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The impact of the UK 'two-week rule' on stage-on-diagnosis of oral cancer and the relationship to socio-economic inequalities

Steve Langton[a,*], Derek Lowe[b], Simon N Rogers[b,c], Annette Plüddemann[d], Clare Bankhead[d]

[a] University of Oxford and Retired Consultant Maxillofacial Surgeon, UK
[b] Evidence-Based Practice Research Centre (EPRC), Faculty of Health, Edge Hill University, St Helens Road, Ormskirk, L39 4QP, UK
[c] Consultant Regional Maxillofacial Unit, University Hospital Aintree, Liverpool, L9 1AE, UK
[d] Nuffield Department of Primary Care Health Sciences, University of Oxford, UK

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ABSTRACT

Background: The 'two-week rule' (TWR) fast-track cancer referral system for head and neck cancers was introduced by the UK government in 2000, to facilitate earlier diagnosis. However, little work has compared stage on diagnosis of cancer before and after the implementation of the system.

Objectives:

- Describe the presentation of oral cancer in Merseyside from 1992 to 2012.
- To evaluate whether stage on presentation has improved after the introduction of the TWR using data from a clinical database in Merseyside 1992–2012.
- To assess the relationship between stage on presentation and social deprivation 1992–2012.
- To assess the change in presentation for different sites within the oral cavity.

Method and setting: Patients were identified using the Aintree (Liverpool) head and neck oncology database, containing all diagnoses of oral squamous cell carcinoma (SCC) between 1992 – 2012. Cancers were clinically staged using the American Joint Committee on Cancer (AJCC) stage groupings and divided into 'early' (stage 1 and 2) and 'late' (stage 3 and 4). Index of Multiple Deprivation (IMD) 2004 data were derived from patient postcodes. Appropriate regression analyses were undertaken.

Results: 1485 consecutive patients diagnosed were studied. Median (IQR) age was 63 (55–73) years and 61% were male. 36% of cancers were located on anterior 2/3rds tongue, 30% floor of mouth, and 34% elsewhere.

'Late' tumour presentation was 52% (95%CI 46.8–56.4%) for 1992–2000, and 44% (95%CI 41.4–47.5%) for 2001–2012 (P = 0.01). *Joinpoint* regression analysis of 'late' presentation indicated a steady fall 1992–2012, at an annual percentage decrease of 1.27% (95% CI −2.3 to −0.2). No statistically significant change in trend was identified either overall or within deprivation groups following the TWR.

For patients in 'more deprived' neighbourhoods, 'late' tumour presentation was: 56% and 47%; in 'less deprived' areas: 48% and 42%, before and after the introduction of the TWR, respectively.

Year of diagnosis, tumour site and IMD2004 were significantly associated with 'late' presentation, and location of tumour was also associated with time period and IMD2004.

Main conclusions: Stage on presentation improved between 1992–2012. Joinpoint analysis showed no significant change in trend following the introduction of the TWR. The rate of improvement was highest for most deprived; nevertheless, deprivation inequality persists and this should be a focus of further initiatives and research.

1. Introduction

In 1995, the first EUROCARE studies were published [1]. These studies indicated that outcomes for some cancers in the UK were worse than the best-performing European countries. More recently, the EUROCARE-5 studies [2] indicated that for head and neck cancer, UK 5-year survival rates compare well with the best in Europe yet 1-year survival rates are still worse than several European countries, suggesting a higher incidence of cancers presenting at an advanced stage in the UK. There is a broad consensus that the relatively poor UK performance in cancer is genuine [3].

Oral cancer is the sixth most common cancer in the world [4] and

* Corresponding author: 2 Ravensdale Road, Bolton, Lancashire, BL1 5DN, UK
E-mail addresses: stephen.langton@kellogg.ox.ac.uk (S. Langton), simonn.rogers@aintree.nhs.uk (S.N. Rogers).

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approximately 6500 cases are diagnosed per year in the UK [5]. The survival of oral cancer is poor, with overall 5-year survival rates in the order of 50%, having remained much the same for the past 50 years despite advances in both surgery and radiotherapy [5,6]. For head and neck cancer, including oral cancer, studies clearly show the correlation between stage on diagnosis and outcome [7,8]. Furthermore, treatment of stage 1 and 2 cancers is considerably less extensive than for more advanced disease; for example, sentinel node biopsy may preclude the need for neck dissection in early cancers and complex reconstruction, with associated morbidity, may often be avoided [9].

The 'two-week rule' (TWR) or 'two-week wait' (TWW) fast-track cancer referral system was introduced by the UK government in 1999 for breast cancer and for all other cancers in 2000 as part of the NHS Cancer Plan [10]. The rule requires that all cases of suspected cancer referred to secondary care by a primary care clinician are assessed by a specialist within 14 days, with the aim of encouraging early diagnosis. This process is facilitated by a set of National Institute for Health and Care Excellence ('NICE') guidelines for primary care practitioners, one set for each cancer type. The 2004 guidelines [11] were revised and updated in 2015 [12].

Harrison and Foot [13] note: *'for the two-week rule to be effective…… the stage at which patients were identified should have fallen since its introduction'*. However, whilst much published research has focused on the process of cancer referral via the TWR, there is relatively little evidence, for all cancer types, on whether the introduction of the TWR and NICE associated guidance has resulted in improved survival or whether cancer cases are presenting at an earlier stage. For oral cancer there is very little such evidence [14]. Data from the National Cancer Registration and Analysis Service (NCRAS) on oral cancer indicate that between 2006 and 2013 there was little difference in 1-year survival between TWR referrals and other 'routine' referrals (77% vs 78%), but emergency presentations did considerably worse (44%). During the same period, 34% of cases presented via the TWR system whilst 6% presented as emergencies. The proportion of oral cancers presenting via the TWR also steadily increased from 24% in 2006 to 33% in 2012 [15].

In addition to improving overall cancer survival, a key UK government health focus is the relationship of social inequalities and cancer [16,17]. Socio-economic differences in survival from head and neck cancers are among the largest of any malignancies [18]]. Oral cancer has a well-established link to social deprivation and is known to have both increased incidence and poorer outcome for the more socially deprived [19]].

This study aims to:

(1) Describe the presentation of oral cancer in Merseyside from 1992 to 2012.
(2) Evaluate the stage on presentation of oral cancers in Merseyside from 1992 to 2012. comparing the periods before and after the introduction of the TWR and NICE guidance in 2000.
(3) Study the relationship of stage on presentation to social deprivation from 1992 to 2012, comparing the periods before and after the introduction of the TWR in 2000.
(4) Examine the changes in stage on presentation in relation to different intra-oral sites.

2. Methods

2.1. Data source

Patients were identified using the Aintree (Liverpool) head and neck oncology database. The Aintree unit, in 2012, served a population of approximately 1.9 million, including Merseyside, Warrington and Chester. Consecutive patients diagnosed with oral SCC (ICD CO1 −CO6) between January 1992 and December 2012 were included. Since 1992, patients diagnosed or treated for head and neck cancer have been entered into this database which contains comprehensive and accurate, validated information on demography, staging, treatment and outcomes. This database was one of the first computerised databases of head and neck cancer in the UK [20] and therefore is one of the few resources containing accurate data on presentation stage for several years prior to the inception of the UK TWR in 2000 and for the years following its introduction. The data included TNM staging using the American Joint Committee on Cancer (AJCC) standards. Cancers were classified into group stages 1–4 using staging following clinical examination and CT/MRI scanning and further classified as (a) 'early' presentations, comprising stage 1 and 2 cases and (b) 'late' presentations, comprising stage 3 and 4 cases. In view of the marked differences in survival and treatment requirements of these groups, 'early' and 'late' categories for oral cancers have been utilised in much previous work [21,22].

2.2. Deprivation data

Patient postcode was used to derive Index of Multiple Deprivation (IMD) data. The overall IMD is conceptualised as a weighted area level aggregation of several specific dimensions of deprivation. We decided to use IMD 2004 [23] where possible as it incorporated data indicators relating to 2001, a year which is close to the centre of the period studied. The IMD 2004 consists of seven domains (income deprivation, employment deprivation, health deprivation and disability, education skills and training deprivation, barriers to housing and services, living environment deprivation and crime) with each domain containing several indicators. Patient postcodes came from an amalgam of sources, mainly from datasets used for other studies over the time period. Checks were made against patient postcode using available electronic records relevant to the time the patient first presented. Specifically, the records for patients presenting in the two years of 1997 and 2003 were checked and for 84% and 90% of patients respectively their postcode was from the time they first presented.

2.3. Analyses

To determine any changes in the stage-on-presentation trend, particularly following the introduction of the TWR, 'Joinpoint' Regression Program version 4.6.0.0 (Surveillance Research Program of the National Cancer Institute, Calverton, USA, 2018), was used to calculate the best-fitting line through the years of data. 'Joinpoint' employs an algorithm to determine whether a multiple-segmented line fits better than a straight line. Each line is connected by an aptly-named 'joinpoint' which indicates a statistically significant ($p < 0.05$) change in trend. The test of significance uses a Monte Carlo permutation method to determine the best fit line(s) for analysis of the time series. 'Joinpoint' analyses were made for percentage of all late (stage 3 and 4) cancers and for least and most deprived groups.

The Chi-squared test was used to test the association of patient groups with 'late' presentation. SPSS version 25 was used for data management, for descriptive statistics and for the Chi-squared tests. Binary regression (STATA binreg procedure, rr link option) was used to assess the association of clinical and demographic variables with late presentation (stage 3 or 4). It was also used to assess the association of time period (1992–2000, 2001–2012) on whether patients presented 'late' after adjustment for other factors as independent predictors and similarly the association with regard to IMD deprivation status. Risk ratios were estimated, as were 95% confidence intervals.

2.4. Ethics

Ethical review was undertaken by the Medical Sciences Inter-Divisional Research Ethics Committee of the University of Oxford who confirmed that the study does not require ethical approval because it analyses information previously collected during normal care.

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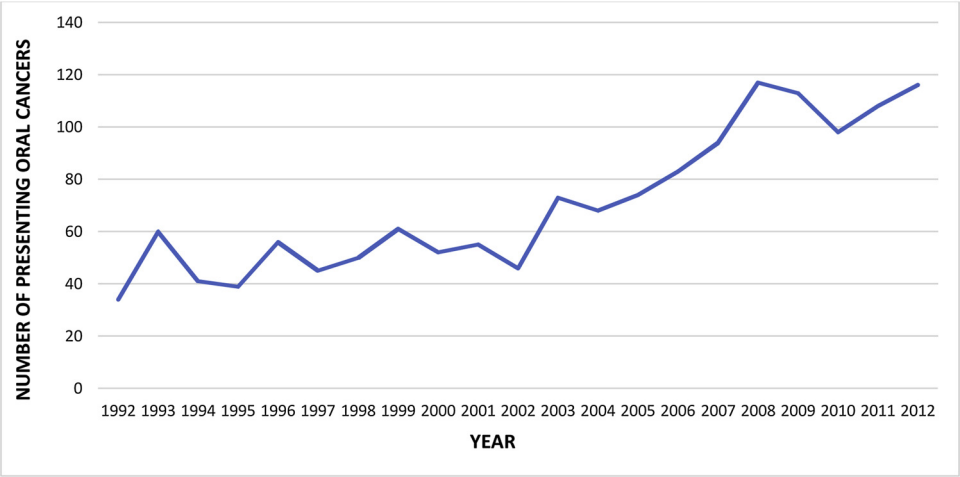

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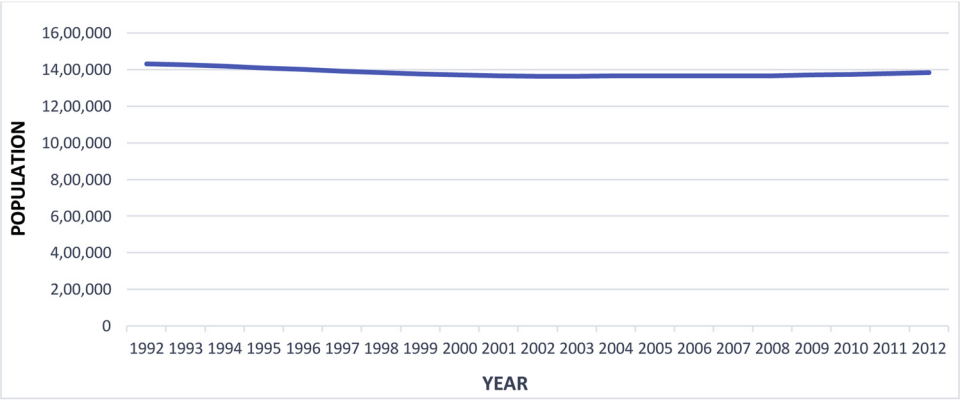

c

Year	Total	% 55-59	% 60-64	% 65-69	%70 -74
1992	1,433,000	5.34	5.39	4.89	4.17
1996	1,401,800	5.31	5.17	4.73	4.25
2000	1,374,000	5.31	5.20	4.83	4.34
2004	1,367,000	6.21	5.03	4.85	4.30
2008	1,368,000	6.10	5.81	4.62	4.31
2012	1,386,000	6.15	5.88	5.22	4.14

Fig. 1. (a) Numbers of oral cancers presenting to Aintree head and neck unit by year, 1992–2012. (b) Merseyside population 1992–2012. (c) Percentages of Merseyside population 55–59 years, 60–64 years, 65–69 years and 70–74 years.
Population statistics provided by Liverpool City Council.

3. Results

3.1. Increasing numbers of oral cancers

There were 1485 patients with primary oral cancers included in this study, with clinical staging known for 1483. From 1992–2012 the number of presenting oral cancers in Merseyside steadily increased, calculated in 'Joinpoint', at an annual percentage change (APC) of 5.8% (95% CI 4.5–7.1). The increase is neither attributable to increasing population nor marked increase in the age-groups associated with the highest incidence of oral cancer (Fig. 1a–c).

3.2. Stage at diagnosis

Over the 21-year period 438 were diagnosed 1992–2000 and 1045 diagnosed 2001–2012. (Table 1). The percentages presenting with late (stage 3 or 4) tumours were 52% (226/438) 95%CI 46.8–56.4%, for 1992–2000, and 44% (464/1045) 95%CI 41.4–47.5%, for 2001–2012, (P = 0.01).

Median (IQR) age at diagnosis was 63 (55–73) years and 61% (905) were male. Tumour location was anterior 2/3rds of tongue for 36% (529), floor of mouth for 30% (438), buccal for 18% (264), lower gum for 11% (160) and elsewhere for 6% (92).

3.3. Deprivation 'groups'

For 1422 patients living in England (Isle of Man and Welsh patients were excluded) data were analysed in relation to IMD deprivation within two patient groups, the grouping split being determined by their median IMD2004 rank of 8261 where rank 1 is the residential neighbourhood in England assigned as the most deprived and rank 32,482 is the least deprived neighbourhood. For the "more deprived" group of

Table 1
Numbers of oral cancers by clinical stage, and by IMD2004 status, for the 21-year period.

Year	Total cancers	Stage 1	Stage 2	Stage 3	Stage 4	% stage 3 or 4 (Late) cancer	%Late stages (MORE DEPRIVED* areas)		%Late stages (LESS DEPRIVED* areas)	
							%	n	%	n
1992	34	8	12	6	8	41.2	47.4	9/19	28.6	4/14
1993	60	6	22	12	20	53.3	60.9	14/23	44.1	15/34
1994	41	4	10	11	16	65.9	73.7	14/19	61.9	13/21
1995	39	5	13	6	15	53.8	41.2	7/17	68.4	13/19
1996	56	13	17	10	16	46.4	46.9	15/32	47.8	11/23
1997	45	11	16	7	11	40.0	47.8	11/23	36.8	7/19
1998	50	10	16	12	12	48.0	72.2	13/18	34.5	10/29
1999	61	14	12	7	28	57.4	56.7	17/30	56.7	17/30
2000	52	16	7	9	20	55.8	58.1	18/31	50.0	9/18
1992–2000	438	87	125	80	146	51.6	55.7	118/212	47.8	99/207
2001	55	18	12	6	19	45.5	56.0	14/25	32.1	9/28
2002	46	10	14	6	16	47.8	47.6	10/21	52.2	12/23
2003	73	14	19	8	32	54.8	57.5	23/40	48.4	15/31
2004	68	14	20	5	29	50.0	48.3	14/29	51.4	19/37
2005	74	23	14	5	32	50.0	52.8	19/36	48.6	17/35
2006	83	28	20	7	28	42.2	45.2	19/42	40.0	16/40
2007	94	29	20	14	31	47.9	53.2	25/47	42.9	18/42
2008	117	40	31	7	39	39.3	39.3	24/61	41.2	21/51
2009	113	34	22	4	53	50.4	53.2	33/62	48.9	23/47
2010	98	36	21	8	33	41.8	48.6	18/37	36.2	21/58
2011	108	38	26	11	33	40.7	42.9	18/42	38.3	23/60
2012	116	55	23	9	29	32.8	28.1	16/57	32.7	17/52
2001–2012	1045	339	242	90	374	44.4	46.7	233/499	41.9	211/504
TOTAL	1483	426	367	170	520	46.5	49.4	351/711	43.6	310/711

* Comprises the 50% of patients living in 'more deprived' neighbourhoods, as determined by the median split of IMD2004 ranking of the area lived in.

patients their median (IQR) IMD rank was 1722 (400–4072), n = 711; for the "less deprived" group this was 18,450 (13155–24042), n = 711. Almost all (88%, 625/711) of the patients within the "more deprived" group for analysis were living in the most deprived '20%' of small areas in England and all but 6 in the most deprived '25%'. For those in the "more deprived" group the percentages of late tumours were 56% (118/212) 95% CI 48.7–62.5% for 1992–2000, and 47% (233/499) 95% CI 42.2–51.2% for 2001–2012, Chi Squared test P = 0.03. For those in the "less deprived" group the percentages of late tumours were 48% (99/207) 95% CI 40.9–54.9% for 1992–2000, and 42% (211/504) 95% CI 37.5–46.3% for 2001–2012, Chi Squared test P = 0.16.

3.4. 'Joinpoint' regression analysis

'Joinpoint' regression analysis of 'late' (stage 3 or 4) presentations from 1992 to 2012 indicated a steady fall in the percentage of 'late' oral cancer over the period of the study; the annual percentage change (APC) was -1.27 (95% CI -2.3 to -0.2). A 'zero joinpoint' model was selected by the software indicating that no statistically significant change in trend was identified at any point in the study (Fig. 2).

Similar analyses were carried out for the 'more' and 'less' deprived groups (median split). For neither group was a statistically significant change in trend calculated. However, a greater APC was observed in the 'more deprived' group -1.66 (95%CI -3.0 to -0.3) compared to the 'less deprived' group -0.79 (95% CI -2.5 to +0.9) (Fig. 3a and b).

3.5. Associations with 'late' presentation

In binary regression, year of diagnosis, tumour site and IMD2004 grouping were significantly associated with 'late' presentation (Table 2).

3.6. Year of diagnosis

The risk ratio (95% confidence interval) for patients in the time period 2001–2012 relative to the time period 1992–2000 was 0.86 (0.77-0.96), P = 0.009; adjustment for each other variables in Table 2 made little difference on this risk ratio (range 0.85-0.86) apart from when adjusting for tumour location after which the risk ratio (95% CI) was 0.93 (0.85–1.02), P = 0.13.

3.7. Deprivation

The risk ratio (95% CI) for the 50% of patients living in the 'most deprived' neighbourhoods relative to 'less deprived' neighbourhoods was 1.13 (1.01–1.27), P = 0.03; adjustment for each other variable in Table 2 made little difference on this risk ratio (range 1.13–1.16) apart from when adjusting for tumour location after which the risk ratio (95% CI) was 1.05 (0.96–1.15). p = 0.30

3.8. Site of cancer

Almost all (84%) of lower gum tumours presented late compared to 27% of tumours of the anterior two-thirds of the tongue. Tumour site was associated with IMD2004 grouping (P < 0.001) and borderline with time period (P = 0.06). There was an increase in tumours of the anterior two-thirds tongue from 30% (132/438) during 1992–2000 to 38% (397/1045) during 2001–2012, with slight declines for all other locations. Patients with tumours in the floor of mouth were more likely to live in more deprived areas with 56% (236/425) living in the most deprived quintile of areas within England compared to between 30–41% for other tumour locations; also 63% (267/425) were within the 'more deprived' half of the sample compared to 35–48% for other tumour locations. 'Late' presentation over time is shown by tumour location, IMD2004 deprivation status (median split) and time period in Fig. 4.

4. Discussion

4.1. Increasing numbers of oral cancers

The increase in oral cancers identified in this study reflects the national picture; oral cancer rates in the UK increased by 32%–33% between 2002 and 2012 [24]. It would seem clear that much work

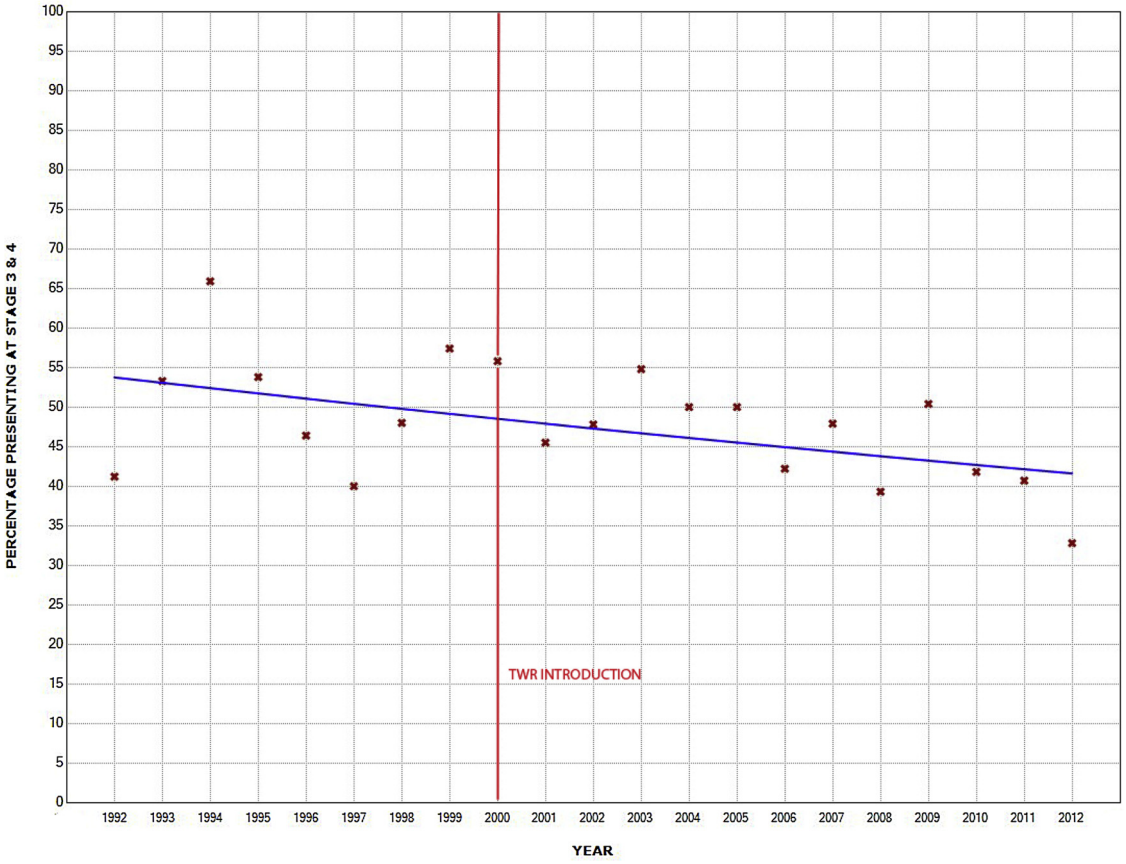

Fig. 2. Joinpoint analysis of late presentations – percentage of oral cancers presenting 'late' by year.1992–2012.
Model selected by *Joinpoint*: 0 joinpoints. Annual percentage change (APC) = −1.27 (95% CI −2.3 to −0.2).

needs to be done on the prevention of oral cancer. The reasons for the increase are not entirely clear. Smoking and alcohol are the most important causes of oral cancer in this study [25]. However, since the 1970s UK smoking rates have markedly declined, although alcohol consumption has steadily increased from the 1960s to the present day [26]. More recently, oral cancers associated with human papilloma virus (HPV) subtype HPV-16 are becoming increasingly prevalent, especially in the oro-pharyngeal region [27]. The data for this study were collected at the central head and neck unit in Merseyside and increasing numbers will be influenced to an extent by centralisation of the oral cancer service following the Calman-Hine report on cancer services [28]. Nevertheless, by the mid to late 1990s almost all oral cancers in Merseyside were managed at the central unit and are, therefore, included in these data.

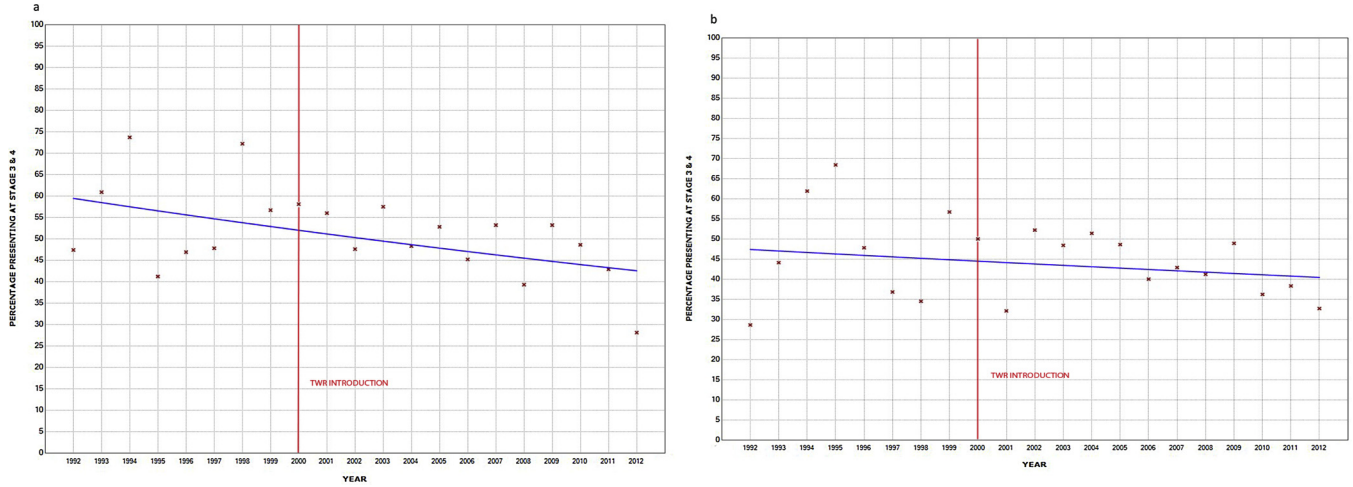

Fig. 3. (a) Joinpoint analysis of late presentations in the 711 patients living in 'more deprived' areas.
Model selected by Joinpoint: 0 joinpoints. Annual percentage change (APC) = −1.66 (95%CI −3.0 to −0.3). (b) Joinpoint analysis of late presentations in the 711 patients living in 'less deprived' areas.
Model selected by Joinpoint: 0 joinpoints. Annual percentage change (APC) = −0.79 (95% CI -2.5 to +0.9).

Table 2
Clinical & demographic factors and presenting with 'late' (stage 3 or 4) oral cancer.

		'Late' stage oral cancer				
		%	n	P value*	Risk ratio	95% CI for Risk ratio
	TOTAL	61	690/1483			
Year of diagnosis	1992–2000	52	226/438	0.01	1.00	Reference
	2001–2012	44	464/1045		0.86	0.77–0.96
Gender	Male	48	437/905	0.10	1.00	Reference
	Female	44	253/578		0.91	0.81–1.02
Age	< 55	42	151/357	0.09	1.00	Reference
	55–64	45	201/444		1.07	0.91–1.25
	65–74	48	179/374		1.13	0.96–1.33
	75–84	52	159/307		1.22	1.04–1.44
Tumour site	Buccal	55	144/264	< 0.001	1.00	Reference
	Lower gum	84	135/160		1.55	1.36–1.76
	Tongue (ant 2/3)	27	144/529		0.50	0.42–0.60
	Floor of Mouth	47	207/438		0.87	0.75–1.00
	Other	65	60/92		1.20	0.99–1.44
IMD2004 split by	More deprived	49	351/711	0.03	1.13	1.01–1.27
Median rank	Less deprived	44	310/711		1.00	Reference
IMD2004 quintiles**	Rank ≤1089	52	148/286		1.47	1.21–1.78
within sample	1090–4748	46	130/283		1.30	1.07–1.60
Rank 1 = most deprived	4749–12168	52	146/283	< 0.001	1.47	1.21–1.78
	12169–20414	48	137/286		1.36	1.12–1.66
	≥20415	35	100/284		1.00	Reference
IMD2004 quintiles***	Rank ≤6496	49	306/625	< 0.001	1.65	1.27–2.16
(England)	6497–12993	53	136/255		1.80	1.36–2.38
Rank 1 = most deprived	12994–19490	47	108/228		1.60	1.20–2.14
	19491–25985	40	69/172		1.36	0.99–1.85
	25986–32,482	30	42/142		1.00	Reference

* Chi-squared test.
** based on an even 20% quintile split of the IMD ranks of the patients in the sample.
*** based on the distribution of IMD ranks across the whole of England.

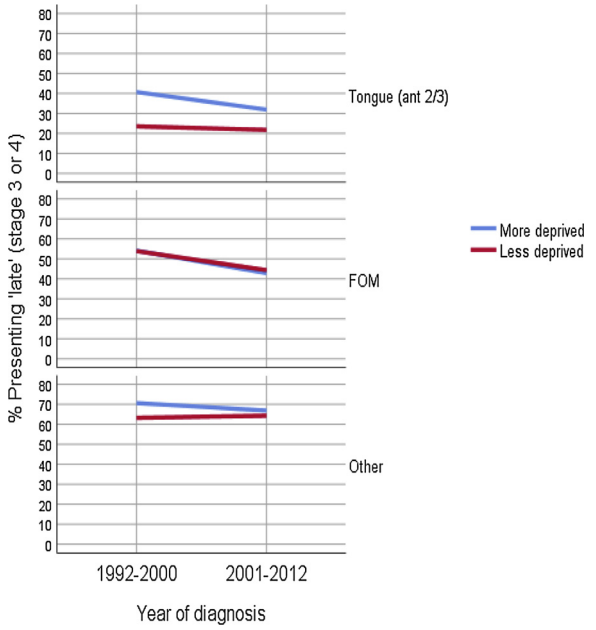

Fig. 4. 'Late' (stage 3 or 4) presentation by tumour location and IMD2004 status (median split) over time (anterior 2/3 tongue, floor of mouth and other sites).

4.2. Stage on presentation before and after the TWR-NICE guidance referral system

This study found that from 1992 to 2012 the percentage of oral cancers presenting 'late' (stage 3 and 4) reduced at an APC of 1.27% per year – with, of course, a corresponding increase in the proportion presenting 'early' (stage 1 and 2). However, in this study, no marked change in the presentation of oral cancer was observed in the period following the introduction of the TWR referral system. The stage on presentation of oral cancer was improving prior to the TWR and continued to improve at a similar rate following its introduction. It is therefore difficult, in the light of the results in this study, to define the exact effect that the introduction of the TWR has had on stage-on-presentation of oral cancer.

There is very limited published work to date in relation to the effect of UK cancer policy on oral cancer outcomes [14]. Published work, in relation to several other cancer types, has presented a mixed picture of changes in survival trends following the implementation of the TWR and associated policies in the NHS Cancer Plan. A study on colorectal cancer, comparing patients referred via the TWR and other methods found no difference in disease stage between patients referred by each pathway [29]. A further study on colorectal cancer compared groups diagnosed before and after the TWR; Kaplan-Meier assessment showed no difference in 2-year survival between the groups [30]. A study on 2746 sarcoma referrals reported that the TWR had 'no impact' on early diagnosis [31]. Conversely, in a study on melanoma, tumours were thinner after the introduction of the TWR and survival improved [32]. In a study of 8049 general practices in England, Moller et al [33] reported that practices with the lowest use of fast-track referral had higher cancer mortality rates. However, in a large study of English cancer survival trends from 1996 to 2013, for 21 cancers but not including head and neck cancer, 26 of the cancer-sex combinations showed steady mortality improvement but with no significant acceleration after the Cancer Plan implementation [34], a pattern reflected in relation to stage on diagnosis in our study.

4.3. Different oral sites

Differences were observed in the change in proportion presenting late at different oral sites. The most marked trend in reduction of late-stage presentation was noted in floor of mouth when compared to anterior tongue and other oral sites, which showed little evidence of reduction over time. The observation regarding floor of mouth may be

attributable to reduction in smoking and alcohol abuse, as it is believed that there is a relationship between these factors and advanced-stage tongue and floor of mouth cancer [35].

4.4. Relationship to socio-economic deprivation

This study identified an overall steady improvement in stage-on-diagnosis of oral cancer in Merseyside from 1992 to 2012 and both the least and most socially deprived groups benefited in this respect. Interestingly, the annual percentage change was greater for the most deprived. Nevertheless, despite this improvement there was a persistent gap to 2012 between the social groups, with a greater proportion of late disease in the most deprived. It is known that oral cancer – like cancer of the lung and oesophagus - is more likely to be diagnosed in socially deprived groups, and socio-economic difference in survival from head and neck cancers are among the largest of any malignancies [18]. Published work has shown that a 'deprivation gap' exists for most cancer types and in some cancer types – brain in men and lung in women – the gap would appear to be increasing [34]. For oral cancer, it is believed that much of the difference can be related to lifestyle factors, especially higher smoking rates among the socio-economically deprived [36]. The nature of the causes of socio-economic differences in head and neck cancers is complex and some deprivation effects on survival from head and neck cancers might be mitigated through earlier detection and referral [18].

5. Strengths and limitations of this study

To our knowledge, this is the first published study examining changes in stage on presentation of oral cancer before and after the introduction of the UK two-week rule and associated guidance for practitioners. The study also examines the change in stage on presentation in relation to socio-economic deprivation.

The study includes validated staging data for 1485 patients diagnosed with oral cancer over a 21-year period, using the Merseyside head and neck cancer database. An important advantage of this database is that it includes accurate staging data from the early 1990s onwards, allowing a stage on presentation comparison to be made before and after the introduction of the NHS Cancer Plan and TWR. The data period is up to 2012 but this was considered appropriate for comparing the periods before and after the introduction of the TWR. We noted an increasing presentation of oral cancers in Merseyside consistent with the national trend; however, due to shifting referral boundaries, changing consultant staff and different referral patterns over a 21-year period incidence rates are difficult to calculate with accuracy from our data.

The study is confined to a single unit, in a region where the incidence of oral cancer is the second-highest in the UK [37]. The findings in this study may be influenced by several factors, including the socio-economic structure of the population and regional incidence of the disease. Whilst regions with similar populations are likely to reflect the outcomes of this study, a comparison with areas of different socio-economic structure and oral cancer incidence would be of interest and value. A further consideration is the fact that in the years immediately following the introduction of the TWR, less than 50% of head and neck cancers were diagnosed via TWR referrals, although there is evidence that the percentage is increasing [14].

In this study clinical staging (including MRI/CT examination when available) was used. The problem with clinical staging is that a small percentage of apparently N_0 cases will, following neck dissection, demonstrate positive nodes. However, if 'pathological' staging is used patients treated with radiotherapy alone do not provide a neck specimen for pathological examination and hence their neck pathology remains unknown. In short, both 'clinical' and 'pathological' staging have disadvantages in a study of this type. For consistency, we elected to use clinical staging.

Regarding deprivation, several versions of IMD existed during the years of the study. We used IMD 2004 for the entire study as it represented a wide range of years included in the study. The vast majority of patient postcodes were those at presentation but a minority were later. IMD focuses on areas but lacks sensitivity to individual deprivation.

6. Conclusions and implications

This study found that the stage on presentation of oral cancer in Merseyside has steadily improved from 1992 to 2000. The improvement continued following the introduction of the TWR in 2001 but 'Joinpoint' analysis did not demonstrate a change in trend. Improvements in stage on diagnosis were evident in both the least and most deprived social groups with the most deprived showing more rapid improvement. However, throughout the study the most deprived presented later than the least deprived and the ''gap' persisted to the end of the study. Despite the improvement in stage on presentation of oral cancer, the number of cases diagnosed per year increased at an annual percentage change of 5.8% for the duration of the study. Amongst oral sites, the most marked reduction in the proportion of late cases was observed in floor of mouth cancers, possibly due to reduction in smoking.

In summary, the introduction of the TWR did not make a notable difference to the steady improvement over time in stage on presentation. Although the rate of improvement in stage on presentation was greatest for the more deprived groups, deprivation inequality remains with the least deprived presenting with more advanced cancer and this should be a focus of further initiatives and research. Furthermore, in the light of the increasing incidence of oral cancer, more work needs to focus on the causes and prevention of the disease.

Ethics approval

Ethical review was undertaken by the Medical Sciences Inter-Divisional Research Ethics Committee of the University of Oxford who confirmed that the study does not require ethical approval because it analyses information previously collected during normal care. The study was carried out in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data

On request.

Conflict of interest

Mr. Steve Langton: none.
Professor Derek Lowe: none
Professor Simon Rogers: none
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Author Contributions

SL, SNR, DL, AP and BD conceived and planned the study. Data were retrieved and validated by SL, DL and SNR. SL and DL wrote the manuscript with input from all authors. Statistics and analyses were carried out by DL and SL. All authors were involved in discussing and

interpreting the results.

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