

Mobile phones in pathology

I read with interest the article entitled 'Applications of camera phones in tele-haematology' by McLean *et al.*¹ The article deals with the use of mobile phones in pathology and specifically haematology in peripheral blood diagnosis.

We have previously published² on the use of mobile-phones in telemedicine, setting out three circumstances that favour their use:

- (1) Mobile phones have been used with success in specialties in which diagnosis is based on images such as dermatology³;
- (2) Microscopes have been miniaturized to 4M (Multi-Modal Miniature Microscopes)^{4,5} which make them easy to integrate with mobile phones;
- (3) Mobile phones now contain 12 Mpixel cameras.

The features of the McLean *et al.* study were that:

- (1) Mobile phone cameras were positioned over the microscope eye-piece;
- (2) All the mobile phones had CMOS cameras, which are known to be particularly 'noisy';
- (3) Detection of the lesion was done by comparing images on the screen of the capture mobile phone versus the receiver mobile phone in nine blood smears using a single image.

It is well known that the main drawbacks in telepathology are:

- (1) Sampling errors, particularly in specialties where diagnosis is done at high magnification, such as haematology and cytology;
- (2) Image quality, since diagnosis is based on colour and shape modifications.⁶

Sampling problems can be minimized by using virtual slides (i.e. digitization of the whole slide).^{7,8}

Image quality depends on pixel density and the colour capabilities of the camera chip, as well as its white balance and colour aberrations. In mobile phone cameras, the 'noise' associated with the CMOS sensor is an added

consideration, together with the visibility of the image, which is related to the display size (i.e. projection magnification).⁹

Although I am in favour of using mobile phones in telemedicine, there are two different situations. First, there is ordinary diagnosis, prevention and treatment, which requires image capture, transmission and display to the recognised standard for health care. Second, there are urgent or emergency situations, including those present in developing countries or in underserved regions, in which the benefit of using telemedicine applications that may be of substandard quality brings more advantages than not using telemedicine at all. In the latter circumstances, the health-care system could be considered negligent for not using telemedicine. McLean *et al.*'s suggested use of mobile phones for tele-haematology appears to belong to the second category.

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