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Evaluation of screening for oral cancer and precancer in a company headquarters

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Abstract – Oral cancer and precancer appear to fulfil many of the criteria for a disease suitable for mass screening. Several commercial organisations in the UK have introduced screening for their employees. One program has been formally evaluated over the course of 1 yr. Of 553 company headquarters staff aged ≥40 yr, 292 (53%) responded to the well-publicised screening invitation and received a simple clinical examination of the oral mucosa from one of two company dentists. In addition, 17 staff were screened from a separate company work-site. After screening, subjects were examined independently by an oral medicine specialist with access to the relevant diagnostic aids. The dentists' screening decisions were validated against the specialist's definitive diagnoses (the 'gold standard'). The true prevalence of subjects with lesions diagnosed as positive (white patch, red patch or ulcer of greater than 2 weeks' duration) was 17 (5.5%). Overall, sensitivity was 0.71 and specificity, 0.99. The compliance rate to screening among headquarters subjects in seven occupational categories did not differ significantly from the occupational profile for all headquarters personnel. Estimates of relative risk of a positive diagnosis were calculated by logistic regression for five independent variables; gender, age, moderate smoking, heavy smoking, and smoking combined with greater than low risk alcohol consumption. Only heavy smoking (≥20 cigarettes per day) produced a significant odds ratio (3.43, $P<0.05$).

Key words: compliance; oral cancer; oral precancer; relative risk; screening; sensitivity; specificity

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There are some 2000 new cases of oral cancer reported in England and Wales each year with an overall incidence of 4.5 per 100 000 per annum. Approximately 60% of patients die from their disease within 5 yr (1). In the industrialized world it is considered the eighth most common cancer, representing between 1 and 2% of total malignancies, and there is evidence that incidence and mortality are increasing (2). Although cancer often apparently arises de novo, there are also a number of clinically identifiable precursor lesions which constitute a detectable preclinical phase (3). Pre-malignant lesions such as leukoplakia, and other conditions associated with a high risk may be present in up to 5% of the population over 40 yr of age (4–6).

Treatment of oral cancer, especially advanced lesions, is associated with significant physical and psychological morbidity whereas small lesions are relatively easy to detect and treat effectively. Poor survival is in part due to a failure to detect small lesions since over 60% of patients present with lesions over 2 cm in diameter, by which stage prognosis is significantly worsened (3, 7). Yet it is recognised that a simple clinical examination can detect asymptomatic disease and result in treatment being instituted early (8). It seems timely therefore to consider the feasibility of screening for oral cancer and precancer. A recent report (9) concluded that oral cancer met most of the criteria of WILSON & JUNGNER (10) for a disease suitable for screening but found insufficient evidence to recommend a national screening program without further research.

In India, where the incidence of oral cancer is high, large scale primary preventive programs aimed at reducing tobacco usage have been evaluated (11). However, few studies have attempted specifically to validate clinical screening for oral cancer and precancer. Nevertheless there is evidence that satisfactory sensitivity and specificity levels can be

achieved both by dentists (12) and, in developing countries, by primary health care workers (13).

IKEDA and coworkers (12) conducted their screening among factory and office workers in Japan. The workplace offers an ideal opportunity for screening (14–16) and although a number of companies have now instituted oral cancer and precancer screening for their employees (17), there have been no formal evaluations of work-site oral screening programs in the United Kingdom. The purpose of this project was to establish the sensitivity and specificity of a screening test for the detection of oral cancer and precancer, and to evaluate a pilot screening program in a workplace environment.

Material and methods

The screening program – Screening was carried out in the London headquarters of a large commercial company. All staff aged 40 yr or over were invited to attend for an oral screening in the surgeries of the on-site company dental practice. The program was widely publicised through the company house magazine, a video screen in the entrance hallway, and by means of an information sheet explaining the importance of mouth screening in the detection of cancer and the nature of the examination. Screening was conducted at dedicated sessions and was carried out by two general dental practitioners who had not received any specific training except for instruction in the screening procedure and the criteria for a positive or negative test.

The screening test consisted of a thorough, systematic visual examination of the lips and mucosal surface of the mouth and oropharynx. It was carried out under a dental operating light using two mouth mirrors to retract and visualise the soft tissues and a gauze swab to manipulate the tongue. The test was recorded as positive if a white patch, red patch or ulcer of greater than 2 weeks' duration was detected. However, these criteria were further qualified by defining lesions or conditions regarded as malignant or premalignant and therefore screened positive, and by indicating lesions which might have a similar appearance but should be regarded as negative (Table 1). An apparently normal mucosa was also classified as negative. Findings were entered on a simple report form. In addition, each subject screened was asked to complete a brief, confidential questionnaire designed to identify high risk lifestyle factors, notably smoking and alcohol consumption habits. Questions covered the amount and type of tobacco used and the duration of use, and the amount, frequency and type of alcoholic drink consumed.

The program was designed to continue long term, and a pathway was established for patients requiring referral. Also all participants were given preventive advice stressing the risk factors for oral cancer and the benefits of a healthy lifestyle.

Evaluation and analysis – After screening, each subject was independently examined by a specialist in oral medicine who was unaware of the findings of the screener but who had the subject's completed lifestyle questionnaire available for scrutiny. The reference criterion ("gold standard") for calculating sensitivity and specificity was the definitive diagnosis by the specialist who had access to any relevant diagnostic aids, including biopsy if considered necessary.

Sensitivity and specificity were computed for each screener separately and for their combined results. Uptake of the program among staff was recorded, and the classification of screened subjects by occupational group was compared for goodness-of-fit with the occupational profile of all eligible staff on the headquarters payroll. Seven occupational staff grades were used for classification purposes. Logistic multiple regression analysis estimating relative risk was carried out using the specialist definitive diagnosis, classified as negative or positive, as the dependent variable. Personal data items and responses from the lifestyle questionnaire, each aggregated and expressed in binary form, represented the independent risk factor variables. The variable, age, was entered as a continuous independent measurement. The cut-points for the dichotomized variables were (1) any use, (2) moderate or (3) heavy usage of tobacco, and (4) higher than safe use of alcohol. The criteria are specified in Table 5.

Results

There were 553 eligible staff aged 40 yr or over on the headquarters payroll and 292 (53%) were screened during the 1-year evaluation period. Seventeen staff were also screened from a separate work-site of the company and included in the analysis. Of those screened, all but 12 were registered patients of the practice.

Table 2 presents a contingency table for frequencies of subjects classified as positive and negative according to the screening test and definitive diagnosis. Seventeen positive lesions were diagnosed by the specialist amounting to a prevalence of 5.5% in the screened popu-

Table 1. Specific lesions or conditions to be regarded as positive or negative in the screening program

Positive	Negative
carcinoma	geographic tongue
leukoplakia	median rhomboid glossitis
erythroplakia	pseudomembranous candidosis
lichen planus	aphthous ulceration
lupus erythematosus	transient white patches
submucous fibrosis	stomatitis nicotina
actinic keratosis	

Table 2. Contingency table of frequencies of positive and negative classifications of subjects according to screening test and definitive diagnosis, together with sensitivity and specificity values

		Test findings		True prevalence
		Positive	Negative	
Definitive diagnosis	Positive	12	5	17
	Negative	2	290	292
Test prevalence		14	295	309

Sensitivity=0.71 (95% CI, 0.46–0.96), specificity=0.99 (95% CI, 0.98–1.00).

Table 3. Comparison of uptake of the screening programme by headquarters staff according to occupational grade, with the occupational profile of all headquarters staff aged 40 yr or over

	Serv.	Cler.	Secr.	Asst. man.	Midd. man.	Sen. man.	Board memb.	All staff
All staff	57	57	62	93	154	119	11	553
% of total	10.3	10.3	11.2	16.8	27.8	21.5	2.0	100
Screened staff	17	33	30	65	85	57	5	292
Proportion of staff screened to total	0.30	0.60	0.48	0.74	0.60	0.50	0.45	0.56

Chi square=12.17, 6 df, $P>0.05$.

lation. There were five false-negative and two false-positive screening decisions, giving an overall sensitivity of 0.71 (95% CI, 0.46–0.96) and specificity of 0.99 (95% CI, 0.98–1.00). The positive predictive value of the screening test was 0.86.

Each screener saw only those subjects who presented for screening at their own scheduled sessions whereas the specialist was in attendance at every dedicated screening session and saw the screened subjects of both dentists. One screener returned a sensitivity of 0.75 (95% CI, 0.50–1.00) and the other, a value of 0.60 (95% CI, 0.17–1.00). Both had specificity values of 0.99 (95% CI, 0.98–1.00 and 0.97–1.00 respectively).

In Table 3, the composition of the *headquarters group who presented* themselves for screening according to occupational grade, is compared with the occupational profile of all eligible headquarters staff. The personnel department graded the staff as service (skilled and semi-skilled manual workers); clerical or secretarial; assistant, middle or senior management; and board members. The composition of the screened group by occupational grade did not differ significantly from that of all headquarters staff ($P>0.05$). However, there was a trend towards an over-representation of assistant managers and an under-representation of service personnel.

Table 4 examines the subjects who were diagnosed as positive according to their gender, age, occupational grading, and type of lesion diagnosed. There were nine cases of leukoplakia (2.9%), and eight cases of lichen planus (2.6%). There were no cases of squamous cell carcinoma. In establishing the definitive diagnosis, five patients were biopsied; two showed epithelial dysplasia, two hyperkeratosis without dysplasia and one, erosive lichen planus.

Table 5 presents the logistic multiple regression analysis producing estimates of relative risk among those screened with five independent variables included. The only independent variable which was statistically significant ($P<0.05$) was heavy smoking. This produced an odds ratio (estimating relative risk) of 3.43 (95% CI, 1.06–11.11) of a positive diagnosis for those who smoked 20 or more cigarettes or equivalent per day. The regression coefficients for the other independent variables were non-significant ($P>0.05$). In testing for goodness-of-fit

Table 4. List of subjects diagnosed as positive with gender, age (in years), occupational group, and diagnosed lesion

No.	M/F	Age	Occupation group	Diagnosed lesion
1	F	52	Middle manager	Erosive lichen planus
2	M	57	Service staff	Leukoplakia
3	M	47	Middle manager	Reticular lichen planus
4	M	55	Middle manager	Leukoplakia
5	M	61	Service staff	Reticular lichen planus
6	F	45	Assistant manager	Leukoplakia
7	F	57	Clerical staff	Reticular lichen planus
8	M	56	Senior manager	Leukoplakia
9	M	53	Senior manager	Leukoplakia
10	M	42	Middle manager	Leukoplakia
11	F	42	Middle manager	Erosive lichen planus
12	M	55	Assistant manager	Reticular lichen planus
13	M	48	Service staff	Leukoplakia
14	F	55	Assistant manager	Reticular lichen planus
15	M	55	Senior manager	Leukoplakia
16	M	54	Senior manager	Atrophic lichen planus
17	F	41	Middle manager	Leukoplakia

Table 5. Logistic multiple regression analysis with definitive diagnosis as dependent variable and gender, age and reported life style factors as independent variables

Independent variable	b coefficient (SE)	P	Odds ratio	95% confidence interval for OR
Gender	0.21 (0.53)	>0.05	1.23	0.43–3.51
Age (yr)	0.03 (0.04)	>0.05	1.03	0.95–1.11
Moderate smoker	−0.39 (0.79)	>0.05	0.68	0.14–3.21
Heavy smoker	1.23 (0.60)	>0.05	3.43	1.06–11.11
Drinker	−6.09 (37.55)	<0.05	0.00	2.48×10^{-35}–2.07×10^{29}
Smoker & drinker	−0.84 (46.68)	>0.05	0.43	7.91×10^{-41}–2.35×10^{39}
Constant	−4.72 (2.22)	>0.05	–	–

Key

Variable	Specification
Gender	Male=1, female=0
Smoker	Current smoker of tobacco in any form or regular smoker within last 10 yr=1, non-smoker (currently or for at least 10 yr)=0
Moderate smoker	Current smoker of less than 20 cigarettes or equivalent per day=1, non-smoker=0
Heavy smoker	Current smoker of 20 or more cigarettes or equivalent per day=1, non-smoker=0
Drinker	Consumer of more than 21 standard units of alcohol (male) or 14 units (female) per week=1, drinker of less than the specified amount=0

of the model, the chi-square value for −2 log likelihood with all conditions included was 124.35 ($P=1.00$) and for goodness-of-fit, 292.13 ($P>0.50$), upholding the null hypothesis that the model did not differ significantly from a "perfect" model.

Discussion

The response rate over the course of 1 yr to the offer of mouth screening for oral cancer and associated precancerous lesions amounted to 53% of all headquarters staff of 40 years of age or over. This appears rather low compared, for example, with the workplace screening program of IKEDA *et al.* (18), who recorded attendance rates of 77% and 60% in factory and office workers from 2 Japanese companies. However, the present figure represents some under-estimation of true compliance. A number of staff who were screened will not have been included in the evaluation since they were unable to attend at one of the dedicated sessions and were therefore not examined by the specialist diagnostician. The lower compliance rate in the present study may be due to the nature of the publicity material given to staff which was fairly forthright in its emphasis of the dangers of oral cancer, and uncompromising in its reference to the risk factors. A higher compliance might have been achieved with a more bland invitation to undergo general mouth, as opposed to oral cancer, screening. This would place a positive emphasis on the benefits of a healthy mouth rather than following a more negative approach centered on the detection of disease.

The overall sensitivity of the screening test in the hands of the two company dentists amounted to 0.71 and compares with the value of 0.48 reported by IKEDA *et al.* (12) and 0.95 reported by WARNAKULASURIYA & PINDBORG (13) in their Sri Lanka study using primary health care workers. Two factors may have accounted for the comparatively low sensitivity achieved in the current study. First, there was no specific training and standardization of the screeners nor assessment of their performance before commencement. They were simply given the criteria for a positive or negative screen (Table 1) and instructed on the conduct of the evaluation and how to complete the recording forms. This was done purposely to test the ability of dental practitioners without special training to screen for oral cancer and precancer. Secondly, 96% of those screened were registered patients of the practice and the two practitioners were therefore aware that the patients were under continuing supervision. This may have made them cautious in designating a patient as positive. It is evident that thorough training in oral soft tissue screening is essential for those involved in any substantive program.

In contrast to sensitivity, specificity values were very high. There was thus a low to negligible frequency of false-positive decision making which is of some psychological importance to those screened and potential economic importance to providers of follow-up secondary care services (19). Of the five false-negative screening decisions, 3 were reticular lichen planus. Only two cases, apparently missed, were potentially serious conditions, one of erosive lichen planus and one of leukoplakia.

The occupational profile of the screened subjects did not differ significantly from that of the eligible headquarters population. Nevertheless, there was a degree of over-representation of the lower management grade and under-representation of service personnel. This reflects the pattern of uptake of oral care services generally where it is found that people in the professional and managerial social classes consistently have the higher asymptomatic attendance rates. Special efforts should be made in work-site screening programs for oral cancer to encourage staff in lower occupational grades to participate since some may be at heightened risk to the disease (20).

The logistic regression analysis, estimating the relative risk of having a positive lesion, incorporated five independent variables concerned with known risk factors. The cut-points were derived from a consideration of documents responding to government targets for reducing dependency on smoking and alcohol (21, 22). It produced a significant regression coefficient only in those claiming to smoke 20 or more cigarettes per day who had an estimated risk more than three times greater than non-smokers. However, the numbers involved in the analysis were small and quantification of the independent variables depended upon self-reported behaviour, which may be a doubtful reflection of actual behaviour.

The study has highlighted some of the difficulties of conducting a rigorous research program in a real life setting. Ideally, all those involved in data collection in a field research study should be unfamiliar with the subjects of the investigation. A larger study among dental hospital patients and subjects recruited from a medical practice list, currently being undertaken by the investigative team, should overcome this shortcoming. Despite the relatively small numbers, a quantifiable risk from heavy smoking was detected. Also a need was identified for specific training in the theory and practice of screening in order to maximise sensitivity while at the same time maintaining a low false-positive rate.

In conclusion, the study afforded a pragmatic evaluation of a screening program which is already established, and provided a useful pilot exercise for gaining practical experience and expertise in further investigations of the feasibility, suitability, and cost effectiveness of screening for oral cancer and precancer.

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