Colorectal cancer is a common cause of death from malignant disease resulting in over 19,000 annual deaths in Britain and 57,000 in the United States. The overall five-year survival rate is only 30% but for those with limited disease at presentation (Dukes's type A tumours) it is 85%. In the commonest method of screening, that is, faecal occult blood testing, small stool samples are analysed for microscopic traces of blood from asymptomatic cancers and polyps. Three large studies of faecal occult blood testing showed more early tumours (Dukes's A type tumours) and adenomatous polyps in the screened than control group, which lead to a reduction in mortality of 15%, 18%, and 33% in an asymptomatic population.

The World Health Organisation has stated that one of the criteria necessary for a successful screening programme is a high compliance. A major problem in colorectal cancer screening trials is encouraging people to participate. A poor compliance means few people benefit and the economic costs are high. This problem of low compliance was identified in the Nottingham trial where only 60% of the test group participated. Unfortunately, compliance is also a problem in other smaller community trials in British general practice, where fewer than 50% of the population participated.

An alternative approach to delivering screening, which may raise compliance, is to develop workplace based screening programmes. On-site health education at the workplace, the availability of occupational medical and nursing staff, and “word of mouth” publicity generated by discussion between employees should encourage participation and ultimately save lives.

In Britain, workplace cancer screening programmes have not been fully evaluated. This study investigated the effectiveness of such screening in a large British company. The company chosen was Brush Engineering, a heavy engineering firm in Loughborough in the East Midlands of England employing 4000 people on a single industrial site. The company manufactures railway locomotives for British Rail and the Channel Tunnel project. If this approach succeeds then other major industries must be encouraged to develop colorectal cancer screening. Furthermore, identification of groups of employees not participating will enable specific targeting in future programmes.

**METHOD**

Senior managers of the Brush Group of companies in the East Midlands of England gave permission for employees aged 41–65 years to receive an invitation to participate in a colorectal cancer screening project during 1992–93. The personnel departments of the engineering company sent a letter to employees explaining the purpose of bowel cancer screening and in this they were offered a free Haemoccult test pack. The scheme was advertised with posters on site and the work’s medical department supported the campaign by answering inquiries. Employees who accepted were sent a Haemoccult pack which included instructions on how to perform the test. Small amounts of stool were collected and applied to cardboard slides from the kit. These were completed by employees on three separate days while on no dietary restrictions. The kits were returned to Leicester General Hospital where they were analysed by a single investigator.

A faecal occult blood test was positive if a blue colour appeared on addition of a solution of hydrogen peroxide and denatured alcohol to the stool sample. People with positive results were asked to repeat the test on dietary restrictions. Avoiding red meat, black pudding, cauliflower, cabbage, spinach, radishes, parsnip, broccoli, and bananas. This method reduces the number of false positives by 60% while not decreasing the initial compliance rate. Any of the slides tested on this second occasion was positive, employees were informed and offered colonoscopy. The length of time between the first positive result and the decision by subjects to undergo investigation was noted.

With the invitation to colonoscopy, employees received a description of the procedure and the standard bowel preparation. Before endoscopy a history was taken and...
employees underwent a complete physical examination. Employees attended as day cases on a routine list.

Individuals whose repeat tests were negative were sent a third kit to complete four months after the negative slides on dietary restrictions. Those who had a normal colonoscopy or negative repeat slides were told to contact their doctor if they later developed a change in bowel habit or related symptoms.

The number of employees who completed kits was analysed by age, sex, and occupation and tested for differences with a \( \chi^2 \) statistic. Occupations were divided into managerial and non-managerial (clerical and blue collar factory workers). The pathology found at colonoscopy was recorded.

### RESULTS

#### Compliance with screening

Total compliance with colorectal cancer screening in this workplace scheme was 25.4% (465/1828 employees, table 1). There was an additional 20.8% (378) of people who requested more kits than male non-managers (35.3% \( \chi^2 = 15.1, p<0.001 \)) and 61–65 years there were no significant difference in completion between men and women (\( \chi^2 = 0.8, \) NS) but female non-managers returned more kits than male non-managers (28.6% \( \chi^2 = 5.6, p<0.02 \)). This difference was due to that in many other one-off programmes where an invitation was sent from family doctors. Therefore, workplace schemes could serve as a complementary or alternative method to community programmes for delivering screening.

#### Compliance according to occupation

From data supplied by the company the occupations of 1803 of 1828 (98.6%) employees were known (table 2). Of the 25 for whom occupation was unknown, 11 returned kits and this small subgroup was excluded from the analysis. Managers responded more than non-managerial employees (28.6% \( \chi^2 = 23.5, \) NS). Males 51–60 years participated more (30.5%) than men aged both 41–50 years (21.9%, \( \chi^2 = 15.1, p<0.001 \)) and 61–65 years (16.6%, \( \chi^2 = 11.6, p<0.001 \)). Compliance in men aged 41–50 years and 61–65 years was similar (21.9% \( \chi^2 = 8.6, p<0.005 \)).

#### Pathology detected

Four of the 434 kits (0.9%) were positive as was one on dietary restrictions. Those who had a normal colonoscopy or negative repeat slides on dietary restrictions. The subject with a positive test had a 1 cm pedunculated polyp at the splenic flexure and found that businesses are interested in developing screening programmes. Participation was lowest in employees in their 40s and 60s and reasons for this need to be explored. Those in their 40s may perceive themselves to be at low risk of colorectal cancer whereas workers over 60 years may feel too old to benefit from screening. Compliance in this study was considerably lower than in the large randomised controlled trial of screening in Nottinghamshire. This may reflect the increased public awareness of screening when it is conducted on a large scale. Furthermore, it is important to consider the convenience to the investigators of delivering screening and if this is not markedly higher at the workplace it is unlikely to be practical on a large scale.

Compliance varied according to occupation with managers participating more. Managers may be more health conscious and better able to appreciate the benefits of screening and future screening programmes should particularly target clerical and blue collar workers. Although compliance according to occupation has not previously been measured in British industry, a general practice scheme found highest acceptance in those with professional occupations.

The proportion of the total target population screened was low. Compliance may have been increased by more publicity such as promotional lectures, although the disruption to working practices prevented this. However, screening was advertised as vigorously as possible by posters displayed in factories and offices and by the medical department answering inquiries. Employees were not sent a reminder if they failed to request a kit to avoid unnecessary harassment, although a second invitation increases the response rate. Other studies have identified reasons for non-compliance including lack of appreciation of asymptomatic illness and screening, fear of hospital investigations and surgery, and unpleasantness of the stool collection procedure.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Managerial (%)</th>
<th>Non-managerial (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41–50</td>
<td>76/286 (26.6)</td>
<td>110/566 (19.4)</td>
</tr>
<tr>
<td>51–60</td>
<td>76/223 (34.1)</td>
<td>128/461 (27.8)</td>
</tr>
<tr>
<td>61–65</td>
<td>14/65 (21.5)</td>
<td>10/80 (12.3)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Managerial (%)</th>
<th>Non-managerial (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41–50</td>
<td>4/13 (30.8)</td>
<td>17/56 (30.3)</td>
</tr>
<tr>
<td>51–60</td>
<td>0/6 (0)</td>
<td>19/40 (47.5)</td>
</tr>
<tr>
<td>61–65</td>
<td>0/1 (0)</td>
<td>0/6 (0)</td>
</tr>
</tbody>
</table>

Compliance in managers was higher than those with non-managerial jobs (28.6% \( \chi^2 = 5.6, p<0.02 \)).

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**Table 1 Compliance with screening**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Female (%)</th>
<th>Male (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41–50</td>
<td>21/71 (26.6)</td>
<td>188/860 (21.9)</td>
</tr>
<tr>
<td>51–60</td>
<td>19/47 (40.4)</td>
<td>213/698 (30.5)</td>
</tr>
<tr>
<td>61–65</td>
<td>0/7 (0)</td>
<td>24/145 (16.6)</td>
</tr>
</tbody>
</table>

The overall compliance for men (25.0%) and women (32.0%) was similar (\( \chi^2 = 3.0, \) NS).

**Table 2 Compliance with occupation based colorectal cancer screening**

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**DISCUSSION**

Recent work proving the effectiveness of screening for colorectal cancer with faecal occult blood testing has supported the case for national screening programmes for the disease. If such programmes are to be developed, then raising compliance is going to be a major issue and ways of delivering screening such as community or workplace schemes will need to be assessed. This study found that compliance with workplace based screening was similar in men and women and higher in managers than non-managers. Uptake in the age group 51–60 years was similar to that in many other one-off programmes where an invitation was sent from family doctors. Therefore, workplace schemes should serve as a complementary or alternative method to community programmes for delivering screening.

Encouraging participation will be easier at the workplace as medical and personnel departments can promote screening through health education publicity campaigns to large numbers of people employed at single work sites. We have previously surveyed both national and regional industries and found that businesses are interested in developing screening programmes. Participation was lowest in employees in their 40s and 60s and reasons for this need to be explored. Those in their 40s may perceive themselves to be at low risk of colorectal cancer whereas workers over 60 years may feel too old to benefit from screening. Compliance in this study was considerably lower than in the large randomised controlled trial of screening in Nottinghamshire. This may reflect the increased public awareness of screening when it is conducted on a large scale. Furthermore, it is important to consider the convenience to the investigators of delivering screening and if this is not markedly higher at the workplace it is unlikely to be practical on a large scale.

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Other studies have identified reasons for non-compliance including lack of appreciation of asymptomatic illness and screening, fear of hospital investigations and surgery, and unpleasantness of the stool collection procedure.
increase uptake in future programmes these reasons need to be addressed in screening invitations.

This study was necessary as there was little information on workplace colorectal cancer screening programmes in British industry. In one previous study workers over 40 years of age in two companies were invited to receive a haemoccult kit and complete a symptom questionnaire. Although overall compliance was 51% with women participating significantly more than men (61% vs 47%), uptake according to age and occupation were not reported. The intense publicity with lectures, leaflets, and small group discussion may have encouraged greater participation than in our study. In America workplace screening has been more extensively investigated. After the discovery of an excess number of colonic cancers at a Texan polypropylene factory, past and present employees over 40 years of age were offered a faecal occult blood test and flexible sigmoidoscopy. Overall participation was 52%, although among current employees it was 68%. Those most likely to participate were aged 50–59 years and those least likely older than 60 years. Attendance at a promotional briefing was associated with an increased level of participation. Pattern and model makers in the Detroit car industry are also at a high risk and were screened. The uptake by a group of workers at one year was 46%, although this fell to 16% five years later. Reasons for non-participation uptake by a group of workers at one year was 46%, although this fell to 16% five years later. Reasons for non-participation were failure to understand the benefits of screening and the frequency of colorectal cancer, unpleasantness of the stool collection procedure, and fear of further investigations and surgery. If companies support and finance screening the health and financial benefits to individuals, businesses and the country would be enormous.

ACKNOWLEDGEMENTS

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