


# Primary care triaging of head and neck cancer referrals using the head and neck cancer risk calculator version 2: impact on a tertiary head and neck service

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## Main Article

Dr L Li takes responsibility for the integrity of the content of the paper

**Cite this article:** Li L *et al.* Primary care triaging of head and neck cancer referrals using the head and neck cancer risk calculator version 2: impact on a tertiary head and neck service. *J Laryngol Otol* 2023;**137**:763–768. <https://doi.org/10.1017/S002221512200192X>

Accepted: 10 August 2022  
First published online: 23 August 2022

### Key words:

Head And Neck Neoplasm; Covid-19; Triage; Primary Care; Referral And Consultation

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## Abstract

**Objective.** This study aimed to investigate the use of the head and neck cancer risk calculator version 2 in a primary care setting and to evaluate the impact of the risk calculator on the number of referrals stratified by urgency and cancer yield.

**Method.** Referrals between April 2019 and August 2019, April 2020 and July 2020 (pre-risk calculator) and August 2020 and July 2021 (post-risk calculator) were analysed. Referral urgency, head and neck cancer risk calculator version 2 score, cancer diagnosis, cancer type and further investigations were recorded.

**Results.** The 2023 patient encounters were analysed; there were 1110 (55 per cent) referrals before head and neck cancer risk calculator version 2 use and 913 (45 per cent) after head and neck cancer risk calculator version 2 use. A higher proportion of older ( $p < 0.001$ ) and male ( $p < 0.013$ ) patients were seen post-head and neck cancer risk calculator version 2 use. All cancer cases were seen on the urgent suspicion of cancer pathway post-head and neck cancer risk calculator version 2 use; however, a higher proportion of patients were seen as urgent suspicion of cancer (51.1 vs 83.5 per cent;  $p < 0.001$ ). Overall, the cancer diagnosis rate increased from 2.7 to 4.1 per cent.

**Conclusion.** The head and neck cancer risk calculator version 2 had high sensitivity in cancer diagnosis. More studies are required to optimise the predicted versus actual cancer probability gap.

## Introduction

Over 1200 new cases of head and neck cancer were diagnosed in Scotland in 2017.<sup>1</sup> The UK National Guidelines for referring suspected head and neck cancer were developed by the Department of Health in December 2000.<sup>2</sup> It stated that there should be a maximum 14-day wait between the patient's referral from primary care to being seen by a hospital specialist. The aim was to improve the head and neck cancer detection rates and reduce diagnostic delay and time to initiation of treatment. Cancer referral guidelines were also published to guide general practitioners with a checklist of red-flag symptoms, which have since been refined several times over the past two decades.<sup>3</sup> Nonetheless, several studies have investigated the effectiveness of these guidelines for suspected head and neck cancer. Concerningly, these studies have demonstrated that only up to 40 per cent of 2-week referrals are diagnosed with head and neck cancer and that the majority of the cancer diagnoses come from outside the urgent referral pathway.<sup>4–6</sup>

In order to refine the referral process, there has been significant progress in recent years in producing statistical models to estimate the risk of head and neck cancer based on a patient's demographic data and presenting symptoms.<sup>7–9</sup> The first head and neck cancer risk calculator was developed in 2016 based on presenting symptoms, signs and demographic data of patients seen across two large head and neck units in England. The head and neck cancer risk calculator was subsequently externally validated in a Scottish population, retaining its predictive power. This study also showed that the English and Scottish populations had directly comparable demographic data, cancer incidence and distribution of presenting symptoms, thereby allowing the use of the head and neck cancer risk calculator across different UK regions. The risk calculator was further refined to increase its prediction potential in 2019 (head and neck cancer risk calculator version 2) by incorporating smoking and alcohol history and updating symptoms in addition to taking into account symptom persistency and laterality. The head and neck cancer risk calculator version 2 has been internally validated with a predictive power of 88.6 per cent.<sup>10</sup>

Following cancer risk prediction, patients can be allocated an out-patient appointment based on the level of risk as determined by the model (urgent suspicion of cancer cut-off:

more than 7.1 per cent; urgent cut-off: 7.1 to 2.2 per cent; routine: less than 2.2 per cent).<sup>10</sup> This individualised approach to risk stratification has the potential to reduce the number of patients diagnosed with head and neck cancer who are referred from outside cancer pathways, therefore reducing the diagnostic delay and enabling better allocation of National Health Service (NHS) resources. In addition, such models could be utilised more efficiently by improving the yield from cancer appointments

Integrating the use of a head and neck risk calculator into routine clinical practice faces many potential challenges. To date, symptoms have been determined in secondary care rather than at the point of primary-care referral.<sup>7,8</sup> For this tool to be most useful, it would be predictive based on primary-care derived (or even patient-reported) data. Therefore, whether the performance of the statistical model will be similar at the point of primary-care referral is unclear.

The head and neck cancer risk calculator version 2 was introduced in NHS Lothian in August 2020 at the interface between primary and secondary care. This study aimed to investigate the use of the head and neck cancer risk calculator version 2 in a primary-care setting. The study objectives were to evaluate the impact of the risk calculator applied in primary care on the number of referrals stratified by urgency and the cancer yield and to determine whether resource utilisation in cancer screening appointments can be improved.

## Materials and methods

In July 2020, regional general practitioners referring patients with suspected throat cancer to ENT in NHS Lothian were directed but not mandated to use the head and neck cancer risk calculator version 2 as a triage aid (Figure 1). General practitioners were prompted to complete the risk calculator as part of a throat referral to secondary care and to include

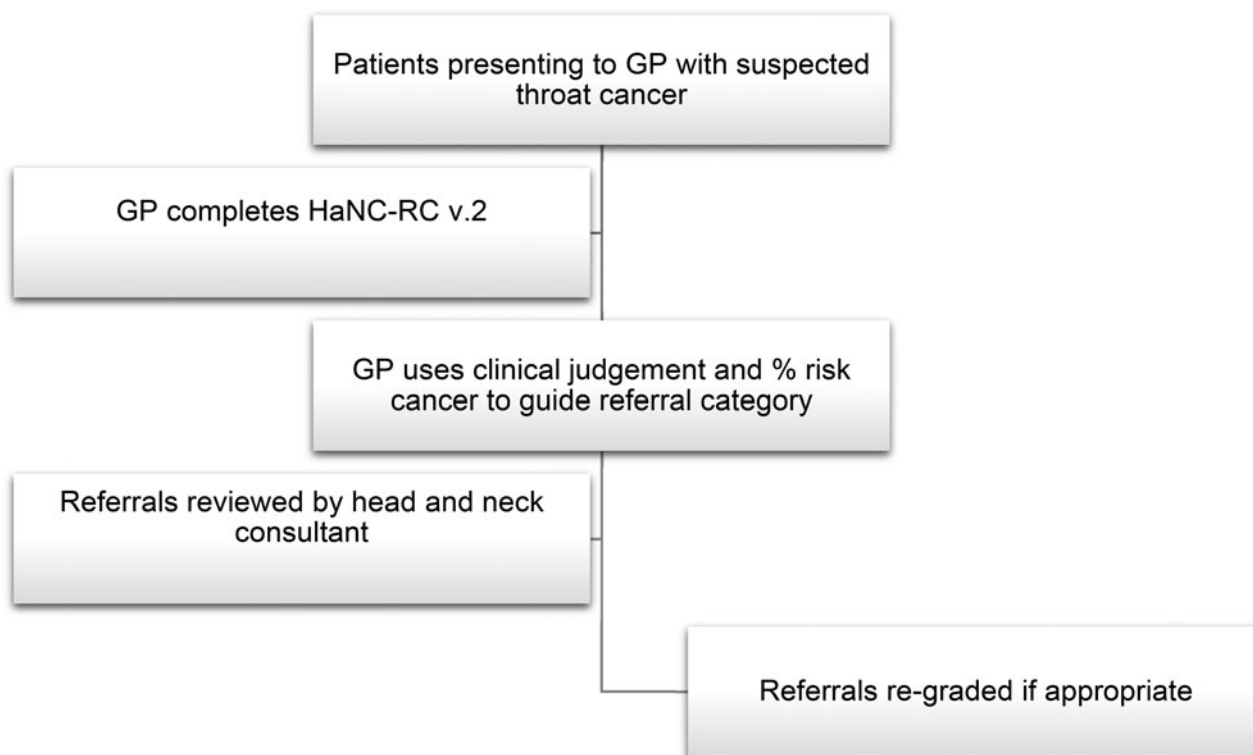
the risk percentage of cancer as determined by the head and neck cancer risk calculator version 2 in their referral. General practitioners could then select the appropriate referral category (routine, urgent or urgent suspicion of cancer) based on their clinical judgment and the head and neck cancer risk calculator version 2 triage aid information. All referrals were re-triaged on receipt by a departmental head and neck consultant and re-graded if considered appropriate. However, the data presented relates to the primary-care triage outcome (Figure 1).

Patients who were seen in (rather than referred to) the department between April 2019 and August 2019, April 2020 and July 2020 (pre-risk calculator) and August 2020 and July 2021 (post-risk calculator) were analysed by a group of medical students, supported by the senior authors, to determine whether the risk calculator was utilised prior to referral, the percentage risk generated by the risk calculator (if utilised) and whether cancer was eventually detected. Only patients seen in the department were included because we were unable to confirm cancer status in those patients referred but still awaiting review at the time of analysis. Because of restrictions on routine appointments during the coronavirus disease 2019 (Covid-19) pandemic, a significant number of routine referrals were awaiting review.

Exclusion criteria were: patients who did not attend their out-patient appointment, those seen by a specialty other than otolaryngology and non-primary care referrals. The referral urgency, head and neck cancer risk calculator version 2 score, cancer diagnosis, cancer type and further investigations were extracted from the electronic patient records.

## Statistical analysis

Statistical analysis was performed using SPSS® statistical software. Comparison of categorical variables was performed



**Fig. 1.** Referral pathway for patients with suspected throat cancer in NHS Lothian. GP = general practitioner; HaNC-RC v.2 = head and neck cancer risk calculator version 2

**Table 1.** Comparison of age and gender in patients reviewed pre- and post-head and neck cancer risk calculator version 2 use

Parameter	Pre-head and neck cancer risk calculator version 2 (n (%))	Post-head and neck cancer risk calculator version 2 (n (%))	P-value
<b>Age group</b>			
- <40 years	206 (18.6)	90 (9.9)	<0.001
- 40–60 years	369 (33.2)	354 (38.8)	
- >60 years	535 (48.2)	469 (51.4)	
<b>Gender*</b>			
- Male	503 (45.3)	470 (51.5)	<0.006
- Female	606 (54.6)	443 (48.5)	

\*One patient in the pre-head and neck cancer risk calculator version 2 period did not have gender specified

using the chi-squared test. A *p*-value of less than 0.05 was considered to be statistically significant.

**Results**

Overall, 2023 patient encounters were analysed; 1110 (55 per cent) were referrals from the pre-head and neck cancer risk calculator version 2 period, and 913 (45 per cent) were from the post-head and neck cancer risk calculator version 2 period. There was a higher proportion of older (*p* < 0.001) and male (*p* < 0.013) patients seen in the post-head and neck cancer risk calculator version 2 group (Table 1).

There were seven cancers diagnosed in patients who were referred as non-urgent suspicion of cancer prior to the introduction of the head and neck cancer risk calculator version 2. Of the limited number of patients referred as non-urgent suspicion of cancer following introduction of the head and neck cancer risk calculator version 2, no cancers were diagnosed in this group. There was no difference in the proportion of patients diagnosed with cancer referred as urgent suspicion of cancer (4.1 per cent vs 4.1 per cent; *p* = 0.51) (Table 2). Overall, the head and neck cancer diagnosis rate was 2.7 per cent before and 4.1 per cent after the introduction of the head and neck cancer risk calculator version 2 (Table 2).

Because use of the risk calculator was not mandatory, 99 of 913 (11 per cent) patients were referred without a predicted score. In the post-head and neck cancer risk calculator version 2 period when the risk calculator was used, there was a smaller proportion of routine referrals (3.6 per cent vs 17.2 per cent) and a higher proportion of urgent suspicion of cancer referrals (86.2 per cent vs 63.6 per cent), but the number of patients

without a score was small. There was no difference in the proportion of cancers diagnosed in the urgent suspicion of cancer referral group (4.6 per cent vs 5 per cent) (Table 3).

Of the 2023 referrals analysed, 828 (40.1 per cent) had a head and neck cancer risk calculator version 2 risk calculator score on referral, with 14 (1.7 per cent) in the pre-head and neck cancer risk calculator version 2 period and 814 (98.3 per cent) in the post-head and neck cancer risk calculator version 2 period. Higher risk calculator scores were found to correlate with an increased likelihood of head and neck cancer diagnosis, particularly when more than 70 per cent (Figure 2).

Based on the head and neck cancer risk calculator version 2 recommended cut-offs (urgent suspicion on cancer cut off: 7.1 per cent; urgent cut-off: 2.2 per cent), 77.1 per cent had a risk calculator score of more than 7.1, with 100 per cent of head and neck cancers being identified within this group (Figure 3, Table 4). The head and neck cancer risk calculator version 2 sensitivity was 100 per cent, but the specificity was low at 13.7 per cent. The negative predictive value was 100 per cent, and the positive predictive value was 4.3 per cent.

**Discussion**

Although primary care physicians can examine the oral cavity and neck, the pharynx and larynx cannot be easily visualised without the use of fibre-optic laryngoscopy. Therefore, patients with symptoms relating to these sites present a diagnostic challenge. The introduction of cancer waiting times and referral guidelines has provided a framework for referral, but problems still exist. Not only is the percentage of cancers referred as suspected cancer low, but the rate of cancer within the non-cancer referral group is high.<sup>4–6</sup>

With the rising number of cancer pathway referrals and increasing pressure to meet government targets,<sup>11</sup> it was hoped that a head and neck risk calculator could lead to improvements in patient outcomes by using signs and symptoms to identify those patients at greatest risk of cancer and therefore reduce diagnostic delays. By providing an individualised cancer risk prediction score at the point of triage, not only would the referring clinician have the opportunity to familiarise themselves with the risk factors associated with head and neck cancer, but a significant clinical impact may also be achievable. One of the key challenges in head and neck cancer is the early identification of patients. Many patients delay before seeking medical attention, and the percentage of head and neck cancer that presents with the urgent suspicion of cancer pathway is high, resulting in patients with late-stage disease and limited treatment options.<sup>12</sup> Implementation of

**Table 2.** Comparison of referral categories and cancer diagnoses in patients reviewed pre- and post-head and neck cancer risk calculator version 2 use

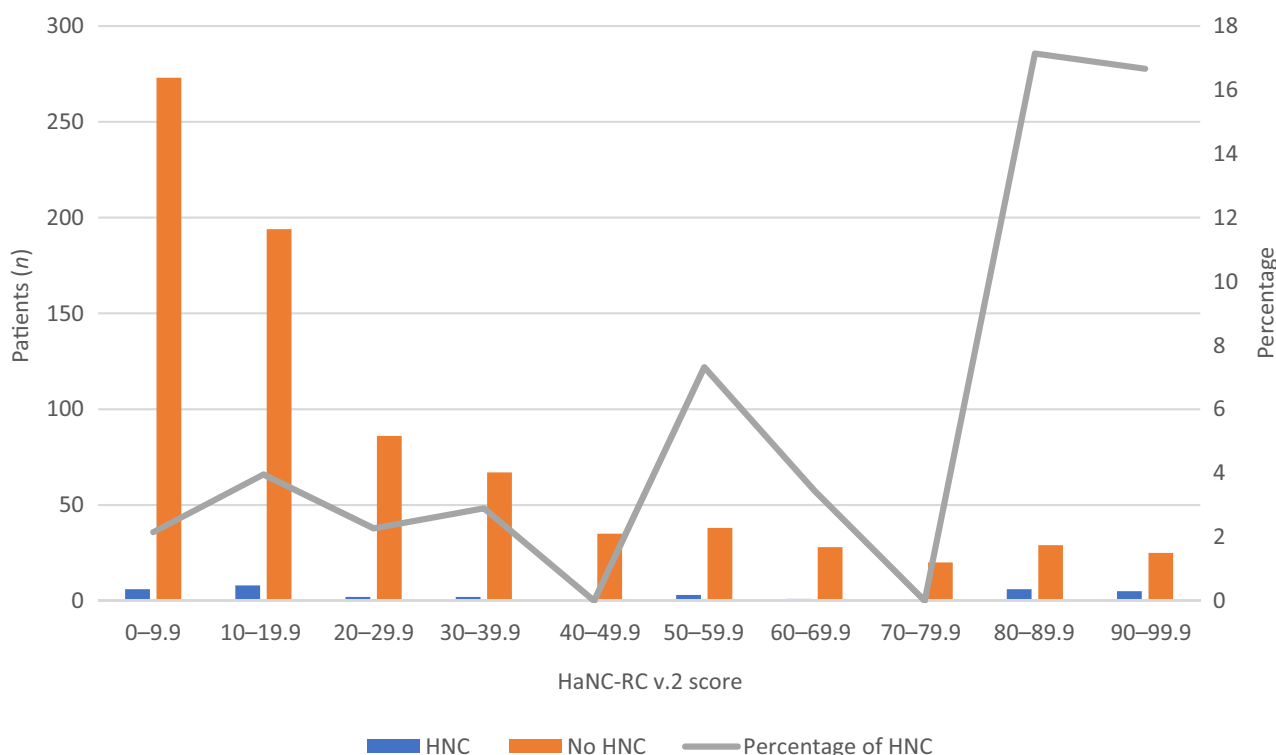
Parameter	Pre-head & neck cancer risk calculator version 2		Post-head & neck cancer risk calculator version 2		P-value
	Patients (n (%))	Patients with head & neck cancer (n (% referral))	Patients (n (%))	Patients with head & neck cancer (n (% referral))	
Routine	345 (31.1)	1 (0.3)	46 (5)	0	NA
Urgent	198 (17.8)	6 (3)	102 (11.2)	0	NA
Urgent suspicion of cancer	567 (51.1)	23 (4.1)	765 (83.8)	37 (4.1)	0.51*
Total	1110	30 (2.7)	913	37 (4.1)	

\*Statistically significant value. NA = not applicable

**Table 3.** Comparison of referral categories in patients reviewed post-head and neck cancer risk calculator version 2 use, with and without a risk calculator score

Parameter	Without score (%)		With score (%)		P-value
	Patients (n (%))	Patients with head & neck cancer (% referral)	Patients (n (%))	Patients with head & neck cancer (% referral)	
Routine	17 (17.2)	0	29 (3.6)	0	NA
Urgent	19 (19.2)	0	83 (10.2)	0	NA
Urgent suspicion of cancer	63 (63.6)	5 (5)	702 (86.2)	33 (4.6)	0.260
Total	99	5 (5)	814	33 (4.6)	

NA = not applicable



**Fig. 2.** Proportion of cancer diagnoses by head and neck cancer risk calculator version 2 (HaNC-RC v.2) score. HNC = head and neck cancer

the risk calculator could reduce this inappropriate referral rate, accurately up-triaging 25 per cent of patients with a head and neck cancer from non-urgent suspicion of cancer pathways. This has the potential to significantly reduce waiting times for this high-risk patient group.

In our experience, introduction of the head and neck cancer risk calculator version 2 at the point of primary care was associated with an increase in the proportion of patients reviewed as suspected cancer (51.1 per cent vs 83.5 per cent;  $p < 0.001$ ). However, this was significantly impacted by the Covid-19 pandemic. In the UK, patients were discouraged from accessing medical services for non-urgent conditions, general practitioners were encouraged only to refer urgent cases, and in secondary care only urgent or potential cancer case patients were offered appointments. Therefore, the percentages of patients seen per clinic type in the pre- compared with the post-head and neck cancer risk calculator version 2 era are not directly comparable, and the conclusions that can be drawn on patterns of referral are limited.

However, by limiting our analysis to those patients who were actually seen, interpretation of the association of risk cancer scores and the actual risk of cancer remains valid. Based on the previously recommended cut-offs initially recommended

by the original authors, the majority of patients (77.1 per cent) had a risk calculator score of more than 7.1, with 100 per cent of head and neck cancers being identified within this group. This is likely to reflect the methodology of the study, where the group of patients analysed was made up of patients who were seen in the department, rather than referred because of Covid-19 delays.

Our data show a correlation between the predicted and actual risk of cancer in a large group of patients referred using the risk calculator. In particular, when the predicted risk score exceeded 70 per cent, the actual risk of cancer rose from around 4 per cent to 17 per cent. This correlation suggests that the risk calculator could be of use in primary care. However, perhaps as expected, it functions differently in the hands of primary care clinicians in comparison with use in the secondary care setting, with general practitioners being generally less familiar with the red flag symptoms indicative of head and neck cancer in comparison with experienced ENT consultants and differences in risk aversion levels. It appears that general practitioners used the head and neck cancer risk calculator version 2 similarly to the Scottish Intercollegiate Guidelines Network and National

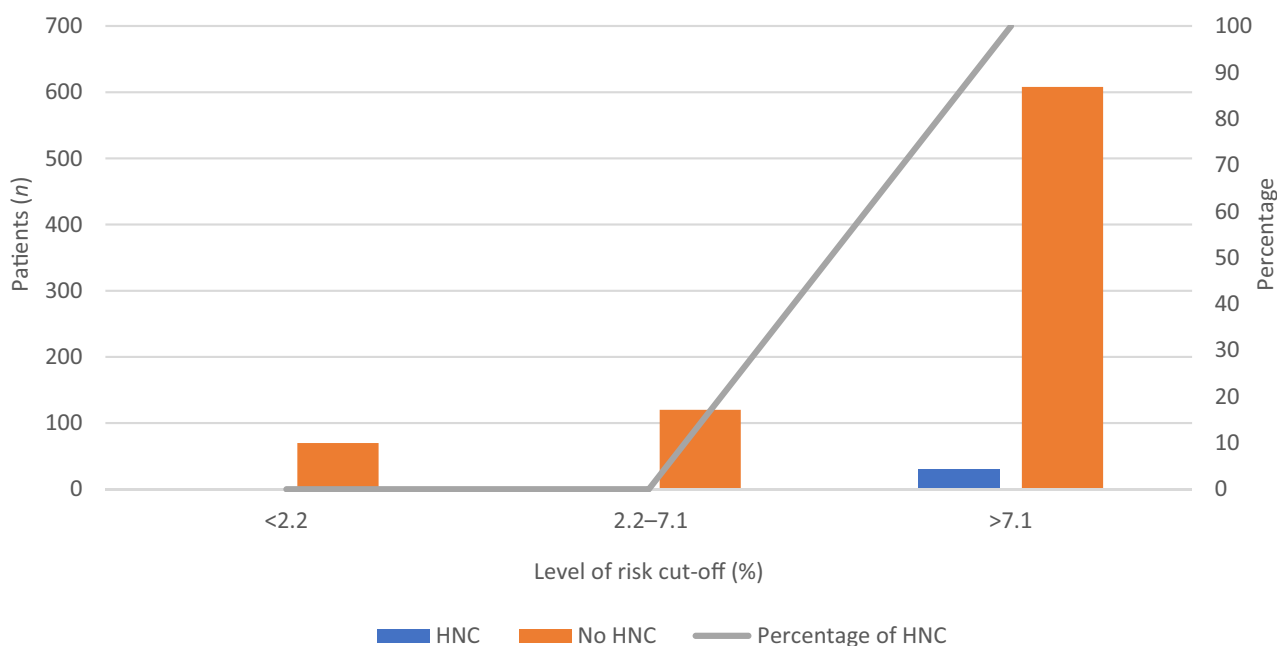


Fig. 3. Distribution of head and neck cancer risk calculator version 2 score based on the original cut-offs among patients being seen. HNC = head and neck cancer

Table 4. Distribution of referrals based on cut-offs\* proposed by original authors among patients reviewed

Parameter	Original cut-offs*	
	Patients (n (%))	Patients with head & neck cancer (n (% referral))
Routine	70 (8.4)	0
Urgent	120 (14.5)	0
Urgent suspicion of cancer	638 (77.1)	33 (100)
Total	828	33

\*Urgent suspicion on cancer cut off: 7.1 per cent; urgent cut-off: 2.2 per cent

Institute for Health and Care Excellence (NICE) guidance. The positive predictive value of the calculator was 4.3 per cent in this primary care validation study, being very close to the 3 per cent positive predictive value referral threshold recommended by NICE.<sup>2</sup> Moreover, actual risk levels were far lower than predicted using the secondary care model, which presents a number of challenges. Again, this may reflect differences in data collection methodology compared with the original validation study, with our own study analysing patients seen, rather than referred, and a comparatively smaller cohort limiting interpretation of empirical probability.

This information can be used locally to good effect. For example, those patients with the highest risk score can be streamed to clinicians with an interest in head and neck cancer and managed in a setting with additional support, such as the presence of clinical nurse specialists for out-patients.

However, the apparent inflation of risk prediction score is likely to encourage clinicians to refer an increasing number of patients as potential cancers, placing secondary care under increasing pressure to review a large percentage of patients urgently. More data in the post-Covid-19 era will be required to confirm this.

In addition, the fact that risk prediction scores are far higher than actual risk presents a problem for the referring clinician

and patient. If the clinician discloses this risk score to the patient, a high level of alarm will be generated unnecessarily. It is also difficult to say to a referring clinician that despite a predictive tool returning an estimated risk of cancer of over 30 per cent, it is considered by secondary care to be adequately low risk to recommend a non-cancer pathway referral.

- A head and neck cancer risk calculator was developed in 2016 from data derived from secondary care
- The calculator estimated the risk of head and neck cancer based on a patient's demographic data and presenting symptoms
- The head and neck cancer risk calculator version 2 correctly identified all cancer cases
- Its addition to the referral process between primary and secondary care for patients with throat symptoms seems to result in a greater percentage of patients referred to the cancer pathway
- The impact has been difficult to assess because of the concurrent effect of the coronavirus disease 2019 pandemic
- The calculator has a high sensitivity in predicting cancer outside of the secondary care setting, but further studies are required to optimise the predicted versus actual cancer probability gap above the high-risk cut-off

We have shown there is a correlation between symptom and risk prediction of head and neck cancer when symptoms are recorded in primary care. However, the risk calculator is available for all to use. When one considers the disconnect between predicted and actual risk in the primary care setting, it is likely that this disconnect is even greater were patients to assess their own symptoms and seek referral based on self-assessed risk prediction. Again, this has the potential to inflate the actual risk and cause alarm. Further work in the community would be required to confirm this.

This is the first paper focusing on use of the head and neck cancer risk calculator version 2 in a primary care setting. Several papers have recently been published that demonstrate the utility of the head and neck cancer risk calculator version 2 with remote secondary care triage, resulting in a significant reduction in the percentage of patients referred as an urgent suspicion of cancer without compromising sensitivity.<sup>13-17</sup> The head and neck cancer risk calculator version 2 in this setting has the

potential to have a meaningful effect on the assessment and management of patients presenting with head and neck symptoms, particularly in the redistribution of resources post-Covid-19. However, our findings suggest that translation from secondary to primary care use of this predictive tool may not be straightforward, and additional work is required to refine the model and adapt it to use in this setting.

### Limitations

Despite a large number of patients seen (over 2000), the number of cancers within our cohort was low ( $n = 67$ ). However, the major limitation of our study is the effect of Covid-19 in restricting the number of non-urgent suspicion of cancer appointments offered during the post-head and neck cancer risk calculator period. It is likely that some routine referrals, still awaiting out-patient appointments, include patients with cancer, which will impact on our results. As only patients who were seen were analysed, it is not possible to accurately evaluate the impact of the head and neck cancer risk calculator version 2 on the total number of patients referred in each group.

### Conclusion

The impact of introducing a head and neck cancer risk calculator into the referral process between primary and secondary care for patients with throat symptoms has been difficult to assess because of the significant implications of the Covid-19 pandemic, which occurred at a similar time. The results from our study suggest that a greater percentage of patients are referred on the cancer pathway following introduction of the calculator; nevertheless, no cancer cases were missed. Our experience suggests that there is a correlation between predicted and actual risk score, although predicted scores significantly exceed actual risk. Although the head and neck cancer risk calculator version 2 appears to predict the risk of cancer outside of secondary care, further work is required to optimise the actual versus predicted probability gap prior to a widespread adoption in primary care referral pathways.

**Competing interests.** None declared

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