An economic view of high compliance as a screening objective

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Accepted wisdom holds that high compliance is essential for a screening programme to be successful. Indeed, a reason that the national breast screening programme is not routinely offered to women aged 65 or more is on the grounds of predicted poor compliance by older women. Increasing compliance is often associated with increased costs. These costs represent a lost opportunity for screening alternative target populations. We question the need for screening programmes to achieve high compliance, and we argue that a screening programme can be efficient with very low levels of compliance. Adopting compliance as a screening objective and as a measure of the success of screening may be detrimental to the efficiency of a screening programme.

The level of compliance in a screening programme is often seen as one measure of its success.[1] Compliance can be defined as the proportion of a target population that actually has the screening test, and compliance rates feature strongly in policy recommendations regarding screening. The new general practitioner contract has targets of 50% and 80% compliance for cervical screening, and, for people aged over 75, 100% compliance for annual health checks is expected.[2] Forrest recommended that routine breast screening should not be extended to women aged over 65 because of expected poor compliance in this age group.[3] This emphasis on the importance of compliance as a measure of success in breast screening was repeated in a recent report on the NHS breast screening programme.[4]

The aim of this paper is to assess whether compliance is a good measure of success in screening. This is important because compliance in itself is not, of course, the real objective of screening. Compliance is merely a proxy objective that may be more easily measurable than the real screening objective. In order to assess whether compliance is a good proxy for the real screening objectives, however, we need to ask what the true objectives are and whether achieving high compliance helps to meet these objectives.

Screening objectives

A screening programme's objective might be a reduction in the morbidity and mortality associated with the target disease. As resources are always limited this objective needs to be couched in terms of resource availability. Thus a screening objective of a maximum reduction in morbidity and mortality within available resources is more realistic. This is an efficiency goal.

Compliance and efficiency

The efficiency of an intervention such as screening may be measured in terms of cost per unit of health gain relative to other uses of resources. The efficiency of increasing compliance is thus determined by its expected health gains relative to health gains from other uses of the resources used to increase compliance. It is therefore important to know both the costs and health gains of increasing compliance, and we need to ask questions such as what is the cost and what are the expected health benefits of increasing compliance from 60% to 70%, and do the benefits outweigh the costs?

Screening programmes tend to be biased towards the non-manual classes in the sense that such programmes are used more by these social groups.[5] Thus, increasing compliance may be expected to attract more people from the manual groups. Some diseases are associated with social class: the incidence of breast cancer is higher in non-maual groups[6] whereas the incidence of cervical cancer is higher in manual groups.[7] Increasing compliance for breast cancer might therefore be associated with a declining rate of case detection and hence a declining rate of health gain. Such gains may not be worth the cost incurred. For cervical cancer, however, increasing compliance might be associated with an increasing rate of case detection with consequent increases in the rate of health gain. Hence, the decision whether to spend extra resources to increase compliance must be made in the context of targeted disease if efficiency is to be considered.

Compliance and screening for breast cancer

Efficiency rather than compliance ought to be the goal of a screening programme. It has to be realised that increasing compliance may result in foregone benefits that are greater than those achieved by the increased compliance. We show how using resources to increase compliance may result in less health benefit compared with an alternative use of the resources in the context of screening for breast cancer.

METHODS OF RECRUITMENT

The Department of Health recommends that recruitment for breast screening should be by fixed appointment rather than open invitation.[8] With a fixed appointment the letter of invitation includes a set date and time for the screening test to take place. The open invitation places the onus on the recipient to contact the screening programme to arrange their appointment. The recommendation to use the fixed appointment for breast screening is based on the appointment method having achieved a 10% higher level of compliance than the open invitation method in a randomised trial of the two appointment methods.[9] However, this study ignored the costs of achieving the higher compliance. It is possible, using data from the original paper, to calculate the opportunity cost—that is, the benefit foregone—of increasing compliance by 10%. This supports the argument that, in some cases, it may not be worth attempting to increase compliance.

COST OF HIGHER COMPLIANCE

Although the study of recruitment methods for breast screening did not present any financial cost data, the authors did reveal the numbers of screening

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appointment slots that were wasted due to non-attendance.[9] As the proportion of costs which varies with screening activity is small,[10] slot wastage is a good representation of the costs of screening. Slot wastage can then be translated into opportunity cost in the form of screening opportunities foregone.

The table shows the cost of each recruitment method. The average cost (calculated by dividing the number of wasted slots by the number of women screened) is 0·28 and 0·026 wasted slots per woman screened for the fixed and open invitation methods respectively.

Costs of screening for breast cancer associated with different methods of recruitment

	Method of recruitment	
	Fixed appointment	Open invitation
No of women invited for screening	188	204
No of women screened	162 (86%)	154 (76%)
No of lost screening opportunities	45*	4†
Average cost (slots wasted per woman screened)	0·28 (45/162)	0·026 (4/154)

*More than 26 (188-162) slots were wasted as non-attenders were sent successive reminders in the form of fixed appointments, which progressively wasted more and more screening slots.
†Presumably slot wastage was kept to a minimum by increasing the size of the invited target population.

However, the important cost to quantify is the opportunity cost of increasing compliance from, in this instance, 76% to 86%. If the target population of the fixed appointment method is assumed to be 188 women then, had the open invitation method been used, 76% (143) of these women would have been screened at a cost of 3·7 slots anyway (143×0·026). With the fixed appointment method, the total cost of screening 162 women was 45 wasted slots. This means that 41·3 (45−3·7) slots were used to screen an extra 19 (162−143) women. If, however, these 41·3 slots could have been used to screen an alternative group of women by means of the open invitation method about 40 extra women would have been screened (41·3−(41·3×0·026)). Therefore, the opportunity cost of increasing compliance by 19 women using the fixed appointment method is the benefit foregone by the 40 women who lose the opportunity of a screening test had the open invitation method been used. The question which now arises is whether the health benefits that accrue to these 19 women outweigh the possible health benefits gained by the 40 women from an alternative target population.

COMPARISON OF BENEFITS

Whether the benefits of increased compliance are greater than its costs depends partly on the characteristics of those whose compliance is enhanced relative to women whose screening opportunity is foregone. It might be that women who need successive reminders to attend screening have characteristics that place them at increased risk of the target disease. Thus, while costs rise so might the rate of case detection.

If the objective of a screening programme is to maximise the numbers of cases detected how may the current allocation of screening resources be best used? If an alternative target population exists then resources presently used to raise compliance from 76% to 86% might detect more cases if the target population is redefined. In the case of screening for breast cancer, the target population could be redefined by reducing the interval between screenings or by extending screening to older women. In this case study the opportunity cost is 2·1 (40/19), which means that 2·1 women from an alternative target population lost the opportunity of a screening test for every extra woman screened by increasing compliance. It follows that, for increased compliance to fulfil the objective of maximising cases detected, the rate of case detection in this marginal compliant population must be at least 2·1 times greater than that in any alternative target population. Thus, committing resources to increasing compliance may not be the most cost effective method of achieving an overall reduction in mortality and morbidity in the general population.

Discussion

It has been argued that low compliance in breast screening will render the screening programme ineffective.[1] It is unclear from the literature at what level of compliance a screening programme should be judged successful. Is 70% sufficient or 80%? If it is 70%, what happens if a screening programme achieved a compliance level of only 69%? If 90% compliance produces a 30% fall in breast cancer,[11] should a screening programme be judged a failure because it only has 45% compliance and so produces only a 15% fall in breast cancer but at half the cost? If a screening programme is judged purely in efficiency terms—that is, cost per unit of health benefit generated—then a screening programme can be judged efficient whatever the compliance rate.

Compliance is only a proxy objective for screening. The real objective of screening might be lives saved or morbidity reduced or avoided. Setting screening objectives in term of compliance is simpler and clearer than setting more complicated objectives such as maximising life years saved, but it can lead to very different policy recommendations.[12] Indeed, it could be argued that setting objectives in terms of compliance has led to breast screening not being offered to women aged 65 or more.

Compared with the cost of screening women aged 50-64, screening of women aged 65-70 has a lower cost per life year gained and screening of women aged 71-75 has a similar cost.[13] Despite this the screening programme is not extended to these women because it might be difficult to fulfil compliance objectives. It might, however, be more efficient to put screening resources into expanding the target population rather than pursuing increased compliance in younger women.

Increasing compliance may be justified in terms of efficiency if there is good reason to suppose that the marginal benefit of the increased compliance equals or exceeds the cost. This would mean that those resources could not be redirected to another health activity that would generate superior health gain. In addition, aiming for high compliance can be justified when a screening service is in its trial stage. Clearly, in a randomised trial of screening versus no screening a significant difference is more likely to be found if compliance is maximised. When a screening service is implemented on a national basis, however, the value of the intervention should already be proved, and the need for high compliance disappears.

It is important to couch screening objectives in terms as close as possible to the true objectives of screening.[12] High compliance may seem to be an attractive screening objective because it is easily measurable, but as those running screening programmes seek to meet compliance targets they may inadvertently be denying screening resources to other populations at risk. This in turn may lower net health benefit achievable by screening. Compliance as a screening objective needs to be reassessed.

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Hypoxia in childhood pneumonia: better detection and more oxygen needed in developing countries

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Even though hypoxia is a major risk factor for death in children with acute respiratory infection in developing countries, oxygen is not part of first line treatment. Because oxygen is not readily available in developing countries it tends to be given to the most seriously ill children, whose outcome is poor. Oxygen might be useful if given earlier in the course of the disease. Clinical signs are not clear cut, however, though the presence of cyanosis and grunting together with a raised respiratory rate can significantly increase the detection of hypoxaemia. A simple oximeter would make detection easier, and oxygen concentrators are more cost effective than bottled oxygen. Ideally oxygen should be given to children in the early stages of clinical pneumonia to prevent deterioration.

Acute respiratory infection is a major killer of children in developing countries, especially of those aged less than 6 months.[1] Although many cases of acute respiratory infection are initially caused by viruses, children are often secondarily infected with bacteria by the time they present to a health facility. The use of standard protocols for antibiotic use has been a major part of control programmes for acute respiratory infection throughout the world and is advocated by the World Health Organisation.[2] Bacteraemia in acute respiratory infection has shown a significant association with hypoxaemia in terms of recorded cyanosis,[3] but oxygen has not been considered as first line treatment in the same way as antibiotics.

Hypoxaemia has been recognised as a risk factor for death in children presenting with acute respiratory infection,[4] but there have been no controlled trials in the developing world of the therapeutic value of administering oxygen. Paradoxically, those children who receive oxygen have a poorer outcome because they are more seriously ill when oxygen is started (Papua New Guinea Institute of Medical Research, unpublished data). Attempts to quantify the effect of oxygen in acute respiratory infection are likely to be considered unethical so we must develop a coherent strategy for the diagnosis of hypoxaemia and the use of oxygen in childhood pneumonia from clinical and pathological principles.

Mechanisms of hypoxia

The principal mechanism for the hypoxia of acute respiratory infection is a mismatch between ventilation and perfusion. The infectious organism, be it viral or bacterial, causes areas of pneumonic consolidation, which become inappropriately underoxygenated relative to their reactive hyperperfusion.[5] The mismatch is not redressed by vascular redistribution to the unaffected parts of the lung as most pneumonia in children is of a bronchopneumonic distribution rather than showing the lobar pattern seen in adults. Moreover, lung compliance decreases as consolidation develops, leading to increased work required for ventilation. Dehydration from fever, panting, and inability to drink lead to haemoconcentration, peripheral underperfusion, and increasing metabolic acidosis and will cause a further deterioration in the general condition. The acidosis also leads to compensatory hyperventilation, which limits the usefulness of an elevated respiratory rate in assessing the degree of hypoxia despite its usefulness in gauging the degree of systemic disturbance. This has been confirmed in studies from the Gambia.[6] The progressive deterioration raises the question of whether this course can be prevented by the earlier use of oxygen.

Are the indications for using oxygen clear and well understood?

Most health care in developing countries is provided by nurses and paramedical workers. Even in district hospitals the triage of new patients and their initial management is rarely done by doctors. It is therefore essential not only that changes in the use of oxygen are compatible with the resources available but also that the indications for its use are understood by the appropriate staff. The recently updated indications for the use of oxygen in the standard treatment manuals used in Papua New Guinea include cardiac failure, grunting, drowsiness, and apnoeic episodes in addition to cyanosis and restlessness.[7]

What clinical signs should be indications for use of oxygen?

As mentioned earlier, an elevated respiratory rate has limitations as an indication for the use of oxygen so other clinical signs must be used. Cyanosis is another obvious candidate, but, although highly specific, it has an unreasonably low sensitivity (T Dyke *et al*, annual symposium of Papua New Guinea Medical Society, 1991).[4] Cyanosis is a late, probably terminal, sign by which to recognise hypoxia. It is also subtle and may be

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