). Primary care physicians were incentivised to improve their practice's performance in relation to the items listed in table 2. The cost of this scheme was high but the effects on performance were swift and there is evidence of reductions in variation in the delivery of care to patients. Although the payments for this scheme went to doctors much of the provision of this care was delegated to nurses.

The evidence base of the UK-QOF was limited but is gradually being reformed with reference to the evidence base about what works cost effectively in primary care.

Table 2: United Kingdom Quality Outcomes Framework (QOF) for primary care, 2004.

Disease	Performance indicator
Asthma	% of patients with asthma who have had an asthma review in the previous 15 months
Cancer	% of patients with cancer reviewed within 6 months of confirmed diagnosis
Chronic obstructive pulmonary disease (COPD)	% of patients with COPD with diagnosis confirmed by spirometry and reversibility testing
Coronary heart disease (CHD)	% of patients with CHD whose last blood pressure measurement was 150/90 mm Hg or less
Diabetes	% of patients with diabetes whose last blood pressure measurement was 145/85 mm Hg or less
Hypertension	% of patients with hypertension with last blood pressure measurement was 150/90 mm Hg or less
Hypothyroidism	% of patients with hypothyroidism with thyroid function tests recorded in the previous 15 months
Mental health	% of patients with severe long-term mental health problems reviewed in the preceding 15 months

In the USA the incentives to provide better care for patients in the community is more muted with monitoring of provision by insurance health plans. However what is clear from the HEDIS data items in table 3 is that there is considerable overlap with the British targets set out in table 2.

Thus with some (sometimes incomplete!) reference to the evidence base, policy makers are recognising the failures to provide efficient interventions for the ageing and chronically ill in the

community. Whilst this policy response is slow it is welcome. It has been known for many years what should be provide for these patients, the surprising thing is that both the medical professions and policy makers have been so slow in using the evidence base to improve patient care and protect the taxpayer and the insurance premium payer from this avoidable inefficiency.

Table 3: The Healthcare Effectiveness Data Information Set (HEDIS) 2008 measures

	Effectiveness of care
1	appropriate testing for children with pharyngitis
2	appropriate treatment for children with upper respiratory infection
3	avoidance of antibiotic treatment in adults with acute bronchitis
4	use of spirometry testing on assessment and diagnosis of COPD
5	pharmacotherapy of COPD exacerbation
6	use of appropriate medication for people with asthma
7	cholesterol management for patients with cardiac conditions
1	childhood immunization status
2	adolescent immunization status
3	lead screening in children
4	breast cancer screening
5	cervical cancer screening
6	colorectal cancer screening
7	chlamydia screening in women
8	glaucoma screening in older adults

Source: http://web.ncqa.org/Portals/O/HESIS2008/2008_Measures.pdf

1.5 The absence of measures of success in health care

Health care can be analysed in terms of structure, process and outcome with each terms being defined as follows:

i) structure relates to how the health care system is funded and provided. Structural analysis focuses on inputs i.e. how the system is funded and the number of physicians, nurses and hospital beds.

ii) process involves analysis of how these inputs are combined to provide packages of care for patients e.g. the treatment of a stroke patient involves rapid ambulance delivery of the patient to hospital, immediate scanning of the patient to determine the appropriateness of using thrombolytics and a rapid and thorough programme of rehabilitation, Hopefully, and not always, such packages should be evidence based.

iii) for the patient the primary issue is their outcome: do the use of health care inputs and the provision of packages of care improve the length and quality of their lives?

Debates about health policy sadly focus on structure and process to the exclusion of the measurement and management of patient outcomes. For instance concerns about hospital costs have led Germany and England to adopt DRG hospital payment systems. DRG systems make cost and prices more explicit but management that focuses on these data to the exclusion of patient outcomes may damage patient care. DRG systems incentivise reductions in lengths of

stay. This may be efficient but in the absence of measurement and management of both cost and patient outcomes this cannot be proven.

Why do nearly all public and private health care systems fail to measure whether health care given to patients makes them better? The patient-consumer would ideally like to know whether an intervention will increase the length and quality of their lives. Routinely in clinical trails, physicians accept the use of quality of life measures that are used before and after an intervention determine whether the patient's physical and psychological functioning has improved or not.

Disease specific and generic quality of life measures have been used in thousands of clinical trails and are available in dozens of languages. But why are these measures not used routinely in health care systems? They would inform patients whether health care made them better and would offer consumer protection from poor practitioners. How can consumer-patients make informed choices about care without this information?

Following the experience of a private insurer in the UK (the British United Provident Association (BUPA)) and piloting in the NHS, the English government has introduced patient reported outcome measurement (PROMs) for 4 types of surgery from April 2009. Each patient entering an English NHS hospital will complete quality of life (QoL))questionnaires before surgery, eliciting the patients perception of their physical and psychological functioning. Three to six months later they will again complete the same QoL questionnaires to determine the improvement if any of functioning given by the surgery (see table 4). The generic QoL measure used is EQ5D which has been widely used in Europe and elsewhere (www.euroqol.org).

Table 4: Measuring Patient Outcomes in the English NHS

Procedure	Condition-specific	Generic
Primary Unilateral Hip Replacement	Oxford Hip Score	EQ5D
Primary Unilateral Knee Replacement	Oxford Hip Score	EQ5D
Groin Hernia Repair	None	EQ5D
Varicose Vein Procedures	Aberdeen Varicose Vein Questionnaire	EQ5D
Plus a standard set of patient-specific questions in all cases		

The English have chosen to use PROMs in the hospital system. I have argued that such measurement might best be based in primary care with physician and nurses routinely measuring patient quality of life and using that information to inform diagnosis and treatment. Completion by patients of these QoL measures is very simple and their responses van be read electronically and become part of the patient record to inform the physician or nurse about the level and changes in physical and psychological functioning before the patient enters their office.

1.6 Overview

Much of medical care lacks an evidence base about clinical and cost effectiveness. This may be one cause of why clinicians exhibit large variations in the type, cost and quality of care given to patients with similar needs and personal characteristics. Clinicians often fail to practice safe medical care, as demonstrated by the medical errors literature, and also they fail to deliver

clinically effective care to all the patients who would benefit from the delivery of what is known from the evidence base to benefit patients. Finally policy makers tend to focus on structural and process reforms and fail to provide patients with consumer protection by routinely measuring success, not just in terms of mortality rates but also in terms of whether health care improves the physical and psychological functioning of patients.

The product of the failure of public and private health care systems to translate an evidence base which is limited but vitally important to patients and taxpayers is remarkably consistent internationally and has survived over three decades, wasting considerable amounts of scarce resources. Health care systems are not only profligate and wasteful; they also fail to protect the patient-consumer from providers who deliver poor and inadequate medical care.

2. Nurse-Physician Substitution

This important policy issue will be dealt with in five sections. Firstly it will be argued that this topic is of increasing policy importance. The second section will set out the criteria which can be used to answer the question of whether nurse-physicians substitution is sensible. In the third section the evidence about nurse-physician substitution in primary care will be reviewed. The fourth section will briefly review nurse-physician substitution in other parts of the health care sector. A final section discusses the potential for capital substitution of both nurse and physicians e.g. by investing in improved information technology.

2.1 Why is this policy issue of importance?

There are two primary reasons why the issue of nurse-physician substitution is of importance: the scarcity of resources; and difficulties in workforce recruitment.

Always and everywhere the resources available to society are limited and the ways in which they can be spent are almost infinite. The consequence in health care is that resources are rationed. Rationing involves depriving patients of care from which they could benefit and which they would like to have. In the context of regions which are relatively poor and with large numbers of highly dependent elderly citizens, often with chronic multiple morbidities, physicians may be reluctant to locate because they may dislike the particular patient workload and they may not wish to live in deprived regions with high unemployment and the associated social problems.

However the first response to such outcomes if there is evidence of a need to improve the quantity and quality of the physician stock in a region, is to use incentives to “bribe” them to locate in such deprived regions. As an English Prime Minister is reputed to have said in the Hanoverian 18th century “every man has his price”! However bribing physicians to fulfill social needs is complex due to the power of medical trade unions, usually called “professional associations”. As the Irish playwright George Bernard Shaw remarked professions are typically a “conspiracy against the laity”. In health care the power of medical associations typically inhibits change which threatens their income and employment status. This natural restrictive practice is found in all labour markets to varying degrees.

Such conservative practices can be mitigated in the face of population health needs, as is the case in regions of EU member states like Germany. Furthermore with the financial crisis and the consequent economic problems the opportunity and the incentive to alter nurse-physician and

other input ratios is sharpened. If one form of labour is particularly scarce, then the substitution of cheaper labour inputs and capital is inevitable. The nice policy change is to demonstrate that this substation is clinically effective and, more importantly, cost effective.

2.2 Demonstrating substitution is efficient: evaluation methods

In principle substituting nurses for physicians and substituting capital, for instance information technology, for labour is attractive. But is it effective and cost effective?

Often when policy makers alter the ways in which health care is funded and delivered to patients, they fail to evaluate the cost and effects of their policies. As Campbell argued 40 years ago (15) all reforms are experiments on citizens. When a new pharmaceutical is produced it is subjected to extensive evaluation to ensure patients are not damaged. When health policies are changed, resources are used but usually there is little evaluation of the reforms. Policy makers may avoid evaluation because as Campbell argued "there is safety behind the cloak of ignorance". If reforms are not evaluated, its advocate can claim "success" and denial is difficult for any opponent!

The "gold standard" for evaluation of medical care and health policy is the randomised trial (RCT). RCTs are complex and expensive to design and implement and are unusual in health policy. The most famous example of a RCT in health policy was the Rand Insurance Experiment which lasted for 8 years, cost $74 million in the 1970s and took nearly two decades to implement, analyse and report fully (16).

With RCTs in health policy unlikely to be funded, the next best alternative is the application of quasi-experimental methods (17). This approach involves to collection of data before and after the intervention and comparing trends with those exhibited by a comparator-control group. There are an increasing number of such studies, often called "differences in differences" in the economics literature.

An example of such a study is the evaluation of a package of community care marketed by United Health, an American organisation, to the English NHS. The "Evercare" model involved case management of frail elderly patients in the community. The assertion was that this package of care would reduce hospital use.

The Evercare package was used in 64 practices (i.e. groups of primary care providers) and all other practices were used as the control, or comparator. Outcome was measured in terms of whether there were reductions in hospital bed days, emergency admissions and mortality for the Evercare patients compared to controls. No observable effects were found and it was concluded that the intervention was ineffective in terms of the outcomes selected (18).

Such evaluations have to be designed and carried out with care. In particular it is essential to have an appropriate comparator with which to compare the experimental group and the selection of outcomes has to be appropriate and explicit from the outset.

With all reforms being experiments it is surprising that the volume and quality of evaluations is poor. Any literature search reveals many studies but the majority of such studies are usually descriptive or poorly designed. Consequently nations reform their health care systems and do not learn from expensive and potentially dangerous to patient's interventions that alter health care structures, processes and outcomes.

2.3 Nurse-physician substitution

Can suitably trained nurses deliver primary care as effectively as physicians?
Answering this simple question is complex. The literature is large, routine search of available data bases elicits thousands of publications that deal with this issue. Most are of little use when reviewed in the context of a robust research design. Thus Laurent et al.(19) in their data search identified and screened 4253 articles but only 25 articles, relating to 16 evaluative studies, met their rigorous inclusion criteria. i.e. 4228 studies were either descriptive or did not use robust evaluative methods when evaluating nurse-physician substitution in primary care.

Most of the studies of nurse-physician substation show that equivalent outcomes were achieved and that patients were at least satisfied with the outcome. In the UK there have been a number of systematic reviews of the literature (e.g.(20;21) (22)). These authors conclude that patients are more satisfied with nurse practitioners, who generally achieve higher levels of patient compliance with treatment recommendations than physicians. In most other attributes of care outcomes were equivalent, although nurses provide longer consultation times and order more investigations of patients than physicians.

These results are confirmed by the Cochrane Collaboration review (19). Their analysis of the 25 robust papers they found from their literature search found 7 studies examining first and subsequent contacts with health care professionals, 5 studies examining urgent first contact consultations only and 4 studies of the management of patients with chronic conditions.

This review of the best quality literature concluded that there were no observable differences in health outcomes for patients, process of care and resource utilisation between the performance of physicians and that of appropriately trained nurses. In the studies of urgent consultations, patient satisfaction was higher when patients were treated by nurses compared to physicians. This may be the product of the longer consultations provided by nurses in which they gave patients more information. The consequence of these longer consultations was that substitution was cost neutral, with only one study identifying cost savings when nurses replaced physicians in primary care.

The authors of the Cochrane review (19) concluded:

> *"Whilst doctor-nurse substitution has the potential to reduce doctors' workloads and direct health care costs, achieving such reductions depends on the context of care. Doctors' workload may remain unchanged either because nurses are deployed to meet previously unmet patient need or because nurses generate demand for care where previously there was none. Savings in cost depend on the magnitude of the salary differential between doctors and nurse, and may be offset by the lower productivity of nurses compared to doctors".*

In the context of deprived areas with problems recruiting physicians to care for patients, these results have to be viewed with caution because:

i) the number of robust studies is very small (but the number of published studies is very large)

ii) patient follow-up was usually less than 12 months and thus the longer term effects of substitution are unknown

iii) the comparator was usually male physicians. There is emerging evidence in the hospital sector that the practice style of women physicians is different in that their productivity in terms of patient cases dealt with is lower than that of male equivalents (e.g.(23)). With the rapid gender change in the medical profession in most Western countries this poses some nice challenges for policy makers. In the context of nurse-physician substitution in primary care, it is relevant to identify the gender of the physician comparators. It must be emphases that this literature does not mean that female physicians are inferior to their male counterparts. What this literature identifies is that female doctors, like nurses take more time with their patients and this may lead to better diagnosis, patient compliance and outcomes. However there are as yet no data on these characteristics of male and female physician practice.

The development of nurse prescribing is increasing the usefulness of these practitioners in both primary care and the hospital sector. For instance in the UK over 20,000 nurses are qualified and able to prescribe the full pharmaceutical formulary. The UK is not unique. The evidence base is (as ever!) incomplete but nurses appear to adhere to treatment protocols more and be conservative in their prescribing

2. 4 Nurse-physician substitution in other sectors

The economic recession is again drawing attention to the potential of substituting nurses for physicians in care processes outside and adjacent to primary care.

There is a robust literature in maternity care that suggests that midwives can act as substitutes to physicians in low/average pregnancy risks and that they are at least as safe, effective and acceptable to women as traditional physician led care models. Midwifery tends to result in fewer technological assessments, fewer interventions in labour and delivery, more natural births and fewer instrumental vaginal deliveries. Outcomes such as morbidity, complications, caesarean section and satisfaction are similar. There is some evidence of higher incidence of breast feeding and lower rates of admission to special care facilities when midwives manage care. An implication is that midwife led birth centres might produce better outcomes at lower cost but such initiatives if financed need careful evaluation.

Can appropriately trained nurses replace physicians in hospital roles? In the USA, Sweden, the Netherlands and gradually even in the conservative UK, nurses are carrying out anaesthesia roles for many procedures. Nurse endoscopists are being used in the UK-NHS and a recent study showed that they are equally as effective as physicians but may not be cost effective again because of their slower speed in carrying out procedures. (24) There has been advocacy of nurse-physician substitution in surgery for routine procedures but the evidence of clinical and cost effectiveness is poor.

As more care is taken out of expensive hospitals and brought nearer to the patients' homes, the use of nurses in these roles will have to be evaluated more carefully. The potential for the provision of more health care services in outpatient facilities brings with it the possibility of significant further substitution of nurses for physicians.

As with the use of nurses as replacements for doctors in primary care, the policy challenge is to evaluate any such reforms using rigorous evaluative methods. Investment in such methods is costly and evaluation is essential. The alternative is opinion and ignorance. The price of knowledge is high but the cost of ignorance is higher!

2.5 Capital substitution

When the price of labour is high and/or the supply of labour inputs is low, can capital be used as a substitute? The development of robotics is continuing and experimental care methods are being developed which coordinate scanning equipment and surgical interventions by robots and may give better outcomes than those achieved by a physicians.

However an area in which countries continue to invest with sometimes disappointing results is the application of information technology to record process and outcomes and facilitate their better management. There are many examples of the potential of improved IT in health care e.g.

i) enabling access to patient records from primary to secondary care, and vice versa to improve patient outcomes;

ii) real time routine recording of activity i.e. what is done to a patient in primary and secondary care;

iii) identification of adherence to agreed and evidence based patient pathways of care and treatment protocols.

The evaluation literature for IT in health care is limited. This literature shows that it is no use having an information system if physicians and nurse do not use it. Thus any investment in IT has to be able to measure their use of such systems. The usual sort of investment in IT innovations is items such as order entry, guides to clinical decision making and automated patient notes.

For example a recent study in the USA used an assessment tool to examine physician interaction with their hospitals' IT system. Some of the results this study reported were startling. Higher order entry scores were associated with significant reductions in mortality from myocardial infarctions and coronary artery by-pass operations. Higher decision making scores were associated with a 21 per cent reduction in complication rates in hospitals. Higher automated note levels were associated with a 15 per cent reduction in all cause mortality.

However these findings must be treated with caution. Correlation does not necessarily imply causation. Higher levels of IT investment were associated with higher levels of resourcing generally in these Texan hospitals. Even so after adjustment for such confounders significant effects remained. However there were also perverse effects e.g. a 35 per cent increase in the risk of complications in heart failure patients when IT was used. Was this due to the identification of effects previously not identified?

The message is simple: evaluate with care. As in areas of nurse-physician substitution is easy to infer good outcomes from poor and biased measurement.

3. Improving workforce recruitment and retention

It is not unusual for labour markets to exhibit periods of scarcity and glut. When it is difficult to recruit physicians, governments tend to increase the intake to medical schools and increase the rate of return to investing in medical skills by raising salaries. Both these policies are expensive and take time to affect local labour markets.

This is an expensive and inefficient response as it perpetuates the inefficiencies discussed in section one. If pay is increased it should be used as a bargaining counter to alter the inefficient practices of practitioners: physicians should be bribed to deliver appropriate and cost effective care and reduce the variations in their clinical practices.(25)

Substitution opportunities should be exploited as they offer a potentailly more efficient resolution of labour market problems. Even though the evidence base for nurse-physician substitution is incomplete, there is sufficient evidence to proceed with progressively radical changes in the workforce used to deliver primary care provided there is continuing and rigorous evaluation of the costs and benefits.

It is possible that the majority of primary care can be delivered by nurses with minimal input from physicians. Whilst nurses may be slower, they appear to use their time to better explain interventions to patients with consequent improvements in compliance with treatment regimes. This slower and possibly more effective work practice reduces the cost advantage of hiring cheaper nurses rather than expensive doctors. However greater patient compliance may improve the quality of care and reduce costs.

Radical innovation in the face of recruitment problems and the economic recession seems both inevitable and sensible. It should not be restricted to primary care as the evolving evidence base indicates that in areas such as anaesthesia and endoscopy nurses can perform as well as physicians. Such challenges to the traditional physician monopoly will be resisted by the medical profession. The challenge will be to demonstrate that outcomes are similar and costs may be less is nurses replace physicians. The current costs and outcomes of the physician monopoly are variable and sometimes observably inappropriate and dangerous for patients.

The affordability of labour and capital substitution depends on the relative prices of competing inputs. Even with the costs of further training of nurses, especially if they are given prescribing freedom, the attraction of substituting them for expensive physicians is considerable. Nurses can be trained more rapidly than physicians thus facilitating the fine tuning of the supply of practitioners to changing demand. The affordability of substituting capital such as IT for physicians, nurses and administrators is less certain due the relative lack of success in designing and implementing systems internationally. With the engagement of the professions, such investments have the potential to improve patient safety, the appropriateness of care and the cost effectiveness of taxpayers' investments.

4 Conclusions

"The perfection of the means and the confusion of the goals seems to be a characteristic of our century" *Albert Einstein*

In the health care industry the focus of policy makers internationally has been on the structure of delivery and funding systems and on health care processes. Structure and process are the means by which nations mobilises resources to improve the health of the population. But no health care system is focused on patient outcomes i.e. whether spending billions of Euros makes patients better in terms of enhancing the length and quality of their lives.

This curious confusion of ends and means facilitates continuing inefficiency in the delivery of health care worldwide. The fundamental challenge for health care reformers is demonstrating that changes in delivery systems improve patient outcomes and reduce costs. There is increasing evidence that nurse-physician substitution is a rational investment, especially where physician recruitment is difficult. Nurses can diagnose, prescribe and refer patients to hospitals independently. The challenge for policy makers is both to radically exploit this potential and prove its superior cost and outcomes by rigorous evaluation.

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