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Strategies for changing the use of diagnostic radiology

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STRATEGIES FOR CHANGING THE USE OF DIAGNOSTIC RADIOLOGY

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CONTENTS

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INTRODUCTION

The relentless increase in the use of diagnostic tests in clinical medicine has led to concern expressed in the NHS and elsewhere about how best to contain utilization. NHS managers are worried about rapidly escalating costs; staff in diagnostic departments are dismayed about workload rising faster than resources; and many clinicians are concerned about the profusion of tests to which their patients are now exposed.

This project paper addresses the problem of containing demand in one diagnostic service, radiology, and for one diagnostic test, pre-operative chest X-rays. However, the principles and strategies discussed are relevant to any test and any diagnostic service.

Much of the discussion in this paper is based on the findings of a study supported by the Kind's Fund and conducted under the auspices of the Royal College of Radiologists Working Party on the Effective Use of Diagnostic Radiology in which four strategies were evaluated for implementing guidelines on the use of pre-operative chest X-rays. Following approval of the guidelines by cogwheel divisions and medical executive committees in four hospitals, one of the following strategies was introduced into each hospital: 1. utilization review committee 2. feedback

on use to consultants 3. new chest X-ray request form, and 4. concurrent review of chest X-ray requests by radiological staff.

The strategies were implemented for one year during which time the use of pre-operative chest X-rays were monitored in the hospitals and in a control hospital which had no intervention strategy. During the fourth month of the intervention period adherence to the guidelines was determined in a sample of patients who had pre-operative chest X-rays.

In addition to describing briefly the effects of these strategies on utilization in the study hospitals, this paper discusses the need for strategies, the process of developing guidelines, and how strategies may be implemented in the hospitals. The success of the strategies are reviewed in the light of other studies in this field. Containing the use of diagnostic tests is discussed within the context of the financial, organisational and attitudinal constraints within the NHS. Finally, some recommendations are made on how unit managers and clinicians might initiate change to contain the use of diagnostic services in NHS hospitals.

The study on which this paper is based was the first conducted in the UK of alternative strategies for containing the use of a diagnostic test, and this paper is probably the most comprehensive review of the subject to date. It should therefore be of interest to managerial, clinical and diagnostic staff working in the NHS.

A more comprehensive report* with detailed research findings is available in the libraries of the following:

King's Fund Centre

King's Fund College

British Medical Association

Department of Health and Social Security

Faculty of Community Medicine

Royal College of Physicians and Surgeons of Glasgow

Royal College of Radiologists

Royal College of Surgeons of Edinburgh

Royal College of Surgeons of England

Royal Society of Medicine

Scottish Health Service Centre

Welsh Office

* Fowkes, FGR. Strategies for changing the use of diagnostic radiology. Full report submitted to King Edward's Hospital Fund for London, 1985

CHAPTER 1

NEED FOR STRATEGIES

During the last twenty five years, substantial changes have taken place in the practice of medicine. Advances in scientific knowledge and innovations in medical technology have led to a vast array of tests available for clinical diagnosis. Developments such as multichannel autoanalysers and computerised tomography mean that the clinicians of today practise a style of diagnosis quite different from that of a previous generation. Greater reliance is now placed on the results of diagnostic tests than on findings in the history and physical examination, such that the number and range of tests used has increased exponentially, almost doubling every 10 years.

Diagnostic radiology has not escaped this trend; indeed, radiological workload has increased at a greater rate than the availability of facilities and manpower. This situation was partly responsible for the Royal College of Radiologists establishing in 1975 a Working Party on the Effective Use of Diagnostic Radiology. The main remit of the Working Party was to explore ways of limiting the unnecessary use of radiological procedures. It's first initiative was to conduct a major research project examining the use and value of pre-operative chest X-rays. This was followed by the formulation of clinical guidelines indicating which categories of patients should have these X-rays.

These recent trends in radiology and the development of pre-

operative chest X-ray guidelines were two important factors leading to the need for strategies to implement the guidelines and reduce the unnecessary use of pre-operative chest X-rays.

Trends in radiology

In the United Kingdom, the National Radiological Protection Board is responsible for monitoring sources and levels of radiation, and has conducted national surveys of the work of radiology departments (Committee on Radiological Hazards to Patients, 1960; Kendall et al, 1980). In 1957, the total number of radiological examinations performed in the NHS was found to be 13 million (Committee on Radiological Hazards to Patients, 1960). When the survey was repeated in 1977 (Kendall et al, 1980), the number of examinations had increased by 64% to 21.3 million. This increase could not be explained by a change in the age structure and size of the population because examinations per head of population had increased by 2% per annum.

Information on radiological workload has also been obtained from statistics on the amount of radiographic film used in the NHS. The use of film increased by an average of 6% per annum from 1966 to 1978 (Wrighton and Oliver, 1980). In 1951, 16.5 million square feet of film were consumed; by 1971 the consumption had risen to 42.5 million square feet (Bull, 1974). This was equivalent to a doubling of consumption every 12 years.

Statistics on radiographic workload collected by the Department of Health and Social Security (DHSS) have also shown substantial changes in recent years (Raison, 1976; Wrighton and Oliver, 1980; Wrighton, 1982). From 1968 to 1980, workload in radiology departments increased by approximately 5% per annum to a total of 306.5 million units in England in 1980 (Wrighton, 1982). (One unit of workload is equivalent to 1 minute of radiographer's time (DHSS and Welsh Office, 1973). This rise in workload has been due to an increase in the complexity of examinations in addition to the greater numbers of examinations performed. From 1957 to 1977 workload per examination increased threefold to a mean of 14.3 units per examination (Wrighton and Oliver, 1980). However, from 1967 to 1977 the rise in Class III (more complex) examinations was only slightly greater than the increase in Class I (simpler) examinations (Abrams, 1979).

This change in the nature and complexity of diagnostic radiology can be attributed to the impact of new medical technology (Evans, 1981; Steiner, 1982). Major advances have included the introduction of image intensifiers and television contributing to increased diagnostic accuracy in a number of fields, particularly cardiology. Computerised tomography (CT scanning) has had a considerable impact on diagnosis particularly of diseases of the nervous system (although CT scanning may soon be replaced by nuclear magnetic resonance). Diagnostic ultrasound has virtually replaced conventional radiography in obstetrics and is being used more widely for other purposes such as the detection of gall stones. Radio-isotope imaging is proving useful in the assessment of functional abnormalities in many organs,

particularly those of the cardiac, respiratory and renal systems.

Such is the variety of imaging techniques now used in radiology departments that any definition of the specialty based on X-rays is misleading (Evans, 1981). As Seaman (1973) has stated, "any signal which is differentially handled by various structures within the body and can be displayed so as to convey information about these structures is properly within the range of diagnostic radiology".

These innovations have had a substantial impact on radiological workload because many are complex and consume a considerable proportion of radiologists' and radiographers' time. However, the great majority of examinations performed in the NHS are still those employing conventional radiology. For example, in the 1977 survey conducted by the National Radiological Protection Board (Kendall et al, 1980), chest X-rays comprised 33% and limb extremities 30% of all examinations. By contrast CT scans comprised only 0.3% of examinations.

These changes in radiological workload have been accompanied by increases in the costs of the service over and above those due to inflation. In 1968/69 the cost of radiological capital equipment in the NHS was £3.6 million; by 1980/81 this figure had risen to £20.1 million (excluding expenditure on CT scanning) (Wrighton, 1982). The equivalent 1968/69 figure for the 1980/81 expenditure was £5 million. Thus, capital expenditure had increased by almost 40% in real terms over a 12 year period. Revenue costs increased at a similar rate to

reach £63 million in England in 1977/78 (Wrighton and Oliver, 1980). Total expenditure on radiological services during that year was £83 million, accounting for 1.3% of centrally funded NHS costs.

An increasing radiological workload has been accompanied by a shortfall in radiological manpower. Almost 20 years ago, the British Medical Journal (Editorial, 1966) drew attention to the problem with a leading article entitled "Shortage of Radiologists". Inadequate recruitment in the United Kingdom and in the United States was attributed mainly to the shortage of academic departments of radiology and to the lack of instruction of medical undergraduates. However, from the mid 1960's the number of consultant radiologists in NHS hospitals increased substantially and by 1978, 740 whole-time equivalents were in post (Wrighton and Oliver, 1980). But the rate of increase was considerably lower than the rise in units of workload (Raison, 1976). In 1978, consultants and senior registrars in England and Wales were each handling approximately 20,000 examinations during the year. According to Wrighton and Oliver (1980), this level of workload was not managed easily; a workload of 15,000 examinations per year was a more reasonable target. These figures would suggest that consultant radiologists in 1978 were probably undermanned by about 25%. Indeed, the DHSS has for several years encouraged health authorities to continue expanding their establishment of radiological posts in both training and consultant grades.

Many solutions, other than expansion of radiological posts, have been put forward for resolving the imbalance between workload and manpower. It has been suggested that non-contrast X-rays could be reported by

consultants who made the requests, (Bull, 1976) or by general practioners employed as clinical assistants (Editorial, British Journal of Radiology, 1975). Radiologists might control workload by vetoing certain requests (Bull, 1976) or by regularly visiting wards and providing a consultancy service to clinical colleagues (Bull, 1976; Shuman and Heilman, 1979). Brindle (1978) in Kings Lynn has reduced workload by creating a waiting list for radiological examinations. This in turn has led to a reduction in demand.

The Education Board of the Royal College of Radiologists has suggested radical changes in the teaching of diagnostic radiology to medical undergraduates which would encourage a more discriminating use of X-rays. The Board recommended "that the undergraduate should understand the values, limitations, hazards and to a certain extent financial implications of high cost technology in clinical management" and ".....emphasis should be given to the role of diagnostic radiology in clinical management strategy rather than to the acquisition of interpretative skills". (Education Board to the Council of the Royal College of Radiologists, 1981).

This major imbalance between workload and manpower was one of the main reasons for the establishment by the Royal College of Radiologists of a Working Party on the Effective Use of Diagnostic Radiology. The minutes of its first meeting held in August, 1975 stated that "radiologists are very concerned about the increasingly expensive and often inefficient use that is being made of diagnostic facilities. Correction of the situation would lead to greater efficiency in

patient management, reduction in radiation exposure and a reduction in the cost of the service, thereby possibly obviating the need for future expansion to meet growing demands".

Indeed, the establishment of the College Working Party reflected a growing awareness among many radiologists of a need for greater discrimination in the use of diagnostic radiology. This was manifest in the British medical press in several articles written by prominent radiologists (Editorial, British Medical Journal, 1977; Evans, 1977; Goldberg, 1977; Sherwood, 1978). Similar attitudes were emerging among radiologists in the United States. In 1971 the American College of Radiology created an Efficacy Studies Committee to make recommendations to the College and its membership on the effective use of radiology in medical diagnosis (Loop and Lusted, 1978). In the American medical press, reasons for the "overutilization" of X-rays were explored, and a more discriminating approach was advised (Hall, 1976; Abrams, 1979). This perspective on the need for a more rational approach to radiological investigation was and is a view shared by many radiologists throughout the world and has been exemplified in a recent WHO publication, "A Rational Approach to Radiodiagnostic Investigations" (Report of a WHO Scientific Group, 1983).

Development of guidelines on use of pre-operative chest X-rays

In order to promote the more rational use of diagnostic radiology the College Working Party considered an important step to be the formulation of guidelines for the use of radiological examinations. Ideally, such guidelines might be based on the results of research on

the effectiveness, safety and cost of the examinations. However, as there was a paucity of such research, the Working Party decided to carry out a series of national multicentre studies to evaluate some commonly used radiological examinations: pre-operative chest X-rays in elective surgery; skull X-rays in head injured patients; lumbar X-rays in the investigation of back pain; X-rays of injured extremities; and straight X-rays in the investigation of acute abdominal pain.

The first multicentre study, conducted under the auspices of the Working Party, investigated the use of pre-operative chest X-rays. Over a period of almost five months, utilization was examined in 10,619 patients undergoing non-acute non-cardiopulmonary surgery in eight hospitals in England, Wales and Scotland. The results of the study showed a wide variation in utilization both between centres (11.5% to 54.2%, of patients X-rayed) and between specialties. This variation could not be explained on clinical grounds. Furthermore, pre-operative chest X-rays did not seem to influence the decision to operate nor the choice of anaesthetic; nor was there any evidence that the pre-operative chest X-ray was of much value as a baseline against which subsequent X-rays might be judged (National Study by the Royal College of Radiologists, 1979).

A few years prior to the multicentre study, the value of routine pre-operative chest X-rays had been questioned in two leading articles in the medical press (Editorial, British Medical Journal, 1975; Editorial, Lancet, 1975). Both articles reviewed a recently published study by Sagel et al (1974) on the value of routine chest X-rays in

patients admitted to a hospital in the USA. In concluding their reviews, neither editorial advocated the use of routine pre-operative chest X-rays and the British Medical Journal went as far as to suggest that it should "... not require too much persuasion for most surgeons and anaesthetists to accept the recommendation that routine chest radiographs should no longer be done on patients under the age of 20 or even 30 years".

The idea of reducing the use of pre-operative chest X-rays was, however, unacceptable to many clinicians. The College Working Party was made fully aware of such attitudes at a seminar on the use of diagnostic radiology convened by the DHSS at Harrogate in 1978. Some clinicians believed that the clinical risk of not carrying out an X-ray was unacceptable and that everything possible should be done to reduce the risk of surgery, irrespective of cost. Others thought that limiting the use of the procedure was morally unjustified and would open the floodgates to medical litigation. Clinicians, especially those in surgery, obstetrics and gynaecology, and anaesthesia felt that their clinical freedom would be threatened. Despite the publication of another editorial in The Lancet doubting the value of pre-operative chest X-rays (Editorial, Lancet, 1979) it appeared at that time that there was little likelihood of more effective use of the procedure being achieved in the forseeable future.

Indeed, the Working Party's perspective on the use of pre-operative chest X-rays as expressed in the report of the multicentre study (National Study by the Royal College of Radiologists, 1979) was at variance with the views of a sister College in the United States.

During the 1970s some professional groups in North America were advocating a more limited use of routine chest X-rays in hospital (Martin, 1981) but the American College of Radiology did not issue guidelines for the use of routine chest X-ray examinations until 1982 (Council of the American College of Radiology, 1982). Even then, they recommended simply that "routine chest radiographs not be required solely because of hospital admission" and made no specific recommendation on the use of pre-operative chest X-rays.

It emerged subsequently that the view of the American College was that "pre-anaesthesia recommendations ... should be set by a panel of anaesthetists and surgeons as well as radiologists. This subject is somewhat more sensitive than the others because it affects other physicians, such as opthalmologists, who perform surgery. For such physicians, the pre-operative roentgenogram is a form of insurance should pulmonary complications from surgery arise" (Merz, 1983). Since then, however, a government agency in the United States, the Centre for Devices and Radiological Health, has issued a draft guideline prepared by a panel of experts (Radiological Health Sciences Education Project, 1984). This guideline states that "pre-operative chest radiography not be required as a routine for operating room admission". But the expert panel felt unable to give positive guidance in the form of a list of acceptable indications for requesting pre-operative chest X-rays.

Given prevailing attitudes in the United Kingdom and elsewhere, the College Working Party realised that the introduction of a change in

practice consequent upon the findings of the multicentre study would take time and would have to be handled carefully. Thus, when publishing the results of the study in 1979 (National Study by the Royal College of Radiologists, 1979) the Working Party described only non-specific "possible" guidelines for the use of pre-operative chest X-rays. The guidelines stated that:

"a) it is unnecessary to have a radiologist's report on any pre-operative chest X-ray unless one has been specifically requested.

b) the use of pre-operative chest X-rays as a baseline for post-operative management at present levels of utilization is not justified. In any event the 90% level of utilization needed to effect this would prove very difficult to achieve in practice.

c) it is advisable on financial and ethical grounds that the pre-operative chest X-ray service should in future be used:

1) selectively only in circumstances where the clinical history or signs place the patient at very high risk of post-operative pulmonary complication and where it is considered the investigation will provide important additional information, and

2) routinely, perhaps only in population groups where the prevalence of undiagnosed chest disease is likely to be high (e.g. immigrants)".

They also issued a cautious policy statement: "... temporary norms of utilization would probably be best derived from the low rather than

the high figures taken from participating centres and we would recommend that utilization for non acute non-cardiopulmonary surgery should run at no more than 12%". The purpose of this statement and the "possible" guideline was simply to influence the prevailing climate of opinion.

The method employed in the multicentre study probably had some effect on the opinions of clinicians and others working in the participating hospitals. Under the guidance of the Working Party, the design of the study was developed collaboratively between staff in the departments of Diagnostic Radiology and Epidemiology and Community Medicine at the University of Wales College of Medicine in Cardiff. Following successful piloting of the method, the co-operation of radiologists was obtained in each of the proposed study centres. The study was then discussed with local clinicians and if their support was forthcoming, approval was sought from cogwheel divisions. Co-operation was also obtained from radiographers, hospital administrators and medical records officers. A senior radiologist was designated the local co-ordinator and a part-time research assistant appointed in each hospital. This method of investigation thus required the co-operation of many health service staff. Such widespread participation may in itself have had an important effect in changing attitudes towards a more discriminating approach in the use of the procedure.

Reinforcement of the message contained in the policy statement and "possible" guidelines took place over a period of two years following the publication of the results of the study (National Study by the

Royal College of Radiologists, 1979). The results were presented by members of the College Working Party at scientific meetings and discussed with clinical colleagues in local hospitals. During this period the Working Party became aware that radiologists in a few hospitals were collaborating with local clinicians in attempting to implement the ideas contained in the general policy statement. However, progress seemed slow and it was doubted whether the sporadic changes in attitude that were occurring during this period would have ever gained sufficient momentum to bring about the national change in attitude that was desired. (Personal communication, Working Party on Effective Use of Diagnostic Radiology).

In 1981 an opportunity arose to determine if the policy statement and "possible" guideline were having an impact on utilization. In South Wales there had been considerable interest in the study on pre-operative chest radiology conducted by the College Working Party; the policy statement had been disseminated among local radiologists by word of mouth at scientific and divisional meetings and by distribution of reprints of the paper describing the results of the multicentre study (National Study by the Royal College of Radiologists, 1979). The Working Party decided to monitor the use of pre-operative chest X-rays at two hospitals in South Wales to determine if these local initiatives were having any effect on practice. Also, they decided to seek evidence of desirable or undesirable clinical outcomes consequent upon any change in practice.

Under the auspices of the Working Party, the author and colleagues in the University of Wales College of Medicine conducted such a study.

The results (Roberts et al, 1983) showed that a highly significant reduction in the use of pre-operative chest X-rays had occurred in both hospitals during the study period ($p < 0.001$). In one hospital (which had participated in the multicentre study) the rate decreased each year from 1977, the year of the original study. In the other hospital (which had not participated in the multicentre study) the use declined abruptly in 1979, the year of publication of the results (National Study by the Royal College of Radiologists, 1979) to a level which was maintained in 1980. In the hospital participating in the multicentre study utilization fell by 42% and was observed across all specialties. In the other hospital utilization in ENT surgery increased by 61% and in ophthalmology by 190%, the latter being largely attributable to a newly appointed consultant who replaced a retiring colleague. However the decrease in utilization in the remaining specialties (40% in general surgery, 41% in orthopaedics and 69% in gynaecology) brought about a 27% reduction overall in that hospital during the study period. In neither hospital was there evidence of a significant change in clinical outcome in terms of an increase in surgical mortality or in post-operative morbidity (using the proxy measure of post-operative length of stay).

This study (Roberts et al, 1983) was an important milestone in the pursuit of the objective of defining acceptable national guidelines. It suggested that a more discriminating approach in the use of pre-operative chest X-rays was considered reasonable by many of the clinicians in the study hospitals and that a reduction in the use of pre-operative chest X-rays had no undesirable effect on patient care

and outcome. This evidence gave the Working Party the confidence to firm up it's preliminary guidelines into a specific recommendation about how pre-operative chest radiology should be used. These guidelines were accepted and ratified by the Board of the Royal College of Radiologists in 1983. The guidelines stated that routine pre-operative chest radiology was no longer justified and that pre-operative chest X-rays should be considered only in patients with acute respiratory symptoms or possible metastases, and for those who had chronic cardiorespiratory disease or who were recent immigrants from tuberculous endemic countries. The latter two categories of patient only required a chest X-ray if they were not X-rayed within the previous 12 months. Appendix I contains the full text of the guidelines.

The difficulty now facing the Working Party was the selection of a strategy to introduce and sustain the implementation of the guidelines in clinical practice. The survey in the two hospitals in South Wales (Roberts et al, 1983) had shown a considerable reduction in the use of pre-operative chest X-rays, but the level of utilization was still well above the recommended level of 12%. In both hospitals over 30% of elective non-cardiopulmonary surgical patients were still having pre-operative chest X-rays. Furthermore, any impact that the multicentre study and its publication had on utilization had probably diminished. Given this difficulty in not knowing how best to proceed with implementation of the guidelines, the author and colleagues in the University of Wales College of Medicine, under the auspices of the College Working Party, decided to conduct a trial in five hospitals in the UK of alternative strategies for implementing the guidelines.

CHAPTER 2

IMPLEMENTATION OF STRATEGIES

Selection of Strategies

The first step in conducting the proposed study was to decide which strategies to include in the trial. Members of the Working Party, a social scientist with a special interest in organisational change, and the author discussed the following strategies and either accepted or rejected them for further study:

1. Financial incentives to be given to those firms who comply with the guidelines and reduce their use of pre-operative chest X-rays. This strategy was rejected in that it had already been tried with some success elsewhere (Wickings, 1977). Furthermore, experiments in clinical budgeting were currently under way in the NHS and were likely to provide more comprehensive information on the effectiveness of this strategy.

2. Personal financial rewards were rejected as a suitable strategy in that a trial in the United States (Martin et al, 1980) had already shown this strategy to have little effect and to cause considerable conflict for physicians when making clinical decisions.

3. Regular feedback to firms of statistics on their use of pre-operative chest X-rays. This strategy was considered to be worth investigating, but only if information was given in confidence to each consultant. The Chairman of the Division of Radiology was considered to be the most appropriate person to disseminate this information.

4. Utilization Review Committee comprising a representative from the Divisions of Surgery, Obstetrics and Gynaecology, Anaesthetics and Radiology to be established in a hospital. This committee would review statistics on the use of pre-operative chest X-rays by firms within the hospital and take whatever steps it considered necessary to encourage a reduction in utilization. This strategy was accepted for study, particularly as this form of peer review had not been tried previously in the NHS.

5. Letter from the Department of Health and Social Security, District Health Authority or Royal Colleges to be sent to clinicians asking them to implement the pre-operative chest X-ray guidelines. This strategy was rejected in that it was thought unlikely to have any effect.

6. Educational seminar and distribution of guidelines to house officers at the beginning of their appointments. This strategy was rejected for two reasons. Firstly, consultants had responsibility for the clinical procedures performed on their patients and it was not thought appropriate to

interfere with this responsibility by attempting to influence house officers directly. Secondly, a single educational seminar was considered unlikely to have a sustained impact on practice.

7. Introduce separate request forms for chest X-rays so that clinicians were required to answer questions on the reasons for performing a pre-operative chest X-ray (which might discourage the "routine" use of the procedure). This strategy was accepted for further study.

8. Concurrent review of requests for pre-operative chest X-rays by staff in the radiology department. The clinical indications for chest X-rays requested from surgical wards would be reviewed by the radiographers when the requests were received in the department. If the request did not adhere to the pre-operative chest X-ray guidelines, the reviewing radiographer would inform a consultant radiologist who would contact the doctor making the request. The College Working Party initially rejected this strategy because they considered that surgeons and anaesthetists might object to radiologists appearing to interfere overtly with their clinical freedom. However, the strategy was later included in the study because the radiologists in one hospital wished to try this approach.

The following four strategies were thus selected for inclusion in the study:

(a) utilization review committee

(b) information feedback on use to consultants

(c) redesign of chest X-ray request form

(d) concurrent review of chest X-ray requests by radiological staff

Study Aim and Method

The aim and objectives of the study were defined as follows:-

Aim

To determine the effect of alternative strategies for implementing guidelines on pre-operative chest radiology in order to make recommendations on how the guidelines might be implemented nationally in NHS hospitals.

Objectives

1. To determine the effect of implementing each of the following four strategies in one NHS hospital for a period of 12 months:

(a) utilization review committee

(b) information feedback

(c) new request form

(d) concurrent review

The effect was to be measured by changes in the proportions of elective non-cardiopulmonary surgical patients having pre-operative chest X-

rays according to

i) hospital

ii) specialty

iii) consultant

2. To determine, following implementation of the strategies, the level of compliance with the guidelines in patients having pre-operative chest X-rays.

Method

Each strategy for implementing the guidelines was pursued in one hospital for one year; another hospital acted as a control. The use of pre-operative chest X-rays was monitored for periods before and during implementation of the strategies. Compliance with the guidelines in patients having a pre-operative chest X-ray was measured for one month during implementation of the strategies.

The five hospitals which agreed to participate in the study were as follows:

University Hospital of Wales, Cardiff

Singleton Hospital, Swansea

John Radcliffe Hospital, Oxford

Bristol Royal Infirmary, Bristol

North Staffordshire Infirmary, Stoke-on-Trent

Data was collected on the use of pre-operative chest X-rays over a baseline period of 2 months and an intervention period of 12 months in each hospital. From the theatre registers, data was obtained by part time clinical assistants on the patient's name, hospital number, operation, age, consultant surgeon, date of operation, and whether the operation was elective or emergency. If such data was not recorded in the register, it was obtained from the hospital master patient index. The master card index in the radiology department was then searched to determine if the patients had had a pre-operative chest X-ray (on the day or 6 days prior to the operation). The principal specialty of each consultant was provided by the medical personnel departments in the local district health authorities. The data from each hospital was transferred onto standard recording forms which were sent to the research headquarters for computer analysis.

Prior to collecting data during the study, the data collection systems were introduced into each hospital for a period of at least one month, clerical staff were trained and tests of repeatability were performed. During the study, any substantial change in the use of pre-operative chest X-rays resulted in a research officer from the headquarters repeating the data collection on a sample of patients to detect any change in the quality of data collected.

Information on adherence to the guidelines was collected during the fourth intervention month in each hospital and also in the

control hospital. Data on all patients having elective non-acute non-cardiopulmonary surgery was abstracted from theatre registers by clerical assistants. The master patient indexes in the hospital radiology departments were searched to determine if the patients had had a pre-operative chest X-ray. From the list of patients in each hospital having pre-operative chest X-rays, 60 patients were selected randomly. A research officer who had been previously trained, then abstracted clinical details from the admission notes in the medical records onto a standard recording form.

In addition to the control hospital included in the study, control data on the use of pre-operative chest X-rays was obtained from two other sources:-

(i) a hospital in Manchester which already had a computerised data collection system in the radiology department (Supplementary Control Hospital I)

(ii) two hospitals in Cardiff (not the University Hospital of Wales which was a strategy hospital) in which a special survey of the use of pre-operative chest X-rays was carried out around the time of the study (Supplementary Control Hospital II and III)

Implementation of Strategies in Hospitals

In each of the four hospitals in which a strategy was to be implemented, the first task of the radiologist who was local co-ordinator was to seek the approval and, where appropriate, cooperation of other radiologists in the hospital. This was carried out informally and also through meetings of the Divisions of Radiology. The guidelines were approved and no radiologist ob ected to their implementation.

The local co-ordinator then approached the Divisions of Surgery, Obstetrics and ynaecology and Anaesthetics and in some hospitals the Hospital Medical Executive Committee to seek approval of the pre-operative chest X-ray guidelines. These committees were also asked to approve implementation of the guidelines in the hospital, and to grant ethical approval for the conduct of the study. The guidelines were circulated to members of the respective committees prior to their meetings; the local co-ordinators attended the meetings to answer any queries about the guidelines and their use. The guidelines were approved without modification in each of the four strategy hospitals, although in two hospitals, some members of the Divisions of Anaesthetics initially did not agree with the guidelines but finally gave their approval for implementation. Approval of the guidelines and the study were recorded in the minutes of each divisional meeting. These minutes were then distributed to consultants in the hospitals.

As many consultants probably did not read the minutes of the

divisional and executive committee meetings and because not all minutes included a copy of the guidelines, the local co-ordinator sent a personal letter to each consultant surgeon, gynaecologist and anaesthetist in the hospital indicating that the guidelines had been approved and asking for their co-operation with implementation. Thus, prior to the implementation of a strategy, the guidelines were approved formally by a committee representing clinicians working in the hospital. Also, each consultant was informed personally by letter about the guidelines and the study. In the control hospital the local co-ordinator did not introduce the guidelines into the hospital and did not communicate it either to the medical committees or to individual consultants.

Utilization Review Committee

In the hospital in which the Utilization Review Committee was to be established (Hospital A), the local co-ordinator asked senior consultants in the Departments of Surgery, Obstetrics and Gynaecology and Anaesthetics if they would be interested in becoming involved in an initiative to reduce the use of pre-operative chest X-rays. These consultants then met with the local co-ordinator and another consultant in the Department of Diagnostic Radiology. At that meeting, a decision was taken to propose the establishment of a pre-operative chest X-ray Utilization Review Committee in the hospital. It was proposed that the committee would meet for approximately one hour on three or four occasions during the following year to review the use of pre-operative chest X-rays in the hospital and to take

whatever steps thought necessary to reduce utilization. In contrast to the other hospitals participating in the study, the consultants at that meeting, and not the local co-ordinator, approached their respective divisions to seek approval for the study and the guidelines. Also, they requested each division to approve the establishment of the Utilization Review Committee and to nominate a divisional representative to sit on the committee. In this way, the divisions would have responsibility for the formation and composition of the committee and it would not be perceived as an external body scrutinising the activities of their members.

The idea of a Utilization Review Committee was accepted readily by the divisions. In each case the consultant who sought the approval of the division was nominated to sit on the committee. The committee comprised the local co-ordinator, a fellow consultant from the Department of Diagnostic Radiology, a consultant surgeon, a consultant obstetrician and gynaecologist, a consultant anaesthetist and an epidemiologist who was responsible for providing the statistics on the use of pre-operative chest X-rays in the hospital. The committee met on three occasions during the year following the approval of the guidelines by the divisions. On each occasion they were presented with statistics on the percentages of elective patients under the care of individual consultants who had had pre-operative chest X-rays. An examples of the mode of presentation is shown in Appendix IIa Statistics on utilization according to anaesthetist were not included because much of the anaesthetic work was carried out by junior staff who rotated throughout the district during the year. Statistics were also excluded for surgeons who performed less than 10

operations per month. Following discussion of the statistics, the Utilization Review Committee then decided whether any action was required to effect a change in utilization. The committee felt reluctant throughout the year to give information on utilization to individual consultants as they thought that this might be counter-productive by creating conflict between the committee and medical staff in the hospital.

The most important step the committee took was to recommend that a notice be placed in the surgical wards and in the anaesthetic department stating that routine pre-operative chest X-rays were not justified and listing the clinical indications for the procedure. A special notice was printed (Appendix III). Before posting throughout the hospital, the notice had to be approved by the Unit Management team. The notice was then distributed by the Unit Nursing Officer to sisters on the wards. One week after distribution, a survey of the wards was carried out and it was found that around one third of notices had not been posted in a prominent position in the ward. This was rectified by futher discussions with the Unit Nursing Officer and the sisters in charge of the wards. The notice was not displayed in one ward in which the consultant surgeon refused to allow any notices to be posted on the walls.

Information feedback

In the hospital with the strategy of providing information retrospectively to consultants on their use of pre-operative chest X-rays (Hospital B), statistics on utilization were distributed twice

during the year. The process of data collection and computer analysis contributed to a delay of approximately two months between the period under observation and provision of the statistics. The data analysis was conducted at the research headquarters and the results were discussed with the local co-ordinator before distribution to the consultants.

Each consultant received information by means of a letter from the local co-ordinator on the percentage of their elective surgical patients who had had a pre-operative chest X-ray. They were also provided with the lowest and highest consultant chest X-ray rates and the average rate for all consultants in the hospital. Thus each consultant was informed of their own position in relation to the practice of colleagues in the hospital, but did not know the names of other consultants whose chest X-ray rates were quoted.

The letter also requested the consultant to draw the information to the attention of their junior staff and to encourage them where possible to adhere to the guidelines. An example of a letter is shown in Appendix IIb. The information was provided in this format to all consultant surgeons, gynaecologists and anaesthetists in the hospital.

New request form

In Hospital C in which the new chest X-ray request form was introduced, must of the data on the standard X-ray request form was stored and analysed by computer and, in order not to disrupt this process, it was decided that the new chest X-ray request form would consist simply of an additional section attached to

the standard request form. The requesting clinician normally completes the top half of the standard request form; the bottom half is completed in the X-ray department. The new chest X-ray request form consisted of a tear-off section which was placed over the bottom half of the standard form and attached on the left hand margin. The requesting clinician completed the top half of the form as per usual and the attached section on the bottom half of the form. On receipt of the form in the X-ray department, the receptionist tore-off the attached section, thus permitting staff in the radiology department to complete the original bottom half of the form.

The tear-off section applied to the bottom half of the standard form is shown in Appendix IV. The new request form was used for ordering all chest X-rays in the hospital and not just pre-operative chest X-rays because it was thought that clinicians would adopt the form more readily if used for all chest X-rays and not just pre-operative X-rays. Clinicians requesting a pre-operative chest X-ray had to indicate if the patient had any of the clinical indications contained in the guidelines. The purpose of this was to trigger the clinician into thinking whether the guidelines applied to the patient in question. If the guidelines had simply been printed on the request form and not in the format of questions, clinicians would probably have ignored the guidelines once they became familiar with the form. The form was also designed to be simple and rapid to complete because the purpose of the form was to test the effect of providing information on the guidelines rather than the effect of making a

request for chest X-ray more cumbersome by requiring clinicians to complete a long and detailed form.

Prior to introducing the new form into the hospital, a draft copy was distributed to members of the District Medical Records Working Party who approved its implementation. The new forms were composed and printed and the tear-off section stuck automatically to the original request forms by the District Health Authority printers. In order to ensure that the new forms were introduced throughout the hospital on the same day, they were distributed to each ward by staff in the radiology department. When a ward had used up their quota of forms, they ordered new forms in the usual way from the printer. Consultants and junior medical staff were sent a letter informing them of the introduction of the new chest X-ray request form. They were also asked to adhere to the guidelines.

The introduction of the new form did create resentment among some house officers particularly as requests for chest X-rays which were not on the new form were returned to the house officer by the receptionist in the radiology department. However within two to three weeks the new form had become established as a routine procedure for ordering chest X-rays.

Concurrent review

In the hospital in which staff in the radiology department were to review requests for chest X-rays from surgical wards (Hospital D), the guidelines had been approved by the Medical Executive Committee in the

hospital. Consultants, but not unior staff, were informed of this decision. The strategy was then implemented by means of radiographers reviewing requests for chest X-rays. Requests for "routine" pre-operative chest X-rays were forwarded to the superintendent radiographer who then contacted a consultant radiologist. The consultant then telephoned the requesting clinician to indicate that it was no longer hospital policy to carry out "routine" pre-operative chest X-rays. The clinician, usually a house officer, was asked if there were any clinical indications necessitating a pre-operative chest X-ray and, if not, was informed that the chest X-ray would not be carried out.

CHAPTER 3

EFFECT OF STRATEGIES

Use of Pre-operative Chest X-rays

Figure 1 shows the monthly trend in use of pre-operative chest X-rays in hospital A (Utilisiation Review Committee). During the six months following approval and distribution of the guidelines within the hospital, the monthly pre-operative chest X-ray rates were lower than during the baseline period. But a substantial and rapid decrease did not occur until notices displaying the pre-operative chest X-ray guidelines were posted throughout the hospital. However, this low level was not maintained, increasing slightly during the latter months of the study.

Changes in the pre-operative chest X-ray rate are summarised in Table 1 in which the data are aggregated for each quarter year of the intervention period. During intervention months 4-6 the pre-operative chest X-ray rate was almost 10 chest X-rays per 100 elective operations lower than during the baseline period suggesting that the distribution of the guidelines had some effect on utilization. Despite a slight increase during the last quarter, the pre-operative chest X-ray rate during the final intervention month was still substantially lower (by almost 20 chest X-rays per 100 elective operations) than during the baseline period. Corresponding to this fall in the rate, the absolute number of pre-operative chest X-rays

performed in the radiology department showed a marked decrease. During the period of least use (months 7-9) 58 pre-operative chest X-rays were performed, which was 73% fewer than during the baseline period (215 pre-operative chest X-rays). This decrease corresponded to approximately six fewer chest X-rays per day in the radiology department. During the final intervention month the pre-operative chest X-ray rate was approximately one third of that during the baseline period.

Figure 1

Hospital A : Utilization Review Committee

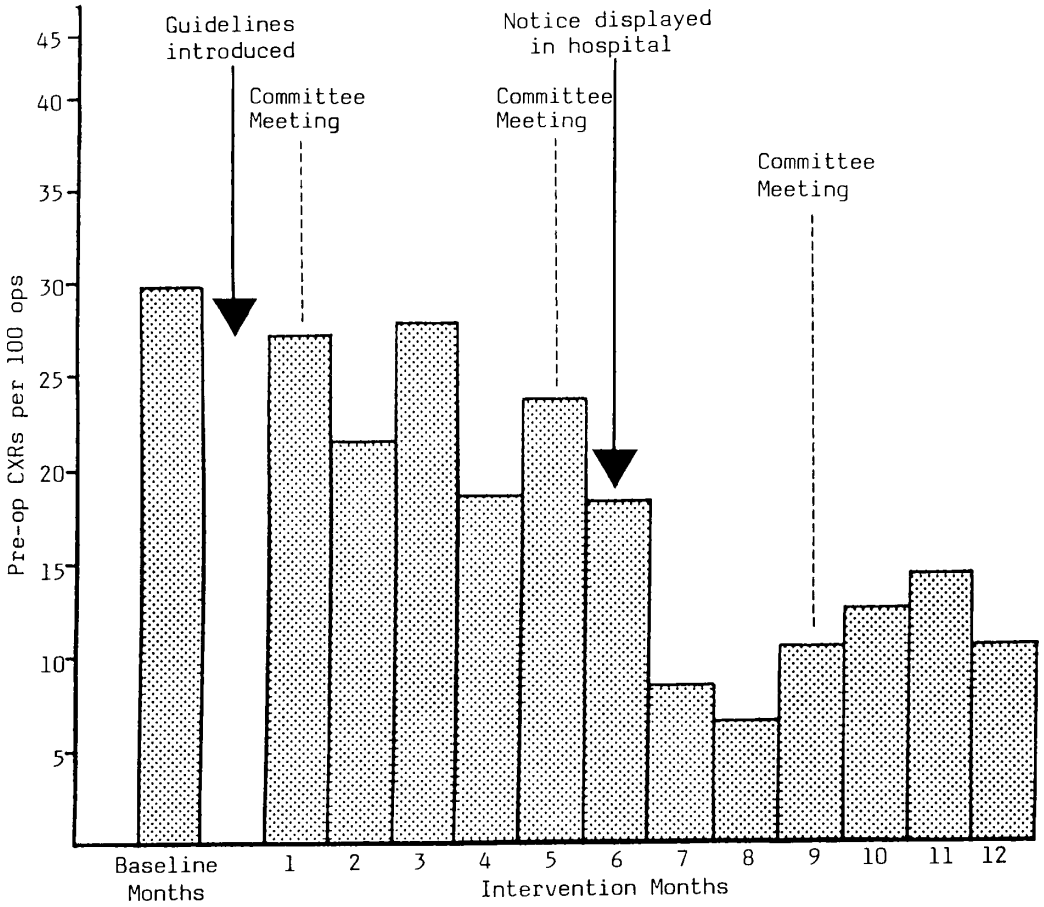


Figure 1

Table 1

Pre-operative chest X-rays for elective operations in Hospital A

	Baseline Months	Intervention Months				Final Intervention Month
	1-2	1-3	4-6	7-9	10-12	12
No. elective operations (monthly mean)	718	975	836	678	697	691
No. pre-operative chest X-rays (monthly mean)	215	252	170	58	86	73
Pre-operative chest X-rays/ 100 elective ops.	29.9	25.8	20.3	8.5	12.4	10.6
Change in pre-operative chest X-rays/ 100 elective ops.		-4.1	-5.5	-11.8	+3.9	-19.3*
Significance of change (p)		.006	<.001	<.001	<.001	<.001*

* Change between baseline period and final intervention month

Hospital A : Utilisation Review Committee

Figure 2 shows the use of pre-operative chest X-rays in hospital B where data on utilization was fed back to consultants on two occasions during the intervention year. Except for an elevated rate of use during the third intervention month, the use of pre-operative chest X-rays fell quite consistently during the intervention year. The high rate during the third intervention month (August 1983) was probably due to the appointment of new house staff in the hospital. Indeed, the new house staff were students in a teaching hospital known to have a relatively high utilization rate during the preceeding years. The approval of the guidelines by the divisions and distribution to consultants was followed by a slight reduction in utilization. On each occasion that data was fed back to the consultant, a reduction in utilization occurred during the following two months.

In Table 2 the data has been aggregated according to the main periods of change: baseline months; intervention months 1-5 (prior to data feedback); months 6-8 (after first feedback); months 9-12 (after second feedback). The change after the first and second feedbacks was -7.5 and -4.2 pre-operative chest X-rays per 100 elective operations respectively. Overall, the rate decreased by 16.1 (55%) between the baseline months and the final intervention month ($p < 0.001$). However, the absolute number of pre-operative chest X-rays only decreased by one third in the radiology department because, during the final intervention month, there were 50% more elective operations performed than during the baseline months.

Figure 2

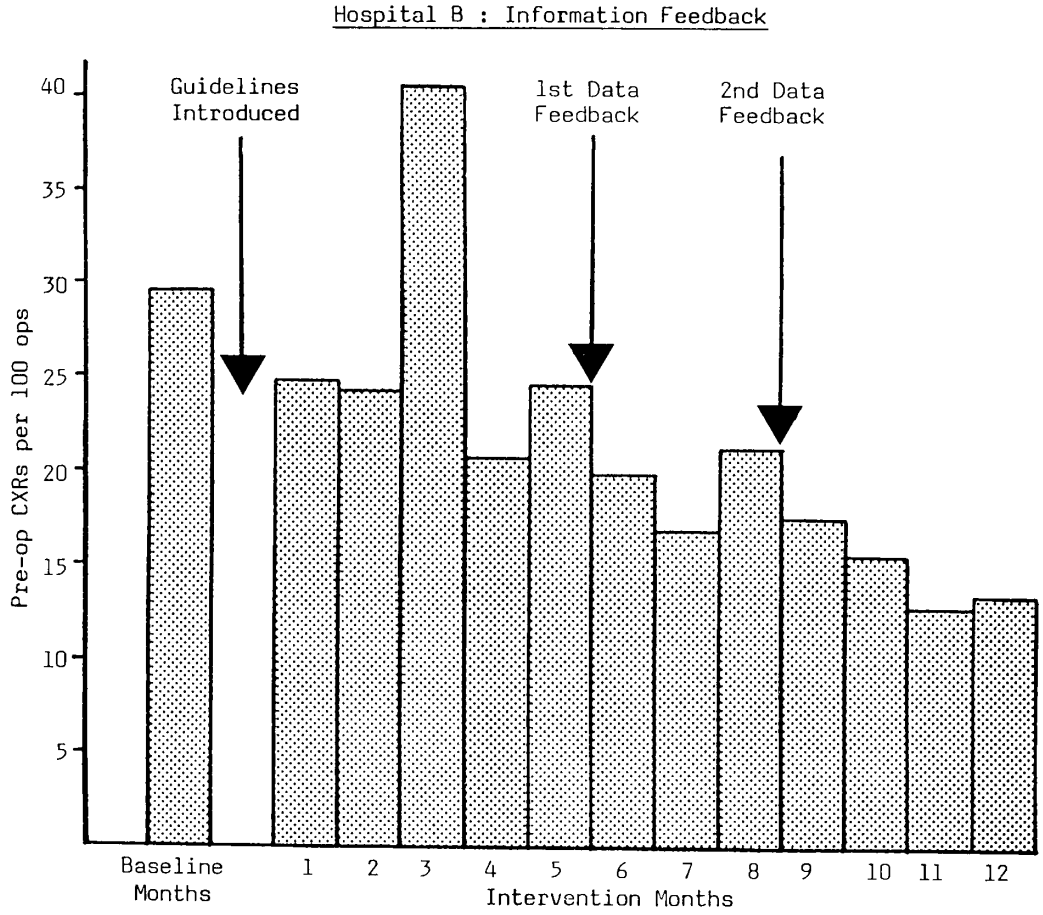


Figure 2

Table 2

Pre-operative chest X-rays for elective operations in hospital B

	Baseline Months	Intervention Months			Final Intervention Month
	1-2	1-5	6-8	9-12	12
No. elective operations (monthly mean)	309	421	412	576	457
No. pre-operative chest X-rays (monthly mean)	91	113	80	88	61
Pre-operative chest X-rays/ 100 elective ops.	29.4	26.9	19.4	15.2	13.3
Change in pre-operative chest X-rays/ 100 elective ops.	-2.5	-7.5	-4.2		-16.1*
Significance of change (p)	.236	<.001	0.002		<.001*

* Change between baseline period and final intervention month

Hospital B: Information Feedback

The new chest X-ray request form was introduced into hospital C during the middle of the first intervention month. Figure 3 shows that during the second intervention month the pre-operative chest X-ray rate fell from 24.2 to 16.2 pre-operative chest X-rays per 100 elective operations ($p < 0.001$). This reduced level of use was maintained during the following four months but, during the seventh month (when new house staff took up their posts in the surgical wards), the rate rose almost to its original level. During most of the remainder of the intervention period, the rate remained at a level higher than during the first few months.

Table 3 shows that the reduction in use occurring between the baseline months and the early months (2-6) was statistically significant ($p < 0.001$). The increase during the latter part of the year was also significant ($p < 0.001$). Because of this increase, the overall change during the year was not significant (-4.6 pre-operative chest X-rays per 100 elective operations, $p = 0.064$). During the period of least utilization, the rate was still moderately high at 17.3 pre-operative chest X-rays per 100 elective operations.

Figure 3

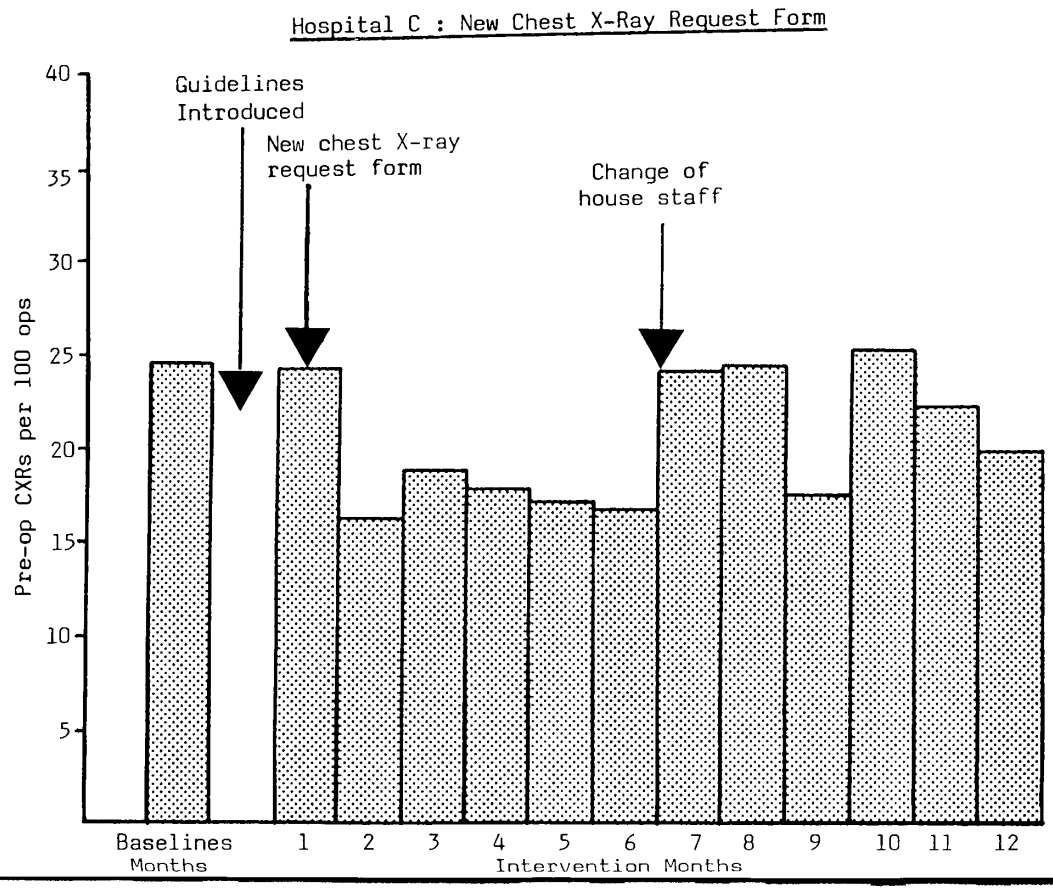


Figure 3

Table 3

Pre-operative chest X-rays for elective operations in hospital C

	Baseline Months	Intervention Months		Final Intervention Month
	1-2	2-6	7-12	12
No. elective operations (monthly mean)	389	501	496	506
No. pre-operative chest X-rays (monthly mean)	96	87	110	101
Pre-operative chest X-rays/ 100 elective ops.	24.6	17.3	22.2	20.0
Change: pre-operative chest X-rays/ 100 elective ops.	-7.3		+4.9	-4.6*
Significance of change (p)	<.001		<.001	0.064*

* Change between baseline period and final intervention month

Hospital C: new request form

In hospital D in which requests for pre-operative chest X-rays were screened by staff in the radiology department, the monthly use of pre-operative chest X-rays is shown in Figure 4. The screening process (concurrent review), was begun during the first month of the intervention period. During the first four months the pre-operative chest X-ray rate was slightly lower than during the baseline period. Since this reduction in use was not substantial, it was decided to inform staff in the radiology department of the current levels of use. In addition, radiography staff were reminded of their role in the review process. Following this feedback the use of pre-operative chest X-rays decreased further during the next three months. The lower levels of use were not maintained consistently throughout the remainder of the intervention year and some fluctuation occurred during the latter five months. Further feedback was not provided to the radiology department.

In Table 4 the monthly use of pre-operative chest X-rays are aggregated according to consistent periods of use. The decrease of 6.8 chest X-rays per 100 elective operations between the baseline period and the first four months of the study was statistically significant ($p = 0.003$). The decrease following feedback to the radiology department was also significant (-8.3 pre-operative chest X-rays per 100 elective operations, $p < 0.001$). Despite fluctuations in use during the latter five months, the overall rate of 23.2 was still less than the 32.6 during the baseline period. Indeed during the final intervention month the use of pre-operative chest X-rays

was at a level 42% lower than during the baseline period ($p<0.001$). Also the absolute number of pre-operative chest X-rays carried out in the radiology department was approximately half that occuring during the baseline period. Thus, despite some fluctuation during the year, the strategy was associated with an overall reduction in use of pre-operative chest X-rays.

Figure 4

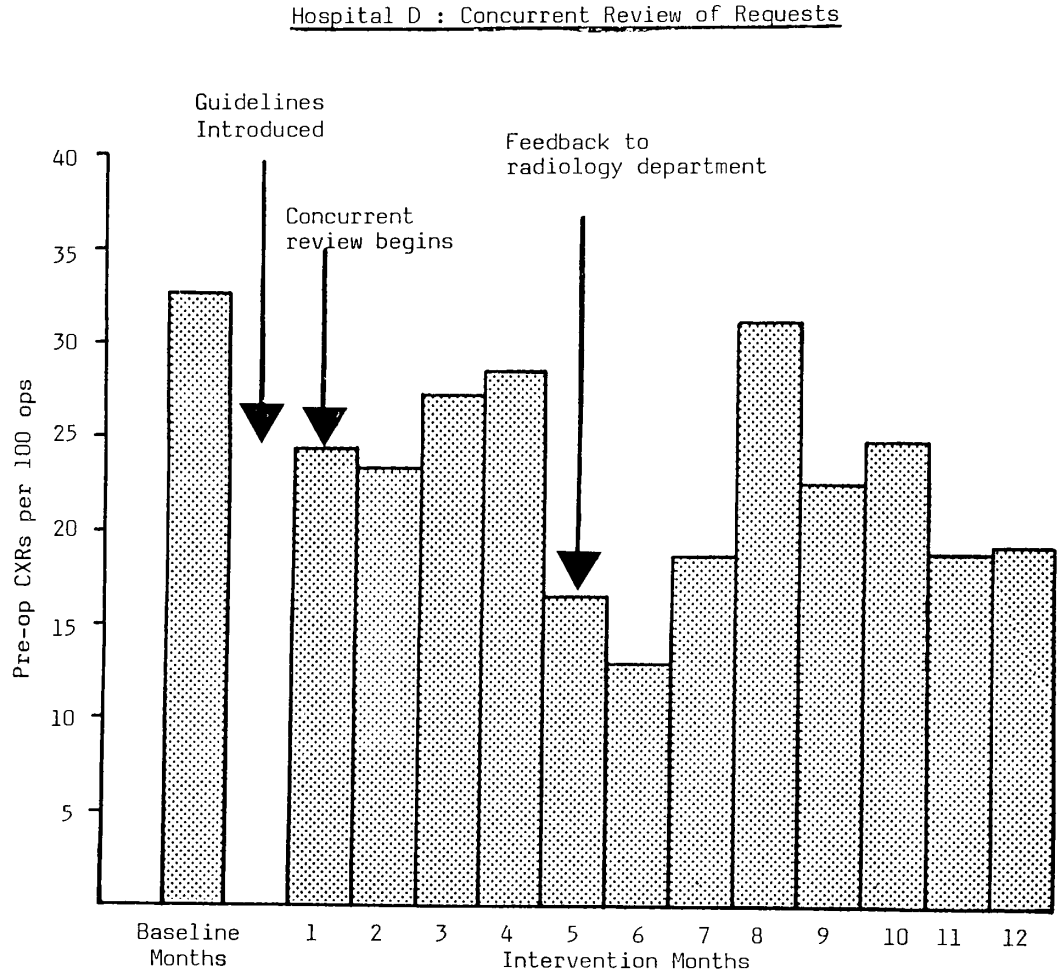


Figure 4

Table 4

Pre-operative chest X-rays for elective operations in hospital D

	Baseline Month	Intervention Months			Final Intervention Month
	1-2	1-4	5-7	8-12	12
No. elective operations (monthly mean)	304	288	300	502	289
No. pre-operative chest X-rays (monthly mean)	99	74	53	116	55
Pre-operative chest X-rays/ 100 elective ops.	32.6	25.8	17.5	23.2	19.0
Change: pre-operative chest X-rays/ 100 elective ops.	-6.8	-8.3	+5.7		-13.6*
Significance of change (p)	.003	<.001	<.001		<.001*

* Change between baseline period and final intervention month

Hospital D: concurrent review

In hospital E, the main control hospital, there was no substantial change in the pre-operative chest X-ray rate during the 12 months in which interventions took place in the other hospitals (Figure 5). The rates were aggregated into four monthly periods for ease of comparison (Table 5). Between successive periods there was no statistically significant change in utilization ($p > 0.05$). The rate during the final control month (21.8 pre-operative chest X-rays per 100 elective operations) was not significantly less than the baseline rate of 22.9 pre-opeative chest X-rays per 100 elective operations. During the final control month, however, the absolute number of pre-operative chest X-rays was slightly higher than during the baseline period due to a greater number of operations performed during that month.

Figure 6 shows the use of pre-operative chest X-rays in the Supplementary Control Hospital I, which had an established computerised system of data collection in the radiology department. It was not possible to distinguish between elective and emergency operations and so the figures relate to pre-operative chest X-rays for all patients having surgical operations. The baseline rate of 7.5 pre-operative chest X-rays per 100 operations was extremely low. This may have been due to a substantial number of emergency operations in the sample, a relatively high number of operations in specialties known to have low pre-operative chest X-ray rates, such as gynaecology and oral surgery, and under reporting of pre-operative chest X-rays. The reporting of pre-

operative chest X-ray was dependent upon house officers assigning chest X-rays to this category on the request form. If pre-operative chest X-rays were not categorised as such; they would be counted as non pre-operative chest X-rays. Given this low baseline rate, the pre-operative chest X-ray rate remained relatively constant throughout the year except for a rate of 15.1 pre-operative chest X-rays per 100 operations during the sixth month.

The pre-operative chest X-ray rates in Supplementary Control Hospitals II and III are shown in Table 6. September 1983 was equivalent to the fourth intervention month (except in hospital C) and September 1984 was eqivalent to the fourth month after completion of the intevention year. In both Hosptials II and III the pre-operative chest X-ray rate was very consistent between the two months sampled. Furthermore, the rate in hospital II of approximately 20 pre-operative chest X-rays per 100 elective operations was sufficiently high to suggest that any lack of change during the control year was not due to rates being at a minimum level and hence unresponsive to factors influencing change.

The evidence from Control Hospital E and Supplementary Control Hospitals I, II and III would suggest that during the period of the study no substantial changes were occurring in the use of pre-operative chest X-rays in NHS hospitals.

Figure 5

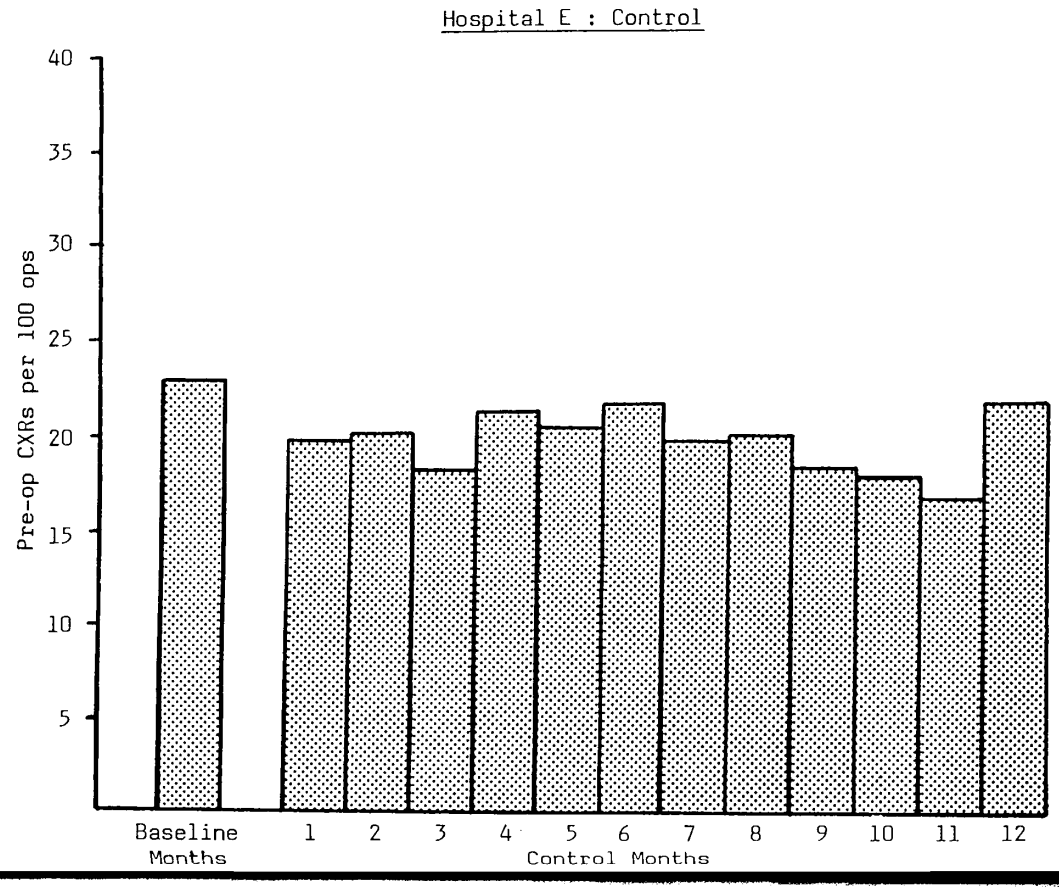


Figure 5

Table 5

Pre-operative chest X-rays for elective operations in Hospital E

	Baseline Months	Control Months			Final Control Month
	1-2	1-4	5-8	9-12	12
No. elective operations (monthly mean)	500	555	613	803	639
No. pre-operative chest X-rays (monthly mean)	115	111	127	156	139
Pre-operative chest X-rays/ 100 elective ops.	22.9	19.9	20.7	19.4	21.8
Change: pre-operative chest X-rays/ 100 elective ops.	-3.0	+0.8		-1.3	-1.1*
Significance of change (p)	.061	.563		.243	.547*

* Change between baseline period and final control month

Hospital E: control

Figure 6

Pre-operative chest X-rays for elective and emergency operations by month in Supplementary Control Hospital I

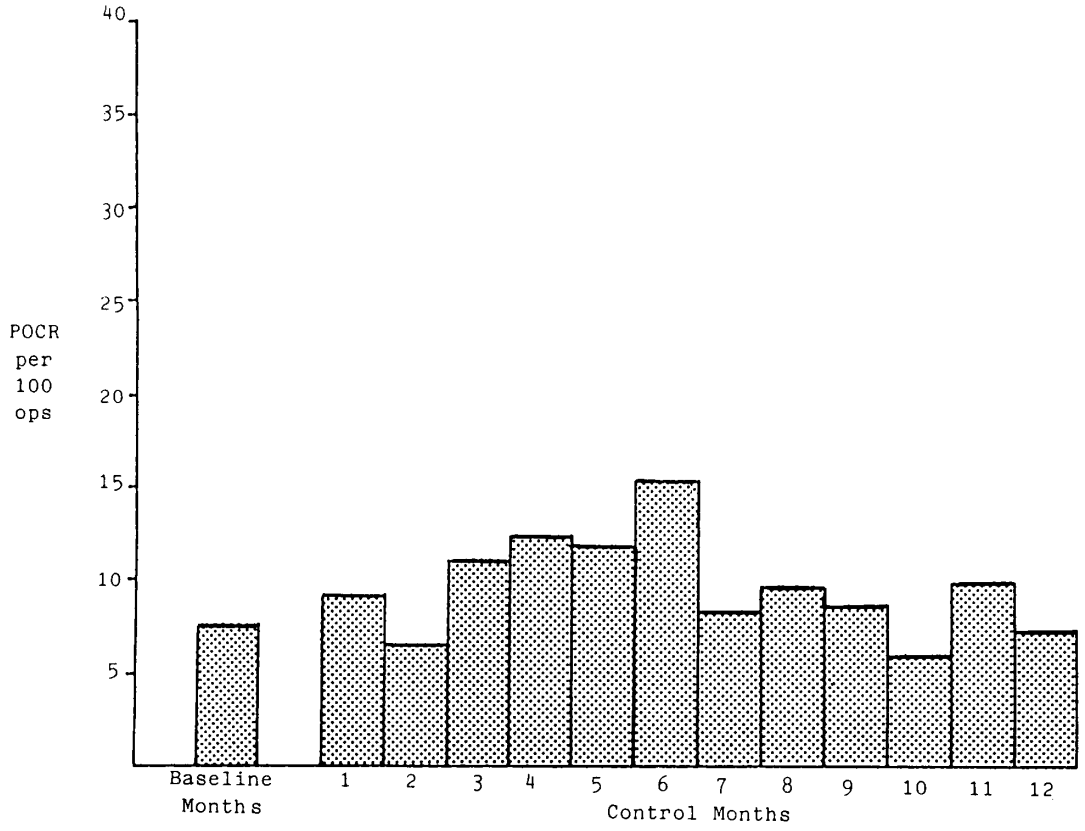


Figure 6

Table 6

Pre-operative chest X-rays for elective operations in supplementary control hospitals II and III

	Hospital II		Hospital III	
	Sept 1983	Sept 1984	Sept 1983	Sept 1984
No elective ops	305	284	350	348
Sample size	102	95	117	116
No pre-op CXRs per sample	20	18	17	17
No pre-op CXRs per 100 elective ops	20	19	14.5	14.5

Source M C Charny (unpublished information)

In summary, these results on the use of pre-operative chest X-rays in the study hospitals indicate that each strategy had an effect in reducing utilization. The lowest level of 8.5 pre-operative chest X-rays per 100 elective operations was achieved by the Utilization Review Committee following the posting of notices in the surgical wards of the hospital. Information feedback was associated with a consistent and gradual reduction in use during the intervention year from a baseline level of 29.4 to 13.3 chest X-rays per 100 operations during the final intervention month. Introduction of the new chest X-ray request form was associated with an immediate but moderate reduction in use (-7.3 chest X-rays per 100 operations), but this was not sustained following a change in house staff. Concurrent review of requests by radiological staff had an intermittent effect which was enhanced by feedback on utilization to the radiology department. The control hospital showed no significant change in utilization throughout the year of the study.

Changes in use by specialty in each hospital matched, with few exceptions, those occurring in the hospital as a whole. Less consistent changes were observed in specialties which already had low levels of utilization. Within each specialty, changes in use by consultants matched those occurring for the specialty as a whole, with a few exceptions, notably in hospital B (information feedback). Thus implementation of the strategies had a reasonably universal effect within each hospital.

Adherence to Guidelines

In each of the five study hospitals, data on the indications for pre-operative chest X-rays were abstracted from the medical records of a sample of patients having pre-operative chest X-rays during the fourth intervention month. Overall, 39% of patients had possible metastases, 38% had chronic cardio-respiratory disease and no chest X-ray within the previous year, and 17% had acute respiratory symptoms (Table 25). Some patients had more than one indication. No patient had the indication of "recent immigrant who had not had a chest X-ray within the previous year". Seventy five per cent of patients had indications for pre-operative chest X-rays as listed in the guidelines; conversely 25% had no indications. Among those patients with no indications, 28% smoked cigarettes (according to the medical record), but this smoking rate was no higher than for patients who had indications ($p > 0.05$).

The main variation found between the hospitals was that in hospital D a higher proportion of patients had acute respiratory symptoms than in the other hospitals ($p<0.001$). This higher level in hospital D may however have been due to a different research assistant collecting the data than in the other hospital. This research assistant had assigned patients to the indication of "acute respiratory symptoms" even if there were other indications such as chronic respiratory disease accounting for the acute respiratory symptoms. In the other hospitals acute respiratory symptoms were only designated as present if there were no other indications which might cause acute respiratory symptoms.

Clinical indications were also examined according to specialty (Table 8). Seventy-three per cent of patients in ophthalmology had no indications for a pre-operative chest X-ray which was much higher than in general surgery, urology and ENT surgery ($p < 0.001$). Among these latter specialties, there was no substantial differences in the proportion of patients with various indications except that a greater number of ENT patients had chronic cardio-respiratory disease and no previous chest X-ray ($p < 0.01$).

The proportion of patients having indications for pre-operative chest X-rays increased slightly with age up to those age 75 years or more (correlation co-efficient 0.99, $p < 0.01$) (Figure 7). In those aged less than 25 years, 62% had indications in contrast to 79% in those aged 65-74 years. This increasing trend with age was accounted for partly by an increase the proportion of patients with "possible metastases'. "Chronic cardio-respiratory disease and no previous chest X-ray within the previous year" occurred in 46% of patients under 25 years of age. This was due mainly to patients with a history of asthma or congenital cardiac abnormalities. These variations in adherence according to age were similar for both males and females.

During the fourth intervention/control month, a total of 2618 elective operations and 535 pre-operative chest X-rays were performed in the study hospitals (20.4 pre-operative chest X-rays per 100 elective operations). Assuming that 75% of the patients having pre-operative chest X-rays had clinical indications, a pre-operative chest X-ray

rate of 20.4 $\times \frac{75}{100}$ would include only patients with indications.

Thus a rate of 15.3 pre-operative chest X-rays per 100 elective operations would on these grounds be acceptable.

Table 7

Clinical Indications in Patients having Pre-operative Chest X-rays by Hospital

Percentage of Pre-operative Chest X-ray Patients

Hospital:	A (n = 53)	B (n = 54)	C (n = 52)	D (n = 60)	E (n = 41)	ALL (n = 260)
Indications						
Acute respiratory symptoms	15%	2%	6%	48%	5%	17%
Possible metastases	34%	28%	46%	42%	46%	39%
Chronic cardio-respiratory disease and no previous CXR	40%	35%	42%	32%	46%	38%
Recent immigrant and no previous CXR	0%	0%	0%	0%	0%	0%
ANY GUIDELINE INDICATIONS	70%	59%	83%	87%	76%	75%
NO INDICATIONS	30%	41%	17%	13%	24%	25%

Table 8

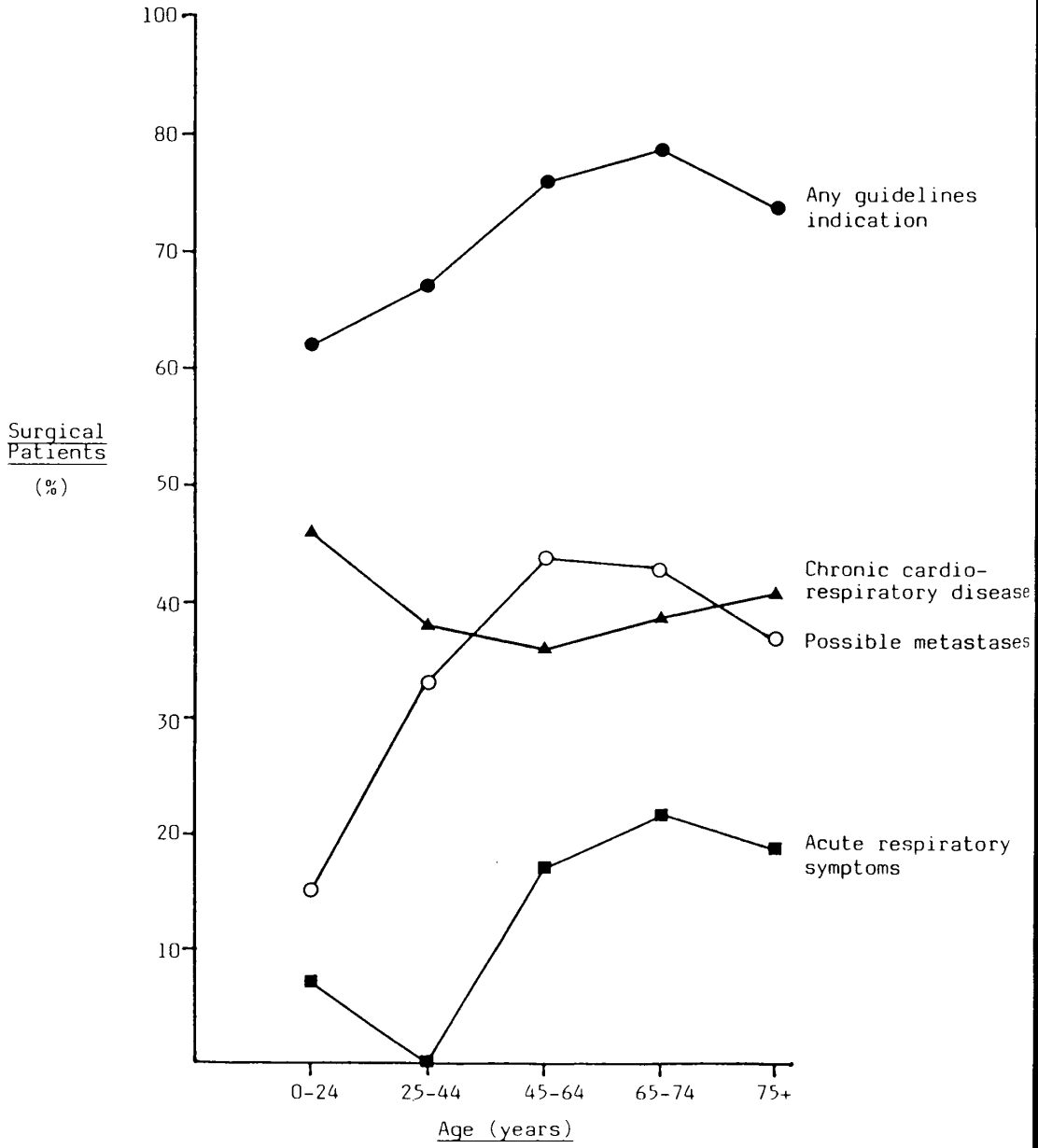
Clinical Indications in Patients having Pre-operative Chest X-rays by Specialty

Percentage of pre-operative chest X-ray patients

Specialty:	General Surgery (n = 129)	Urology (n = 29)	ENT Surgery (n = 24)	Ophthalmology (n = 22)	Other (n = 27)	Unknown (n = 29)
Indications						
Acute respiratory symptoms	19%	28%	17%	5%	11%	10%
Possible metastases	40%	62%	54%	0%	22%	41%
Chronic cardio-respiratory disease and no previous CXR	38%	41%	67%	23%	22%	41%
Recent immigrant and no previous CXR	0%	0%	0%	0%	0%	0%
ANY GUIDELINE INDICATIONS	79%	93%	87%	17%	67%	72%
NO INDICATIONS	21%	7%	13%	73%	33%	28%

Figure 7

Clinical indications in patients having pre-operative chest X-rays by age of patients



Cost savings

In the National Health Service the Standard Accounting System does not require the costs of individual diagnostic tests to be specified. Consequently, a standard method of attributing costs to chest X-rays and other diagnostic procedures has not been developed. Costs of diagnostic tests have been estimated in ad-hoc studies of patient and disease costing where estimates have been made of the cost to the NHS of treating a patient with a specific disease.

In a trial of patient costing in Manchester (Babson, 1973), the cost of an X-ray was based upon the number of work units assigned to the X-ray. Unit values for each X-ray are published by the DHSS (1973) and are used as a means of estimating workload in radiology departments. The average unit cost in a department can be calculated by dividing the total annual expenditure of the department by the annual number of work units. A chest X-ray has been assigned a unit value of six (DHSS 1973); the cost of a chest X-ray is therefore six times the cost per unit. In a patient costing survey at Northwick Park Hospital in 1971/72, Perry (1974) estimated that the cost per unit was 21 pence. The cost of a chest X-ray was therefore £1.26p.

In a study in South Wales examining the costs of alternative methods of treating varicose veins, Piachaud and Weddell (1972 a and b) used a different method for estimating radiology costs. They noted the number of X-ray films required for each radiological investigation and using the known cost of an X-ray film, calculated the total cost of

films used for each procedure. From standard hospital costing returns the ratio of the total cost of all X-ray films to the total departmental cost was obtained and it was assumed that this ratio was constant irrespective of the type of investigation performed. Using this ratio the cost of an individual radiological investigation was estimated as follows: cost of investigation = cost of films for investigation x total departmental cost divided by total film cost. Using this formula and data from Northwick Park Hospital, Mason et al (1973) calculated that a chest X-ray would cost between £1.50 and £3.00 in 1971/72.

Stilwell (1984) has recently developed a more detailed system for estimating the costs of X-rays in a hospital in the West Midlands. This system includes estimates of not only revenue expenditure but also the costs of capital. The cost of a chest X-ray in 1983 was estimated to be £4.24p broken down as follows: medical salaries 28p, radiographer and non-medical salaries £1.16p, film 93p, chemicals (minus silver recovered) 36p, medical administration 11p, hospital overheads 87p, capital 40p, other 12p. On applying this method in the University Hospital of Wales the author estimated that a chest X-ray cost £5.04p in 1983. The difference between the costs in the University Hospital of Wales and the hospital in the West Midlands could be attributed almost entirely to the higher capital costs in the former.

This method of X-ray costing developed by Stilwell is undoubtedly the most sophisticated to date. The costs of a chest X-ray will vary between departments depending upon such factors as the average amount

of time spent by radiologists and radiographers on the procedure, costs of the capital equipment and size and nature of other work undertaken in the department. In most departments in 1984, the cost of a chest X-ray using Stilwell's method is likely to be in the region of £5.00 per examination. Chest X-rays performed at the bedside and as on-call procedures would inevitably cost more.

The cost savings resulting from a reduction in the use of pre-operative chest X-rays will not be equal to the product of the cost of the X-ray and the numbers reduced, but will depend on how a radiology department adapts to the change in workload. On the assumption that other procedures do not replace pre-operative chest X-rays, savings in the short term will accrue from reduced use of materials such as film and chemicals and will amount to aapproximately £1.00 per chest X-ray. In the medium term, depending on the surgical workload in the hospital and the size of reduction in the percentage of patients having pre-operative chest X-rays, further savings could be made by dispensing with a half-time or full-time radiographer. Rogers and Matthews (personal communication) in a survey of the work of diagnostic radiology departments in Wales have estimated that approximately 20 pre-operative chest X-rays could be carried out by one radiographer during a half day. Depending on the patterns of work within a department and whether any reduction in pre-operative chest X-rays was spread evenly throughout the week, a half-time radiographer might be released if the reduction amounted to 100 pre-operative chest X-rays per week. It is unlikely that the workload of any other staff, such as radiologists, secretaries, and porters, would be affected to such a

degree that would permit a reduction in their establishment. In the long term, with re-organisation of other work in the department, the full costs of the chest X-ray (approximately £5.00 per X-ray) might be saved.

Figure 8 shows the short, medium, and long term savings feasible in a hospital according to the surgical workload and reduction in use of pre-operative chest X-rays. For example, in a hospital performing an average of 900 elective non-cardiopulmonary operations per month and reducing the use of pre-operative chest X-rays from 60% to 10% of operations (50% difference), the annual short, medium and long term savings would be £5,400, £9,600 and £27,000 respectively. A hospital performing 200 operations per month with a 20% difference in use of X-rays would have annual short term savings of £480, and long term savings of £2,400. The medium term savings would be no greater than the short term because the reduced radiological workload would be inadequate to dispense with a half-time radiographer. Some savings would be made if radiographers were employed on an hourly basis.

FIGURE 8

FIGURE 8

ANNUAL SAVINGS IN EXPENDITURE BY REDUCING PRE-OPERATIVE CHEST RADIOLOGY ACCORDING TO ELECTIVE SURGICAL WORKLOAD IN A HOSPITAL

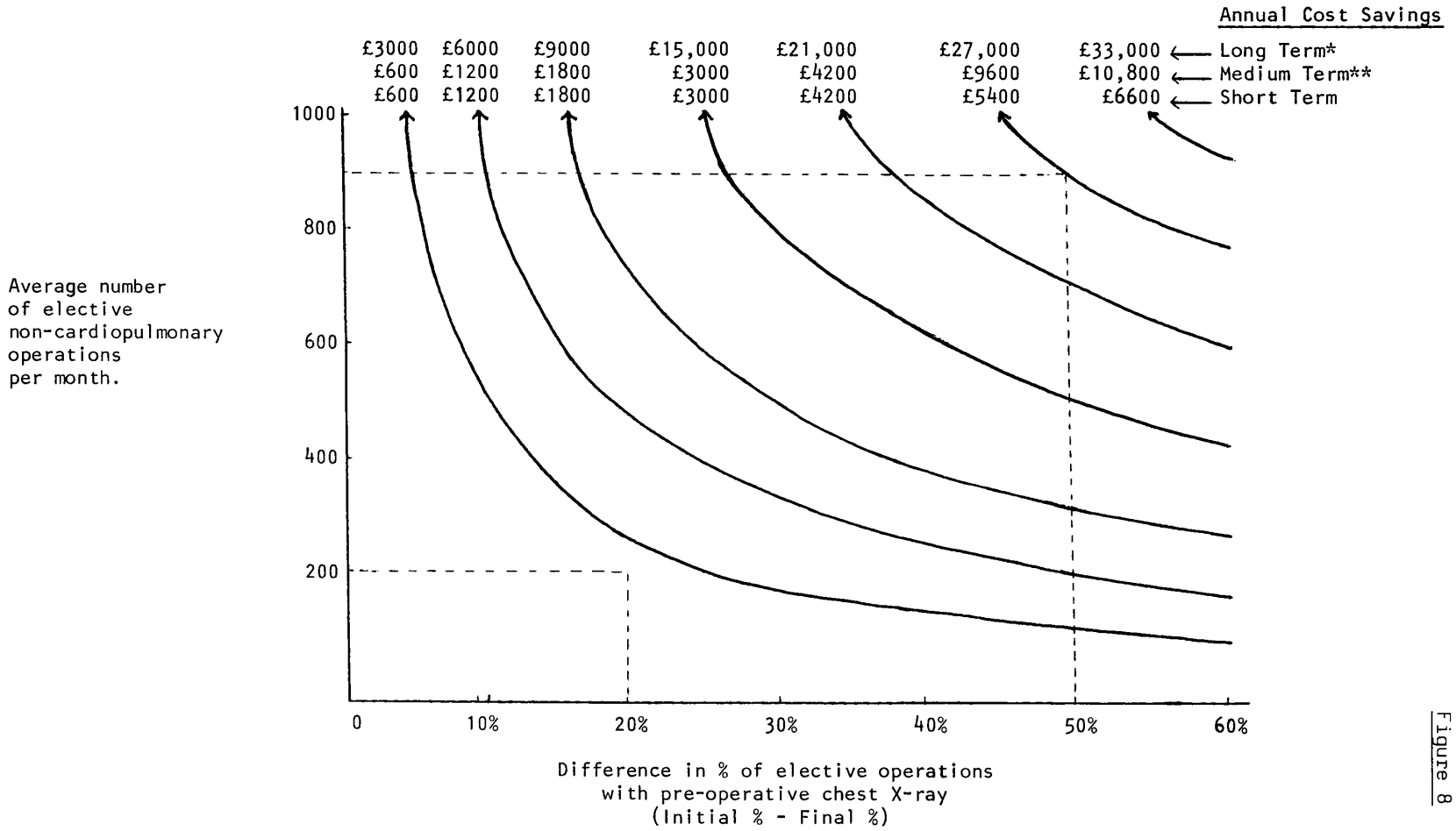


Figure 8

* Assuming cost of chest X-ray £5 at all levels of use of pre-operative chest X-rays.
**Based on mid point salary of half-time Senior Radiographer Grade II (including contributions) = £4,200.

CHAPTER 4

SUCCESS OF STRATEGIES : OVERVIEW

During the intervention year the use of pre-operative chest X-rays decreased in each of the strategy hospitals. No significant change in utilization occurred in either the control or supplementary control hospitals. The effects of similar interventions on the use of other diagnostic tests, when examined in conjunction with the results of this study, allow some conclusions to be drawn about the success of these strategies in changing the use of diagnostic tests.

In Hospital A (Utilization Review Committee) and Hospital B (information feedback), the interventions took place a few months after the implementation of the strategy because data on utilization had to be collected before the intervention was applied. Utilization during the first four months in these hospitals, when compared with that during the baseline period, gives some indication of the impact of introducing the guidelines to the divisions and to the consultants. Knowledge that their performance was being monitored might also have affected consultants' utilization. The decline in use in both hospitals suggests that introduction of the guidelines and the monitoring process had some effect, but these reductions were relatively small compared to those that took place when he interventions were applied. Obtaining approval of guidelines by divisions and requsting consultants to implement them would appear to be insufficient to create the extent of change which is possible.

Furthermore, the response to the introduction of the guidelines varied considerably between consultants whereas there was a more consistent response to the specific interventions applied within each strategy.

Utilization Review Committee

During recent years many hospitals in the NHS have established drug utilization review committees. The Utilization Review Committee in this study was probably one of the first committees established within a hospital in the United Kingdom to perform a regular peer review of the use of a diagnostic test. This innovation might well have been perceived by the clinicians in the hospital as a threat to their clinical freedom. However, the concept of the committee was accepted readily by the divisions; this was due undoubtedly to the political skill and high standing of the local co-ordinator (who was also chairman of the Utilization Review Committee). The opportunity for each division to nominate their representative on the committee was probably another factor which enhanced support. The committee was perceived not as an external body but as an internal review committee performing a form of self audit. It is unlikely that the consultants felt threatened by the committee in that utilization fell only marginally during the first few months when they knew that the committee had been established.

A substantial reduction in utilization did not take place until the committee took positive action by directing that a notice describing the guideline be posted on the walls of each surgical ward. The committee felt sufficiently confident of the support of consultants that they attempted to influence the actions of house officers

directly and bypass consultants, who had responsibility for the clinical actions of their junior staff. When a low level of utilization was obtained, the committee did not take further action to sustain this level of use. However, the effect of the notices did not continue at the same level: during the latter months of the intervention period, the pre-operative chest X-ray rate increased, but the level of 10.6 during the final month was still well below the baseline level of 29.9 pre-operative chest X-rays per 100 operations.

In the United States, many hospitals have had experience with utilization review committees. These committees were established during the early 1970s to review the appropriateness of admission and length of stay of hospital inpatients. This programme of 'Utilization Review' was instituted by the Federal Government in an attempt to contain the rapidly increasing costs of medical care. Other reviews, which examined clincial practice in more detail, were developed on an experimental basis. For example, in one "pre-paid health plan" in which patients paid a fixed sum for medical care each year, clinicians were reimbursed for the services which they provided (Buck and White 1974). A process of review under the supervision of a Medical Review Committee was established to monitor the use of certain procedures, including three diagnostic tests (urinalysis, haemoglobin and blood glucose). If utilization was considered inappropriate, clinicians were not reimbursed. This process of review led to a reduction in use of thirteen procedures including the three diagnostic tests.

In a similar peer review system, which was conducted experimentally in

New Mexico, a review of the use of injections in primary health care clinics resulted in a decline in utilization by more than 60% (Brook and Williams, 1976). These experiments using utilization review committees differed from the strategy used in this study in that they combined both peer review and a financial or other penalty for non-adherence with good clinical practice as established by the review committee.

A few studies have examined the effect of review committees on the use of diagnostic tests including X-rays. In one primary care programme in New York City a reduction in the use of most diagnostic tests was achieved including a marginal but statistically significant reduction ($p < 0.001$) in the use of chest X-rays from 4.6% to 3.9% of patient attendances (Paris et al, 1980). In another experiment in a University Hospital in Atlanta, the review committee was very similar to the one participating in this study. The "Medical Care Evaluation Sub-Committee on Cost Containment" was composed of representatives of the medical staff in each department, senior surgical and medical registrars, and three members of the hospital administrative staff. The purpose of the committee was to evaluate patterns of practice and make recommendations on strategies for cost containment to the Medical Staff Executive Committee. These recommendations included a new policy for carrying out chest X-rays on patients admitted to hospital. This policy, which was adopted by the Executive Committee, stated that routine chest X-rays should not be performed on patients under 20 years of age, postero - anterior views should be performed on patients aged 20 to 39 years of age, and postero - anterior and lateral views should be performed on patients 40 years of age or over (Armistead and

Hofmann, (1981). There was no indication as to how the policy was implemented but, despite the relatively conservative guidelines adopted, the authors stated that "follow-up studies have indicated that the annual savings to patients amount to approximately $20,000".

Utilization review committees concerned with the use of diagnostic tests have not been widely adopted in the U.S.A. although there is still considerable support for the idea. In a recent review, Griner and Glaser (1982) recommended that "hospitals should develop mechanisms for examining patterns of test use in a systematic way and compare these patterns with appropriate standards, just as infection/control committees monitor patterns of antibiotic use and recommend remedial strategies when indicated". Such initiatives have however been superceded by the introduction of reimbursement to hospitals according to Diagnostic Related Groups (DRGs) (Editorial, Lancet, 1983) in which hospitals are reimbursed fixed amounts according to patients' diagnoses.

The notice describing the guidelines, which was displayed in the surgical wards, had a substantial effect on use. Eisenberg (1977) noted a similar effect in a trial designed to reduce the use of prothrombin time as a screening procedure on patients admitted to a hospital in the United States. Following education of housestaff on appropriate utilization, notices urging discretion in the use of the procedure were posted in the wards in the hospital. At the beginning of the study prothrombin times were performed on 87% of hospital admissions; on displaying the notices in the hospitals use declined

during the following six months to 55% of admissions. However, somewhat in keeping with the findings of this study, the low level of use was not sustained and eighteen months later had returned to original levels. In Eisenberg's view, the lower level of utilization could have been maintained if the same or a different stimulus for change was repeated or if the original stimulus had been accompanied by an incentive. He also recommended that senior medical staff in hospitals should be involved in attempts to change the practice of house officers because junior medical staff on hospital rotations often changed positions every few months.

The success of the Utilization Review Committee in implementing change in this study was probably due to several factors. Firstly, the Committee was concerned with the use of only one procedure and there was considerable resolve among the members to reduce utilization and demonstrate the effectiveness of the Committee. Secondly, the Committee was provided with reliable and up-to-date data on current practice, which gave them confidence to respond accordingly. And thirdly, the Committee was not restricted to one intervention but had the flexibility to act according to the prevailing situation in the hospital. If the study was extended over a longer period of time, different measures would probably have to be introduced to sustain a low level of use until such a time that this low level became accepted practice. The enthusiasm of the Committee did not wane during the intervention year. As the commitment required by the members was for only one hour every three months, the committee could probably have functioned for a much longer period.

Information feedback

The feedback of information on use of pre-operative chest X-rays had a consistent effect on utilization during the study period. During the months following the first feedback, use fell from 26.9 X-rays to 19.4 X-rays per 100 elective surgical patients; following the second feedback, use fell to a monthly average of 15.2 X-rays per 100 patients. The lowest level of use attained in the hospital (during the final intervention month) was 13.3 pre-operative chest X-rays per 100 elective surgical patients. After the first feedback 8 out of 10 consultants decreased their use of pre-operative chest X-rays; 6 out of 10 consultants doing likewise after the second feedback.

The information on use of pre-operative chest X-rays did not appear to generate a great deal of interest among the consultant surgeons and anaesthetists. According to the local co-ordinator in the hospital, the use of X-rays was discussed occasionally between consultants and radiologists, but only one consultant wrote to the local co-ordinator asking for further information. This consultant had a relatively high utilization rate and requested further information on the rate according to the age of his patients. Additional statistics provided to the consultant showed that his utilization was high at all ages and that his high rate overall could not be explained by a relatively large number of older patients.

(1) Feedback of statistics on use of tests

Other studies in which statistics on the use of diagnostic tests were provided retrospectively to clinicians have shown the strategy to be

of mixed value. In an outpatient clinic in Baltimore, feedback of haematological, biochemical and radiological tests ordered on each patient and the percentage of those tests found to be abnormal produced no effect on the use of tests over a period of one year. Indeed the number of tests per patient increased from 0.7 to 1.5 (Pozen and Gloger, 1976). No commentary was provided on the statistics fed back to the medical staff; this may partly explain why utilization was not reduced. Rhyne and Gehlbach (1979) coupled feedback to residents on their use of thyroid function tests with an educational seminar. This created a reduction in use for a period of three months but with no further feedback, use returned to pre-intervention levels.

In another study aimed at reducing the use of a specific test, Eisenberg et al (1977) informed house officers and consultants about their inappropriate use of the lactate dehydrogenase test (LDH). Overutilization remained at the same level both before and during the intervention period. The authors postulated several reasons for this failure to change practice. Firstly, the clinicians may have been unconcerned about the costs of care and even if they were, the feedback on only one test may have been perceived as inconsequential when considered against the battery of other tests ordered each day. Secondly, the feedback was provided by junior and not senior staff in the hospital; house officers would be more likely to respond to figures of authority in the hospital. Finally, there was no incentive, in the form of a reward or sanction, for the house officers to change their practice and respond to the information on

overutilization.

(2) Feedback on costs

In several experimental studies feedback has included costs in addition to numbers of tests requested. In a recent experiment in Brent Health District (Wickings et al, 1983), consultants were provided with monthly reports of their use and costs of diagnostic and other services. The information was also presented intermittently to divisions; this allowed consultants to compare their own firm's performance with those of colleagues. After a period of three years, there was no evidence to suggest that any consultant's pattern of work or expenditure had changed markedly. The authors concluded that to effect change, the provision of information on expenditure must be accompanied by another intervention in the form of education or an incentive.

In a similar study conducted in Australia, feedback at four weekly intervals to consultants on the numbers and costs of tests requested by members of their team produced no effect on levels of use (Grivell et al 1981). The authors suggested that a major reason for the lack of change was that feedback was provided to senior staff when in fact the junior staff ordered tests. The consultants may not have discussed the information with their junior staff. This lack of communication between senior and junior medical staff may also have occurred in this study. In a subsequent study, Grivell et al (1982) included in their feedback of information a league table of named consultants ranked according to costs generated in clinical chemistry. Even this widely publicised information comparing costs between

clinicians had no influence on numbers of biochemistry tests ordered per month. As the authors pointed out, high users may well have justified their position by referring to the supposedly special nature of patients under their care.

Some studies including feedback on costs have been successful. In one study conducted in the United States (Schroeder et al, 1973) clinicians were sent information on their costs and use of tests and drugs. Anonymous rankings of physicians according to levels of expenditure were also included. The total costs of laboratory tests requested (including diagnostic X-rays) fell during a three month period by almost 30% (although drug costs increased by 6%). In a general medical unit in a teaching hospital in the United States, regular review once a month by consultants and house officers of the costs and use of services by patients under their care over a period of three and a half years resulted in a smaller increase in the costs of services than those provided by other specialties (Lyle et al, 1979).

Provision of daily information on charges incurred by patients has been shown to produce a substantial change in the use of diagnostic investigations (Henderson et al, 1979). Interns were randomly allocated to receive or not receive daily printouts of patient charges: this resulted in laboratory and radiological charges being over one third lower in the intervention group than in the control group. In another trial, however, conducted in a surgical unit provision on a daily basis of services rendered and costs attributable

to patients undergoing cholecystectomy, appendicectomy, breast biopsy, and inguinal hernia repair produced no significant decrease in costs of care for these patients when compared with a control surgical unit (Forrest et al, 1981). The cost information was inserted into the notes each day and it is conceivable that the medical staff may not have looked at the information on a regular basis, thus accounting for the lack of change.

(3) Feedback by audit of medical records

Medical staff can also acquire information on their use of diagnostic tests by reviewing the medical records of patients currently in hospital or recently discharged. (This method of feedback does not involve the provision of summary statistics on utilization). In a trial attempting to modify the test ordering behaviour of medical residents, Martin et al (1980) randomly allocated 24 junior doctors in one hospital into three groups. The first group reviewed at regular intervals the medical records of patients in their wards; the second group received a moderate financial incentive if they reduced the use of tests; the third group acted as a control. During the year of the study the group reviewing medical records showed the greatest decrease in the numbers of laboratory tests ordered (a reduction of 47%). Repeat testing decreased significantly in all three groups but there was no change in the use of radiological tests. The impact on radiological utilization may have been limited because baseline levels of use may already have been low and because relatively few X-rays are repeated in comparison with other laboratory investigations. When the strategies were withdrawn, the record review group continued to use fewer diagnostic tests while the financial incentive and control

groups returned towards baseline levels of use. The authors concluded that this form of record review was successful because the process of feedback was accompanied by education of residents. Also, exposure during the record review to the opinions of senior staff may have affected residents' attitudes towards the use of diagnostic tests. That personal contact in a tutorial may have an impact on clinical practice has been suggested by the results of other studies which have shown that tutorials may effect a change in practice, for example, in the use of antibiotics (Klein et al, 1981) and in the management of hypertension (Inui et al, 1976).

However, regular review of medical records in a Birmingham hospital did not produce a greater reduction in numbers of tests ordered by clinicians participating in the review than by those in a control group (Heath, 1981). The author suggested that no substantial change took place because only emergency medical admissions were reviewed, and these patients were unlikely to have had many investigations. Another explanation, however, is that the review of medical records involved the assessment of many aspects of care; hence, the detection of overutilization of diagnostic tests may have been diluted by concentration on other issues.

(4) Feedback on other clinical activities

Feedback on other aspects of clinical care has also had mixed success on, for example, the use of drugs (Brown and Uhl, 1970), the process of care for cholecystectomy patients (Mitchell et al, 1975) and tonsillectomy rates (Wennberg et al 1977). In the United Kingdom one

of the most ambitious programmes concerned with feeding back information to consultants was conducted by the Information Services Division of the Scottish Health Service in the form of Scottish Consultant Review of Inpatient Statistics (SCRIPS). Statistics on numbers of discharges, diagnoses, ages, and lengths of stay of patients discharged from wards were provided regularly to consultants. This feedback of information had almost no effect on clinical practice and was subsequently withdrawn. A survey of consultants' opinions of the system (Parkin et al, 1976) showed that 61% thought it was of no value, 44% found it difficult to understand, 46% thought there was too long a delay in the provision of data and 64% were concerned at the extent of errors in the data. However, 82% stated that they would in the future like to receive routine data of some sort. The lack of involvement by consultants in the planning and provision of data was probably a major factor in the failure of SCRIPS. The system was undoubtedly perceived as an external review of practice and was probably counterproductive in motivating behavioural change.

On balance the results of studies examining the effect of feeding back information to clinicians on their use of diagnostic tests would suggest that feedback per se has little effect in changing practice. The success of the strategy is partly dependent upon the method of feedback and in particular whether it is accompanied by some form of comment on performance, educational intervention or incentive. The provision of cost information may also be useful. But whatever technique is used, success is unlikely unless the recipients participate fully in the process of feedback and are motivated to change their practice.

The change in use of preoperative chest X-rays in this study probably occurred because, in addition to providing data on use, each consultant was aware of his or her position in relation to colleagues in the hospital and an ideal target of use was presented. Also by approving the guidelines and their implementation, the consultants had in principle accepted that change could take place. Furthermore, consultants were unlikely to justify high usage on the basis of differences in their patients from those in other specialties because most patients were relatively fit and proceeding to elective surgery.

In the United Kingdom radiologists would appear to be sceptical about the value of information feedback to clinicians. In a survey of diagnostic departments, which included 217 radiology departments, West (1984) found that 15% of radiology departments routinely reported data on utilization to clinicians and of these almost half did so only "occasionally". Doubts about the value of the information and lack of staff for data analysis were the reasons given for not reporting data to clinicians. Interestingly, 14% of radiologists stated that they were reluctant to restrain clinical demand.

New request form

The introduction of the new chest X-ray request form in Hospital C was associated with an almost immediate reduction in use of pre-operative chest X-rays which was maintained throughout the first half of the intervention year. The return of utilization to almost baseline levels co-incided with the change of house staff in the hospital. This pattern of utilization was consistent for most consultants,

indicating that the new form had a universal effect on the requesting behaviour of house officers.

The form was constructed in such a way as to remind the house officers of the guidelines and to discourage their use of routine X-rays. It was not possible for house officers to tick "routine" or "no clinical indication", the implication being that these were not acceptable reasons for requesting pre-operative chest X-rays. The new form could be filled in rapidly, taking only a few seconds longer to complete than the original request form. Thus, the reduction in requests was probably not due to a disincentive associated with the completion of a long and tedious request form, but was more likely to be due to changing attitudes to the use of routine pre-operative chest X-rays consequent upon repetitive reminders to house officers whenever the forms were used.

The main difficulty experienced with the new form was it's introduction into the hospital. When chest X-ray requests were submitted on old forms and returned to house officers for resubmission on new forms, considerable resentment was caused. However, once the forms had been in use for about three weeks there was no further difficulty. This initial resentment may have been partly responsible for the relatively high pre-operative chest X-ray rate during the month when the forms were introduced. The first month did however coincide with the changeover of house-staff and the forms were not introduced at the very beginning of the month.

Few attempts have been made to influence requesting of tests by alteration of request forms. In a teaching hospital in the United States, Wong et al (1983) modified the request form for thyroid function panels from a checklist to a problem orientated format in which the sequence of tests necessary to confirm a suspected diagnosis was displayed on the form. Prior to introduction of the new forms, the medical staff were informed of the appropriate use of thyroid function panels at various medical staff meetings and in a laboratory bulletin which was circulated to every clinician in the hospital. The educational initiatives had no effect on the use of thyroid function tests, but when the new forms were introduced, numbers of tri-iodothyromine (T3) and thyroid stimulating hormone (TSH) tests ordered per month fell by an average of 38% and 61% respectively.

The authors of this study (Wong et al, 1983) concluded that reductions in use were not only due to information on the form indicating appropriate requesting but also because previous forms had encouraged over-use by simply requiring house officers to tick a box opposite each test. House officers who were ignorant of the appropriate test to request would simply order all the tests. Indeed, Lundberg (1983) has pointed out that laboratory request forms with lists of tests, which he calls "menus", and rapid reporting of results encourages over-use. On the other hand, blank request forms and delays in reporting decrease use, but tend to lead to administrative confusion. An appropriate balance between these two extremes is required in order to encourage optimum use of tests.

In this study, the new request form acted as a reminder to the clinicians on the appropriate use of a test. In recent years other forms of diagnostic reminders have been explored, particularly those based on computerised information systems. For example, Young (1980) has described a house officer information system which is used in a medical unit in Brimingham. Diagnostic problems are entered into the system and the computer responds with a printed sheet of useful information for managing the problem (including the appropriate diagnostic tests to use). Although he reported the effects of the system on the use of investigations by only two house officers, the numbers of unnecessary tests performed on patients cared for while the system was in operation decreased and led to a slight saving in patient laboratory costs. De Dombal et al (1974) in Leeds have developed a similar system to assist in the diagnosis of abdominal pain. Clinicians' diagnostic performance improved markedly when using the computer, but when the computer facility was withdrawn performance returned to the pre-trial level. In the United States, computer reminders of the appropriate use of drugs (MacDonald 1976) and of the follow-up treatment of patients having throat cultures (Barnet et al 1978) have led to improvements in the quality of care.

From the results of this study and others in which diagnostic reminders are incorporated into clinical practice at the point of request, it would appear that such reminders are successful in changing utilization of diagnostic tests. There is a danger, however, of regression to former levels of activity if the reminder is withdrawn (or if there is a change of staff). Also, clinicians may

become immune to the reminders. It would be interesting to know if the house staff using the new form in the first half of the intervention year still had relatively low rates of utilization during subsequent appointments.

Concurrent review

In hospital D in which the radiology department attempted to limit routine pre-operative chest X-rays by screening requests, utilization fell overall during the intervention year. However, there was considerable variation in use from month to month which may have occurred because of difficulties in screening every chest X-ray request that reached the department. Utilization fell markedly after the radiology department was fedback information on utilization suggesting that the review process had improved. The lowest level obtained was 13.1 chest X-rays per 100 elective operations during the sixth intervention month. This was a 60% reduction in utilization from baseline levels which suggests that if consistently applied, concurrent review has considerable potential in reducing utilization.

Control of the use of clinical resources after a request has been made, but before the resource is consumed, has been attempted in hospitals in the United States. In one hospital an antimicrobial control programme was instituted in which requests for certain expensive antibiotics generated an automatic consultation by an infectious disease specialist. The recommendations of the specialist were not mandatory, neither was there a restriction on the use of drugs, but this process of concurrent review resulted in a 30%

reduction in the costs of antimicrobial drugs prescribed in the hospital (Craig et al, 1978). With the development of hospital formularies in the United Kingdom similar mechanisms for reviewing the prescribing of non formulary drugs have been developed.

Preoperative cross matching has also been subject to the same type of review. Following the development in a New York State hospital of guidelines for cross-matching prior to surgery, a request for cross matching which exceeded the level stated in the guidelines resulted in a physician from the blood bank contacting the clinician who ordered the cross match. This process led to a substantial reduction in preoperative cross matching in the hospital (although the guidelines were not followed strictly). (Mintz et al, 1978). Reports from other hospitals have also indicated that substantial reductions in cross matching can be obtained by this procedure (Nelson, 1976).

Another approach to the control of requests by diagnostic departments has been initiated in the clinical chemistry laboratories in British Columbia (Hardwick et al, 1982). In a system called "structuring complexity" the intensity of laboratory examination is escalated according to a pre-determined protocol. For example, multiple thyroid function tests will only be performed after an initial thyroxin (T4) test has been shown to be abnormal. The laboratory controls this process by determining which test to perform according to the protocols, irrespective of the request made by the clinician. This system of control has resulted in a 15% reduction in thyroid testing

and a 12% reduction in laboratory charges.

Thus, concurrent review has the potential to achieve reductions in the use of diagnostic tests and other resources. Success however is dependent upon the acceptability of the review process to clinicians and to the method of review. Ideally, an unnecessary request for a specific test should generate an automatic review and should not be dependent upon the continuous surveillance of busy professional staff in a diagnostic department. For example, criteria might be drawn up so that the receptionist in a department could easily classify requests as "acceptable" or "possibly unacceptable". The latter designation would result in an automatic review of the request by a professional staff member assigned this responsibility.

The results of this study and of other trials examining strategies for change in the use of diagnostic tests suggest that each of the four strategies examined may have an effect in changing practice. Information feedback is probably the least successful unless it is combined with intensive and persistent educational programmes or some form of incentive or sanction. Concurrent review may be extremely successful but only if the method is acceptable, automatic and easily enforced. Also staff in the diagnostic department may have to spend some time in reviewing and discussing requests with clinicans. Redesigning request forms to remind clinicians of the indications for applying tests combined with appropriate education would appear to have the potential to sustain consistent change in practice (at least

for several months) with minimal effort on the part of radiologists and other professionals within a hospital. There is however the possibility that forms may not be completed correctly and lose their value as a reminder. (Note for example the lack of information currently provided by clinicians on the "clinical details" sections of current request forms). A Utilization Review Committee would appear to offer the greatest opportunity for changing practice particularly as the committee can respond to changing patterns of use and institute a variety of interventions. However, the Utilization Review Committee per se is not the agent of change but is the authoritative body implementing interventions within the hospital. These interventions might comprise one or more of those evaluated in this study.

One of the greatest difficulties in implementing a change in clinical practice, is to sustain the change. Ideally this study might have continued for considerably longer than one year. No matter what strategy is used, sustaining change requires the long term interest and commitment of individuals within a hospital. Such individuals might comprise the members of a Utilization Review Committee or a consultant radiologist providing feedback on use to clinicians or providing concurrent review in the radiology department. This on-going interest and commitment is unlikely to be sustained unless information on utilization is provided either continuously or intermittently so that the success or otherwise of the strategies are known. Monitoring of utilization is thus a necessary complement to any of the strategies examined in this study.

Choice of a strategy for change need not be limited to one

intervention. Indeed, a combination of interventions is likely to be more successful (Eisenberg and Williams, 1981). Griner et al (1979) sustained a reduction in the use of chest X-rays and other tests in a hospital over a seven year period. Several interventions were used including (a) administrative changes (for example, the elimination of an automatic chest X-ray on admission), (b) weekly seminars for residents on the use of tests, (c) weekly distribution to residents of the itemised account sent to one of their patients, (d) education of new house officers on "good" laboratory practices, (e) participation of medical staff in research projects on the optimum use of the laboratory and finally (f) critical review of laboratory tests by consultants during ward rounds. These multiple interventions were successful but they did require a substantial commitment in time and energy to promote a more discriminating use of tests. Such enthusiasm might not be encountered in many hospitals.

CHAPTER 5

CONTAINING THE USE OF DIAGNOSTIC SERVICES IN THE NHS

The effect of the strategies employed in this study in implementing change in the use of pre-operative chest X-rays, when considered in conjunction with the results of other trials of these strategies, permits some judgements to be made on what strategies might be implemented in the NHS to change the use of radiology and other diagnostic services. But before making recommendations on this mattter, other issues of medical care in the NHS need to be discussed. What are the causes of the high use of diagnostic tests? What is the place of regulatory control, financial incentives and clinical budgeting? How should monitoring be a component part of a strategy for change? How useful are clinical guidelines? What are current medical attitudes and how might they be changed to encourge more discriminating use of diagnostic tests?

Causes of high levels of use

In recent years the results of several surveys of the use of diagnostic tests in hospitals in the NHS suggest that unnecessary investigation is commonplace (Hampton et al, 1975; Sandler, 1979; Stilwell et al, 1980; Roberts, 1984; Sandler 1984). There are several reasons why clinicians tend to over-investigate. In the case of preoperative chest X-rays and many other tests, house officers usually take decisions to order the tests. Often tests are ordered as a matter of habit (Cummins, 1980; Eisenberg & Williams 1981) and the house officer is frequently ignorant about the value of tests

requested (Wong, 1983). These habits tend to be passed from one generation of doctors to another, comprising "occupational rituals in patient management" (Bosk,1980).

It is also customary for many diagnostic tests, such as the pre-operative chest X-ray, to be used for routine screening purposes rather than to elicit the cause of symptoms and signs (Editorial, Lancet, 1984). The prevailing attitude is that patients should be investigated widely "just in case" a diagnosis is missed, many house officers feeling the need "to be complete" in their assessment of patients (Hardison, 1979). The fear of uncertainty that an apparently healthy patient proceeding to surgery may have a respiratory condition leads the clinician to carry out a pre-operative chest X-ray. The over-riding reason for this action is reassurance of the clinician while the perceived benefit to the patient becomes a secondary consideration.

In the United States and to a lesser extent in the United Kingdom, the fear that omission of a test might lead to a legal suit on the grounds of medical negligence also contributes to the unnecessary use of tests (Hardison, 1979; Cummins, 1980; Eisenberg and Williams, 1981; Wong, 1983). This is particularly true for the use of skull X-rays in patients with head injuries (Cummins, 1980) but may also be a factor influencing the use of other radiological procedures including preoperative chest X-rays.

House officers often believe that consultants wish them to perform

certain tests although the consultants' "wishes" may never have been stated overtly (Hardison, 1979). Informal discussion with houseofficers participating in this study revealed that some attributed their high use of preoperative chest X-rays to the wishes of consultant anaesthetists and surgeons. Not only is there perceived pressure from consultants, but also that "we will get in trouble if we don't" (Hardison, 1979). Indeed, consultants do tend to criticise junior staff for failing to obtain particular tests (Eisenberg and Williams 1981; Wong, 1983). These attitudes may well explain the greater use of diagnostic tests by younger and less experienced clinicians than those who are older and in more senior positions (Childs and Hunter, 1972; Freeborn et al, 1972; Greenland et al, 1979). The situtation persists because consultants do not tend to rebuke their junior staff for performing unnecessary investigations and there is no incentive for the consultant to do so.

Consultants may perceive that limiting the use of diagnostic tests is not a clinical responsibility (patients under their care will not benefit) but is a managerial responsibility of more relevance to administrators than doctors (Fowkes and Roberts, 1984). The evidence from this study would support this hypothesis in that consultants approved of the preoperative guidelines but probably did not take steps to advise their junior staff to change their practice. Distribution of letters and guidelines to consultants at the beginning of the intervention period had only a slight effect on utilization. The consultants may have been reluctant to impose on their junior staff a code of practice, which they felt was not entirely "clinical".

Controlling clinical expenditure

The organisational structure and management arrangements within the NHS are currently inadequate to overcome those factors tending to maintain a high use of tests. There is no effective procedure controlling clinical expenditure at its point of commitment. Cogwheel divisions and district management teams enable clinicians to contribute to major planning and policy decisions but these committees have almost no influence on the consumption of resources at the clinical level (Kinston, 1982). This study has shown that simply requesting doctors to exercise clinical restraint in the use of a procedure in the name of economic efficiency and social responsibility is unlikely to be very effective. However, appropriate use may be achieved by clinicians themselves working within an organisational framework that permits freedom of activity within certain well defined and regulated limits (Kinston, 1982).

(1) External and internal regulation

Attempts at external regulation (such as the imposition of rules on the use of tests by the DHSS or district health authorities) would probably be unsuccessful. Not only would the rules be difficult to formulate because of our lack of knowledge of appropriate use, but would be extremely difficult to implement because of resistance by many clinicians to external regulation. Kassirer and Paulker (1978) have argued strongly against the imposition of such regulation in the United States, particularly as the potential costs of regulation would be substantial. Furthermore, rigid regulations determining when

diagnostic testing would be permitted could result in sub-optimal care for patients who did not fit into certain diagnostic categories.

Internal regulation, using techniques such as those explored in this study, may not be entirely successful because they require self restraint and a continuing voluntary commitment to controlling the use of tests. The ideal approach might be some form of internal regulation combined with incentives or restrictions agreed in advance by doctors and their employing authorities. Such incentives or restrictions could still allow considerable flexibility in the use of tests. Indeed, over ten years ago, Ashley et al (1972) put forward the idea of a "wide tolerance tariff system" in which the use of each diagnostic test would be permitted up to certain levels of utilization. As Kinston (1982) states, "rationing may be arranged so as to maximise and sharpen the use of clinical judgement. For example, working ---------- within a certain amount of radiography use, leaves much room for discretion for each patient".

Few attempts have been made to restrict the use of diagnostic tests by placing an upper limit on utilization. In a trial in a Veteran's Hospital in the United States (Dixon and Laslo, 1974), house officers were permitted to request only an average of eight clinical chemistry and haematological tests per patient per day (which was less than the current level of use in the hospital). The upper limit could however be exceeded in an emergency. The authors did not state how the limits were imposed but the restrictions did cause a reduction in the use of laboratory tests by 25%. Repeat tests were virtually eliminated. The percentage of tests considered by the authors to have some influence

on patient management increased substantially, which suggested that the reduction in testing was accompanied by a more discriminating approach to utilization. It should be noted that such limitations on the use of diagnostic tests required an adequate system of monitoring and control in the diagnostic departments and was dependent upon good relationships between clinical and laboratory staff.

(2) Financial incentives

Health care systems structured on a fee for service basis provide incentives for clinicians to administer more services (Schroeder and Showstack, 1978): the higher the use of diagnostic tests, the greater the profit. Moloney and Rogers (1979) have suggested that, in the United States, methods of reimbursing doctors for services rendered should be changed so as to neutralise the financial incentives to use diagnostic tests. Rates of payment for tests, for example, might be more closely related to the investment of time required to perform the tests. This strategy would not be possible in the NHS where medical staff are paid salaries which are mostly independent of the level of services provided. A financial reward to reduce use of diagnostic tests would have to take the form of an additional payment made to the clinician. A system of personal financial rewards would however not necessarily have the desired effect on utilization.

In a controlled trial of strategies to reduce the use of diagnostic tests in a hospital in Boston (Martin et al, 1980), one group of house officers were offered a financial reward, the amount being dependent on the extent of reduction in use of diagnostic tests. The financial

incentive group did not perform fewer tests (including X-rays) than a control group of house officers. This was not surprising since the maximum financial reward was only $375 and was in the form of gift certificates to be used for the purchase of medical books or journals. The authors reported that the personal financial reward caused some conflict within individuals; because of this and the poor results obtained, they considered such a system of financial rewards to be an inappropriate strategy for reducing the use of diagnostic tests. They did acknowledge, however, that a financial incentive might work under other circumstances. It is unlikely that such a system of financial reward would be acceptable in the NHS. The medical profession and the public might think that such a system would lead to the witholding of necessary investigations.

(3) Clinical budgeting

A more acceptable form of incentive to encourage clinicians to reduce their use of unnecessary investigations is clinical budgeting. This involves senior staff in clinical, diagnostic and other departments working out in some detail the clinical services to be provided in the immediate future and the expenditures required to finance these services. Each head of department is then provided with an appropriate budget and if the agreed service is provided within budget, the department is entitled to some benefit, such as the purchase of new medical equipment (out of all or part of the savings) (Wickings et al, 1983). There is thus an incentive for the clinicians to achieve a more efficient use of resources.

Several experiments in clinical budgeting have been conducted in

recent years. One of the first was at the Westmimster Hospital where seven wards were allocated budgets and seven wards acted as controls. The wards with budgets all achieved savings allowing them to finance improvements in their services. Some savings were achieved by a reduction in the use of diagnostic services. For example, bacteriology costs were reduced by up to 55%, mobile X-ray equipment was used less often, chest X-ray utilization fell by 72% in the intensive care unit and by 57% in the coronary care unit, and the cost of immunological investigations was reduced by 67% (Wickings, 1977). Furthermore, the participating clinicians appeared to like the system: the opportunity to spend money saved in one sphere on requirements in another was attractive, and the cooperation and friendliness between members of staff were enhanced (Gibberd, 1982). In a geriatric unit in Cumbria, Chinn et al (1981) also found that clinical budgeting was a considerable boost to the morale of staff.

Some clinicians have however expressed reservations about clinical budgeting. Bartlett et al (1981) calculated that approximately 80% of costs were fixed in a typical neurosurgical unit; this suggested that the opportunities for reducing costs by means of clinical budgeting were minimal. Concern has been expressed that when savings are made, efficient departments may have greater reductions in their budget in the future than less efficient ones (Gibberd 1982). Another criticism of clinical budgeting is that participation requires a considerable commitment of time by consultants. However, in most studies, the time required has been shown to be minimal, accounting for about one hour per month of consultant time (Wickings et al, 1983).

does not define the circumstances under which an X-ray ought to be taken or need not be taken (Bovell, 1976) "Negligence is a failure to do what a reasonable man would have done in the circumstances" (Kloss, 1984). Thus a clinician who does not carry out a test while adhering to guidelines drawn up by an eminent group of medical specialists is unlikely to be deemed liable for any untoward consequences to a patient. In most cases of medical litigation both the employing health authority and the doctor are liable and generally come to an agreement about sharing damages. Clinical guidelines not only assist in protecting the individual doctor but also the employing authority. Health authorities may thus be more willing to encourage a discriminating use of diagnostic tests if clinical guidelines are available.

Although Pilling (1976), in reviewing cases of medical negligence over a 20 year period, did not find one case due to failure to perform an X-ray, patients are now more ready to demand inquiry into clinical judgement or demand litigation; this will undoubtedly encourage more defensive medicine on the part of doctors and lead to an ever increasing use of diagnostic tests (Editorial, Lancet, 1982). Guidelines will have an important part to play in counteracting any such increase in defensive medicine.

Medical Attitudes

Implementation of guidelines on the use of diagnostic tests could be facilitated by an increase in the social and economic awareness of clinicians. Traditionally the attitude of doctors is that the best

should be done for individual patients no matter what the monetary cost. The idea that the consumption of resources by one patient may deprive another patient of benefit is a relatively new concept for many doctors. However, the emphasis of the present UK government on cost efficiency, the publicity given to financial limits imposed upon the NHS, and the impact of financial cutbacks and redistribution of resources within the NHS have brought to the attention of the medical profession (and the public) that there is a limit in the finance available for the provision of medical care.

Any attempt to change the use of resources at the clinical level is perceived by many doctors as a threat to their clinical freedom, that is, to their right to do whatever in their opinion is best for their patients. But as Hampton (1983) points out, clinical freedom "at best.....was a cloak for ignorance and at worst an excuse for quackery" and he suggests that the demise of clinical freedom is upon us "crushed between the rising cost of new forms of investigation and treatment and the financial limits inevitable in an economy that cannot expand indefinitely". This notion of clinical freedom is deeply ingrained within the profession but if resources are to be used more effectively, efficiently and equitably, the medical profession must accept that complete clinical freedom is not compatible with this aim. Doctors require to perceive their clinical actions not only in terms of the benefits to the individual patient but to the population as a whole.

Another change of attitudes that may encourage more cost effective use of diagnostic tests is that more reliance is placed on the history and

In the NHS currently, the DHSS is funding several experiments in clinical budgeting; the results of these will more clearly delineate the advantages and disadvantages of such a system. However, the evidence to date would suggest that clinical budgeting as a means of providing an incentive for clinicians to be more discriminatory in their use of diagnostic tests (and other resources) is worthy of further development.

(4) Need for monitoring

Whatever strategies are employed to reduce the unnecessary use of diagnostic tests, a reliable information system is required to monitor utilization. Creating a more rational use of resources is a long term commitment and those involved need to know the success of their interventions and where to redeploy their efforts.

The complex data collection process which was necessary in this study to assemble useful information from several hospitals demonstrates the considerable variability in methods of routine data collection and storage in the NHS. Collecting information on the use of a single test (such as a pre-operative chest X-ray) may be an extremely cumbersome process. The Körner Committee (Steering Group on Health Services information, 1981) has made many recommendations for future information requirements in the NHS. The Committee recommended that radiology departments should collect information on (i) numbers of requests for examinations according to six defined groups and (ii) the source of the request (i.e. the consultant team). More detailed information on individual investigations was not considered necessary

except in a small sample of departments who currently have computerised information systems.

Monitoring numbers of examinations according to only six defined groups is unlikely to be helpful to clinicians or utilization review committees monitoring the implementation of guidelines for specific investigations. On the other hand, the level of precision obtained in this study may not be required for routine monitoring. For example, simply monitoring numbers of chest X-rays requested by surgical firms may be an adequate measure of preoperative chest X-ray use because in most surgical firms over 90% of chest X-rays requested are pre-operative (Unpublished data from National Study by the Royal College of Radiologists, W P Ennis, 1979). This information could be collected quite easily because X-ray registers in most departments list individual procedures and source of requests. Monitoring would simply require regular aggregation of the data from registers. Such data is routinely entered into a computer in some hospitals (Hartley, 1982); this process is likely to be commonplace within the next few years. Expenditure on improving current recording systems would be worthwhile because, when combined with appropriate strategies to reduce the unnecessary use of tests, considerable overall financial savings might accrue.

(5) Role of clinical guidelines

Guidelines for the use of diagnostic tests have the potential, if correctly applied, to contribute to more effective utilization. Such guidelines may have to be based on incomplete evidence because for

many diagnostic tests, particularly common tests such as full blood counts and multi-channel investigations in clinical chemistry, there have been very few studies examining their benefit to patients. However, for most tests, adequate evidence exists to allow clinicians to draw up reasonable guidelines for utilization. As has been demonstrated in Chapter 2 (Literature Review), the evidence would suggest that pre-operative chest X-rays should not be used as routine procedures but there is no evidence indicating which patients would benefit by having pre-operative chest X-rays. Despite this incomplete evidence, few would disagree with the clinical guidelines drawn up by the Royal College of Radiologists Working Party which include a sensible list of clinical situations in which pre-operative chest radiology should be considered. Indeed, the guidleines developed by the Working Party may be somewhat liberal in that in some hospitals in this study a lower level of utilization was achieved than the level in which patients were shown, at least from the medical records, to have clinical indications (15 pre-operative chest X-rays per 100 elective operations).

The format of the guidelines may indeed depend upon the precision of the evidence on which they are based. The Royal College of Radiologists guidelines on preoperative chest X-rays (Appendix I) and skull X-rays (K T Evans et al, 1983) are lists of clinical indications, but guidelines can also be constructed in a more detailed and precise format , for example, as algorithms (branching flow charts) (Editorial, Lancet, 1982). Algorithms in complex clinical situations may be almost unworkable but they have been used successfully where a limited number of clinical decisions have to be

made (Grimm et al, 1975, Wirtschafter, 1978).

Guidelines in the form of a simple list of clinical indications for performing a diagnostic test do appear to be successful in creating a change in practice. For example, the Royal College of Radiologists guidelines on the use of skull X-rays in patients with head injuries led to a 50% reduction in use in one accident and emergency department (Fowkes et al, 1984). Similar guidelines used in other departments have also had a substantial effect on the use of skull X-rays (Phillips, 1979, Cummins et al, 1980; Corden, 1981). A protocol for selecting these patients with injured extremities requiring X-rays created a 5% and 17% reduction in the use of upper and lower extremity X-rays respectively (Brand et al, 1982). Finally, in a primary health care clinic in Seattle, guidelines were formulated for the use of chest X-rays in patients having routine health examinations. The guidelines simply indicated that an X-ray should be considered only in high risk groups, namely heavy smokers, patients aged 55 years or more, and certain occupational groups. Implementation of the guidelines resulted in a reduction in the use of chest X-rays by two thirds (Thompson et al, 1983). In many of these studies, the precise format of the guidelines may not be the main stimulus to change, but the more presence of the guidelines provoke more critical appraisal before requesting a test.

In addition to guidelines giving clinical advice on the use of diagnostic procedures they also assist in protecting the legal liability of clinicians. In the case of diagnostic radiology, the law

physical examination than tests as the means of making a diagnosis. During the last 30 years, medicine has advanced primarily as a scientific discipline with the increasing development of sophisticated diagnostic technology; this has led to diagnostic tests being considered as the most reliable and proper way to make diagnoses. Only rarely in hospital practice is a diagnosis made on the basis of a history and physical examination alone. This attitude prevails despite several studies showing that commonly used diagnostic tests do not often contribute to decisions on diagnosis (Hampton et al, 1975; Sandler, 1979). Hampton et al (1975) evaluated the relative importance of the medical history, the physical examination and laboratory investigations in the diagnosis and management of 80 new medical outpatients. Laboratory investigations were considered useful in only seven patients. In a similar study of 630 medical outpatients, Sandler (1979) found that routine haematological and urine tests contribute to less than 1% of diagnoses. Seventy three percent of diagnoses were made on the basis of the history and physical examination and only 23% on the basis of diagnostic tests.

Education at both the undergraduate and postgraduate level has an important part to play in changing attitudes towards a more discriminating use of diagnostic tests. In the United Kingdom very few, if any, medical schools run specific courses on cost effective clinical decision making. In the United States on the other hand, around one third of medical schools reported in 1978/79 that they had special programmes in which health care cost containment was taught to undergraduates and/or junior doctors (Hudson and Braslow, 1979; Russe

et al, 1981).

Medical schools with cost containment programmes have instituted a variety of educational techniques such as self-instructional packages on cost effective use of the laboratory and X-ray departments (Clarke, 1981), and student peer reviews of the use of laboratory tests (Garg et al, 1979; Zeleznik and Gonnella, 1979). One course on the cost effective use of diagnostic tests employed several education techniques including seminars, simulated patient care exercises, special case presentations, newsletters and retrospective reviews of the use of diagnostic tests (Williams et al, 1984). Surprisingly, this comprehensive course had no significant effect on students knowledge, attitudes or simulated test ordering behaviour, although most students stated that they thought the programme was useful. Despite the absence of convincing evidence about short term effectiveness, the authors did not discontinue the course because they thought that a cumulative exposure to similar ideas throughout training might have an important effect on the long term attitudes and practices of the students.

Other academics in medical schools have suggested that education in cost containment should be integrated throughout the medical curriculum with emphasis on creating appropriate attitudes rather than knowledge of costs and effectiveness (Lawrence, 1979; Praiss and Gjerde, 1980). Students' attitudes are influenced to a great extent by their observations of the work and attitudes of senior clinicians and academics; it is therefore important that cost effective care is an important goal of the medical school and it's teachers (Williams et

5. Information feedback to consultants resulted in a consistent and gradual reduction in use of pre-operative chest X-rays throughout the year. Other studies have had variable success with feedback. Simply providing information on utilization is usually of limited value. Success is more likely if feedback is accompanied by a comment on performance, an educational intervention, or an incentive. Feedback during tutorials or medical record reviews may be more successful than providing statistical returns. In this study, feedback was accompanied by the pre-operative chest X-ray guidelines and a target level of use.

6. The new chest X-ray request form achieved a moderate reduction in use which was not sustained following a change of house staff. The results of other studies suggest that the request form is an appropriate vehicle for reminding clinicians about the use of tests, but that the effect may not persist if the reminder is withdrawn or is not accompanied by appropriate education.

7. Concurrent review of requests by radiology staff achieved a reduction in use; this was enhanced by feedback of data on use to the radiology department. Other studies have shown concurrent review to be successful in changing practice. But the process may be time consuming for staff in the diagnostic department and thus difficult to sustain over long periods of time.

8. Some strategies such as external regulation of the use of diagnostic tests and personal financial rewards have been shown in other studies to be of limited value. It is doubtful if such strategies would be feasible or acceptable in the NHS.

9. Clinical budgeting has been shown in other studies to have an effect on the use of diagnostic tests. Giving clinicians more responsibility for the use of resources is likely to lead to long term improvements in efficiency. The results of further trials of clinical budgeting are awaited.

10. The data collection system employed in this study was too cumbersome and time consuming to be used for the routine monitoring of pre-operative chest X-rays.

11. Sustaining a reduction in utilization in the long term is difficult and may require a variety of interventions and a continuous incentive such as that offered by clinical budgeting.

12. The use of diagnostic tests, including pre-operative chest X-rays, is affected by clinical habit and medical attitudes to diagnostic testing. A more discriminating attitude to the use of tests is required among the medical profession.

Recommendations

The aim of this study was "to determine the effect of alternative

achieved by incorporating some of the strategies examined in this study within the framework of budgeting.

7. Cost effective decision making should be given more emphasis in medical undergraduate curriculums so as to encourage a generation of clinicians with a more discriminating approach to the use of diagnostic tests including pre-operative chest X-rays.

APPENDIX I

Guideline for pre-operative chest X-ray use among patients admitted for elective non-cardiopulmonary surgery

"Routine" pre-operative chest X-ray is no longer justified. However pre-operative chest radiography may be clinically desirable in certain patients in the following categories:

(i) those with acute respiratory symptoms

(ii) those with possible metastases

(iii) those with suspected or established cardio-respiratory disease who have not had a chest radiograph in the previous 12 months

(iv) recent immigrants from countries where TB is still endemic who have not had a chest radiograph within the previous 12 months

It should be noted that none of the above categories of request is routine and the reasons for examination should, therefore, always be given in the usual way.

Royal College of Radiologists Working Party on the Effective Use of Diagnostic Radiology

APPENDIX IIa

Utilisation Review Committee Meeting 7th November 1983

Hospital :

PERCENTAGE OF ELECTIVE SURGICAL PATIENTS

HAVING PRE-OPERATIVE CHEST X-RAYS

Consultant	Baseline Jan-Feb 83 May 82 (%)	Aug-Sept 83 (%)	Change
A	0	18	+
B	36	22	-
C	52	22	-
D	24	11	-
E	11	27	+
F	10	29	+
G	44	24	-
H	24	36	+
I	70	34	-
J	34	7	-
K	53	29	-
L	38	14	-
M	27	8	-
N	30	22	-
O	38	26	-
All Consultants	30	21	-

APPENDIX IIb

1st November 1983

Dear Mr

Use of Pre-Operative Chest X-rays

Further to my letter of 29th April, 1983 I have some information on the use of pre-operative chest X-rays in Hospital. The following table shows the proportion of elective surgical patients under your care in May-August 1983 who had pre-operative chest X-rays.

	% elective surgical patients having pre-operative chest X-rays
Patients under your care	%
Consultant with lowest pre-op chest X-ray rate	1%
Consultant with highest pre-op chest X-ray rate	73%
Average for all consultants	25%

The results of recent research suggest that if the enclosed guidelines were adhered to, the proportion of elective patients having pre-operative chest X-rays would be about 3%.

I should be grateful if you would bring this information to the attention of your staff and encourage them where possible to adhere to the guidelines.

Yours sincerely,

Consultant Radiologist
Local Co-ordinator of Pre-op CXR Survey

al, 1984). Given the growing interest in cost containment in medical care in the United Kingdom, it would not be surprising if some medical schools take more active steps to create clinicians who are more discriminating in their use of diagnostic tests and who are aware of costs and effectiveness.

If a shift in attitudes and practice towards more cost effective use of diagnostic services is to be sustained in the long term, clinicians require to participate in the process of creating change. Management theory suggests that, among professionals who have uncertain tasks requiring extensive problem soving, participation in making policy decisions is the most effective way of changing behaviour (Weisbord & Stoelwinder, 1979). Clinicians require to be involved in the process of change at an early stage including the identification of problems for review, development of guidelines, and planning the strategies of implementation (Eisenberg and Williams, 1981). Developments in medical education to create doctors who are more socially and economically aware may lead to a greater willingness, to participate in schemes to improve the use of diagnostic services.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following conclusions are based mainly on the findings of this study considered within the context of other work in this field.

1. The pre-operative chest X-ray guidelines were readily accepted by the divisions and medical executive committees in the hospitals.

2. The strategies were successfully introduced and sustained throughout the intervention year. None had to be withdrawn because of a lack of co-operation by NHS staff.

3. Each strategy had an effect on the use of pre-operative chest X-rays in the respective hospitals. This effect was, with few exceptions, consistent within each hospital for both specialties and consultants.

4. The Utilization Review Committee achieved the lowest level of use as a result of displaying the pre-operative chest X-ray guidelines in surgical wards. Other studies have found utilization review committees to be successful in reducing the use of diagnostic tests. Much of this success may be attributed to the standing of the committee in the hospital and the scope and flexibility of interventions implemented.

strategies for implementing guidelines on pre-operative chest radiology in order to make recommendations on how the guidelines might be implemented nationally in NHS hospitals".

Given this aim, the following recommendations are made:

1. The guidelines should be distributed widely throughout the NHS. They should at least be circulated to radiologists accompanied by a summary of evidence showing the limited value of pre-operative chest X-rays. Radiologists should also be made aware of the results of this study, in particular that the pre-operative chest X-ray guidelines are acceptable to many clinicians and that utilization can be reduced.

2. Senior radiologists should be encouraged to obtain formal approval of the guidelines by cogwheel divisions and medical executive committees.

3. Given the success of utilization review committees in this and other studies, radiologists, clinicians and unit managers might be advised to establish such a committee in their own hospital. The committee should comprise a nominated representative from each of the divisions of surgery, obstetrics and gynaecology, anaesthesia, and radiology.

4. Radiologists should monitor the use of chest X-rays requested by

surgical firms. In most departments, data may be obtained easily from the radiology register. Number of chest X-rays requested by a surgical firm is a suitable measure of pre-operative chest X-ray utilization given the difficulties in obtaining more accurate data. Statistics may be presented two or three times a year to the Utilization Review Committee.

5. The Utilization Review Committee might introduce appropriate interventions to change the use of chest X-rays. A combination of one or more of the following interventions might be worthwhile:-

   (1) notices displaying guidelines in surgical wards.

   (2) feedback on use to firms including copy of guideline and target level of utilization.

   (3) concurrent review, especially if a system can be devised in the radiology department to sustain such a review.

   (4) education of new house officers (given that utilization tends to increase with a change over of staff).

[A new chest X-ray request form is not recommended because (i) only a moderate reduction was achieved in this study, (ii) sustaining change is difficult, and (iii) the introduction on a permanent basis of a new form for only one test might not be acceptable in many hospitals.]

6. If clinical budgeting is implemented in the NHS, long term change in the use of radiolgical investigations may be best

IMPORTANT NOTICE

ROUTINE PRE-OPERATIVE CHEST X-RAYS ARE *NOT* JUSTIFIED

Consider only if:-

1. acute respiratory symptoms
2. possible metastases
3. chronic cardio-respiratory disease and no chest x-ray in last year.
4. immigrant from TB endemic country and no chest x-ray in last year.

Chairman, Radiology Review Committee.
November, 1983

REQUEST FOR CHEST X-RAY (To be completed by the Clinician)

Attach stickly label in this space. If not available, enter required information

SURNAME ..... SEX .....

FORENAMES ..... WARD LEVEL .....

ADDRESS .....

..... Hospital No. .....

DATE OF REQUEST ☐☐ ☐☐ ☐☐

AGE (years) ☐☐

CONSULTANT (.....) ☐☐

IS THIS A PRE-OPERATIVE CHEST X-RAY Yes ☐ No ☐

IF PRE-OPERATIVE CHEST X-RAY, DOES PATIENT HAVE:

Chronic cardio-respiratory disease and NO CXR within last year — Yes ☐ No ☐

Recent immigrant from TB endemic country and NO CXR within last year — Yes ☐ No ☐

Possible pulmonary metastases — Yes ☐ No ☐

Acute respiratory symptoms — Yes ☐ No ☐

Other (State .....)

APPENDIX IV

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