

- ing%20UD%2029.05.pdf (accessed August 2016).
- Dental Protection Limited. Tooth whitening. 2014. Available at: <http://www.dentalprotection.org/uk/publications-resources/updates/position-statements-displaypage/2014/12/08/tooth-whitening> (accessed 4 June 2016).
  - Dental Defence Union. The legal position on tooth whitening. 2014. Available at: <http://www.theddu.com/guidance-and-advice/latest-updates-and-advice/the-legal-position-of-tooth-whitening> (accessed 4 June 2016).
- DOI: 10.1038/sj.bdj.2016.618

## Oral cancer

### Breath of death

Sir, yet another patient presented late to our outpatient service with a large oral growth. Questioning confirmed early self-detection several months previously. Late diagnosis of malignancies in developing nations is due to limited access in rural areas to biopsy services. Anecdotal discussion with colleagues confirms a 'breath of death', a peculiarly pungent halitosis noted in the breath of oral malignancy patients. Our hypothesis is that the genetic makeup of tumours and their distorted molecular pathways lead to synthesis of unique proteins that generate 'signature odours'. If this were true, a paradigm shift in early detection of malignancies might rely not on visual detection but on analysis of patients' volatile molecular samples. The keen sense of smell of dogs is already used for detection of narcotics and explosives; pattern analysis to detect malignancies in this manner has been demonstrated.<sup>1</sup>

Reverse engineering of biological olfactory mechanisms and pathways may improve

electronic olfaction to enable reliable diagnostics.<sup>2</sup> It is not impossible to imagine a future where a compact, affordable electronic olfaction module plugs into a clinician's smartphone enabling odour analysis even at locations remote from healthcare facilities (Fig. 2). Algorithms comparing detected molecules with online databases of 'olfactory signatures' would suggest a mathematical probability of oral malignancy. Animals' reliance on olfaction to detect prey, predators and mates hints at the potential sensitivity and specificity of electronic olfaction.

The non-invasive quality of odour analysis promises speed, painlessness and affordability. Apart from malignancies, odour analysis might help to detect even metabolic disorders in the doctor's office. Even while writing this letter, news has emerged that malaria could be diagnosed by a breath test. We anticipate this to be a future path of research in computational biology. Odours have never been more exciting for life sciences; clinicians of yore would be surprised and pleased at such emerging new diagnostic tools.<sup>3</sup>

N. Uppal, P. Singh, India

- Horvath G, Andersson H, Nemes S. Cancer odour in the blood of ovarian cancer patients: a retrospective study of detection by dogs during treatment, 3 and 6 months afterward. *BMC Cancer* 2013; **13**: 396–402.
- Bijland L R, Bomers M K, Smulders Y M. Smelling the diagnosis: a review on the use of scent in diagnosing disease. *Neth J Med* 2013; **71**: 300–307.
- Drake W M. General patient examination and differential diagnosis. pp 18–19. In: Glynn M, Drake W (eds). *Hutchison's clinical methods*, 23rd edition. Saunders, Elsevier, 2012.

DOI: 10.1038/sj.bdj.2016.619

## Khat and cancer

Sir, we read the letter *Oral health: The destructive effects of khat* by Dr Marway.<sup>1</sup>

Dr Marway has observed destructive effects of khat on oral health in habitual khat chewers but it can be attributed to consumption of high sugar drinks and sugar tablets to counteract the bitter taste. It was observed by W. Luqman and T. S. Danowski that dental cavities are rare in Yemen when khat chewing people are not consuming sugar sweetened beverages.<sup>2</sup> There is a correlation between habitual khat chewing and oral cancer.<sup>3</sup> Oesophageal and gastric carcinoma have been observed in khat chewers in both men and women in Yemen.<sup>4</sup> There is evidence connecting khat chewing to genetic damage of the oral mucosa and cancer.<sup>5</sup>

Mahantayya V. Math,  
Yashoda R. Kattimani, India

- Marway R. Oral health: The destructive effects of khat. *Br Dent J* 2016; **221**: 2.
- Luqman W, Danowski T S. The Use of Khat (*Catha edulis*) in Yemen: Social and Medical Observations. *Ann Intern Med* 1976; **85**: 246–249.
- Soufi H E, Kameswaran M, Malatani T. Khat and oral cancer. *J Laryngol Otol* 1991; **105**: 643–645.
- Gunaid A A, Sumairi A A, Shidrawi R G et al. Oesophageal and gastric carcinoma in the Republic of Yemen. *Br J Cancer* 1995; **71**: 409–410.
- Kassie F, Darroudi F, Kundi M, Schulte-Hermann R, Knasmüller S. Khat (*Catha edulis*) consumption causes genotoxic effects in humans. *Int J Cancer* 2001; **92**: 329–332.

DOI: 10.1038/sj.bdj.2016.620

## Dental education

### Mobilising resources

Sir, I refer to the letter published in June<sup>1</sup> and the proceedings of the lower house of Indian Parliament on 19 July 2016 regarding the issue of unemployment among Indian dental graduates.

On 19 July 2016 Dr Retna De Nag, a member of the Indian Parliament (MP), a doctor by profession, raised the issue of acute unemployment among new Indian dentists in a speech in the lower house.<sup>2</sup> She spoke of the 309 dental colleges in India that produce about 36,000 dental graduates every year compared to 8,000 in 1970, pointing out that the real issue is due to this mushrooming of dental colleges about which the Dental Council of India (DCI) had done nothing. She accused the DCI of failing miserably in performing its primary function and said that the regulator should have acted in time to adjust the availability of dentists dependent on demand.

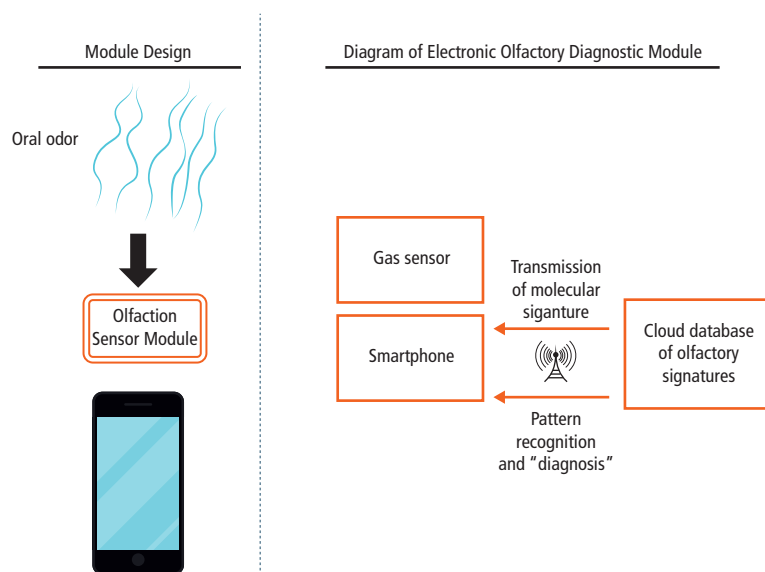


Fig. 2 Diagram of electronic olfactory diagnostic module