No longer 'written off' – times have changed for the BBV-infected dental professional

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Abstract

There is a recognised potential risk of transmission of blood-borne viruses (BBVs) from infected healthcare workers to patients during exposure prone procedures (EPPs). The restrictions placed on performance of EPPs by infected clinicians in the UK have had a particularly significant impact on dentists, because of the exposure-prone nature of most dental procedures and the difficulties in identifying alternative career pathways in the profession that do not involve EPPs. More recently, the significant positive impact of antiviral drugs on viral load together with a re-categorisation of EPPs in dentistry have resulted in evolution of the guidance with a consequent significant improvement to the career prospects of dentists infected with BBVs. This paper provides an update for practitioners on the progress that has been made and outlines the current position with respect to practice restrictions.

Background

In 2006, David Croser [1] wrote an opinion piece for the *British Dental Journal* entitled 'Written off', in which he described the plight of UK dentists infected with human immunodeficiency virus (HIV) and who, as a result, had to cease practising dentistry in the United Kingdom. The problems faced by dental practitioners infected with blood-borne viruses (BBVs) were particularly acute, because virtually all routine clinical dental procedures were classified as exposure-prone procedures (EPPs) according to the Department of Health definition: '*Those invasive procedures where there is a risk that injury to the worker may result in the exposure of the patient's open tissues to the blood of the worker. These include procedures where the worker's gloved hand may be in contact with sharp instruments, needle tips or sharp tissues (eg spicules of bone or teeth) inside a patient's open body cavity, wound or confined anatomical space, where the hand or fingertips may not be completely visible at all times*'. [2] Clearly, there are very limited career options for dentists who are unable to perform EPPs. This original correspondence spawned a succession of letters and comments over several years in the *British Dental Journal* in support of changes to the guidance. [3-22]

Since David Croser's paper in 2006[1] there have been a number of incremental changes to guidance which significantly improve the outlook for BBV- infected healthcare workers (HCWs), including dentists, whose work involves EPPs. In particular the outcome of the work of the UK Department of Health Tripartite Working Group, which included members from the Advisory Group on Hepatitis (AGH), the Expert Advisory Group on AIDS (EAGA), the UK Advisory Panel for Healthcare Workers infected with Blood-borne Viruses (UKAP), the Department of Health (DH), the National AIDS Trust (NAT) and other outside experts provided a persuasive case for amendment of the guidance on HIV infected HCWs. The ensuing change, which now permits HIV-infected HCWs to perform EPPs under specific conditions, represented a major breakthrough when it was launched in January 2014.[23]

It is important to recognise that whilst much of the debate in the *British Dental Journal* has focused on dentists infected with HIV, very similar problems were faced by clinicians infected with hepatitis B virus (HBV) and hepatitis C virus (HCV). Significant advances have also been made in respect of opportunities to return to work for those infected with these two viruses, but have been less well publicised. As for HIV, many of the changes have been made possible because of major advances in antiviral drug discovery and the evidence base surrounding the efficacy of these drugs in reducing the risk of transmission. Furthermore, recent review of the classification of EPPs in dentistry by UKAP has resulted in significant amendments which are likely to have a potentially positive impact for dentists infected with BBVs.

Recognition should also be given to the response of the dental profession in engaging with the need for universal high standards of infection control when treating patients.[24] Furthermore, the value of participating in a regular inspection of all dental surgeries by an independent third party mandated by law has had a significant impact through the work of the Care Quality Commission (http://www.cqc.org.uk/content/dentists) and, in Scotland, the Combined Practice Inspection (http://www.sdpbrn.org.uk/completed-projects/combined-practice-inspection/).

This paper aims to provide a summary of the background to the changes that have been introduced and ensure the reader is familiar with the current UK position for the management of BBV-infected HCWs.

Healthcare worker to patient transmissions

Patient safety is the pre-eminent issue in all policy making in this area and it must be acknowledged that there have been verified transmissions of HIV, HBV and HCV to patients from infected HCWs, as referenced below. The risk of transmission depends not only on the procedure type and relative infectivity of the virus itself (HBV>HCV>HIV) but also on the HCW's viral load, which partly explains the complexity of the guidance. Our knowledge of the level of risk posed by HCWs to patients in this wide range of possible infective states has taken many years to accumulate. Much of that knowledge is based on epidemiological and molecular virological studies of identified transmissions, an evolving process which continues and a summary of which now follows.

HIV

Since the early 1990s, dentistry has carried the burden of the first reported transmission of HIV from an infected HCW to a patient. The highly publicised and widely reported 'Florida Dentist' case,[25, 26] in which six patients of David Acer were infected with HIV, caused significant public alarm[27, 28] as well as concern among all those involved in healthcare delivery. Extensive molecular epidemiological investigations were undertaken[29, 30] which showed that the dentist and the six patients were infected with very closely related strains of HIV, but the mechanism of the transmissions has never been identified. This incident was closely followed by two separate look back exercises relating to HIV-infected dentists in the USA,[31, 32] neither of which identified any transmissions.

Since then, there have been only three further reported transmissions from HIV-infected HCWs. These incidents relate to transmission from an orthopaedic surgeon,[33, 34] a nurse[35] and an obstetrician,[36] in each case to a single patient.

In the final report of the DH Tripartite Working Group in 2011, the risk of transmission of HIV from an infected HCW to a patient during a category 1 or 2 EPP (which includes all procedures in general dental practice) was described as negligible.[37] The risk estimate for an HIV-infected HCW on combination antiretroviral therapy (cART) transmitting HIV to a patient during a category 3 EPP ranged from 1 in 33,000 to 1 in 833,000.[37]

HBV

Hepatitis B virus is the most infectious of the BBVs. A significant exposure of a non-immune HCW to a significant sharps injury from an HBeAg positive patient carries a 1 in 3 chance of transmission. Not surprisingly, therefore, the risk to patients from infected HCWs is correspondingly high. The first indications of a possible risk to patients emerged in 1974[38-40] with reports of acute hepatitis in patients of two chronically infected dentists. The evidence for risks from infected dental personnel became more concrete over the next few years.[41, 42] An interesting review in 1986, which examined the potential for HBV transmission to patients from infected HCWs, identified dentistry as an especially high risk area, noting the common themes of HBeAg positivity in source HCWs and the impact of glove wearing.[43] The preventive role of operating gloves was demonstrated graphically in one study of a dentist who infected 55 patients over a period of approximately three years when he operated un-gloved but did not infect any of 8000 subsequent patients once he commenced routine glove wearing.[44] Whilst procedures such as glove use have had a major impact in reducing risk, it was clear that transmissions could still occur even when infection control procedures were followed , as exemplified by transmissions from a thoracic surgeon to 19 patients reported in 1996.[45] This case, and others, of transmissions from HBeAg positive HCWs resulted in guidance which prevented such individuals from undertaking EPPs in the UK. [46]

However, it subsequently became evident that HBeAg negative HCWs could also transmit HBV to patients.[47] These HCWs were shown to have high HBV DNA levels and consequently a further tightening of regulation requiring measurement of viral load for those HCWs who were HBsAg positive but HBeAg negative was introduced. [48]

Successful implementation and the efficacy of the policies for HBV infected HCWs has resulted in there being no detected transmission of HBV from HCWs to patients since the policy changed in 2000.

HCV

There have been well characterised transmissions of HCV to patients during healthcare procedures.[49] Most commonly these appear to have been related to unsafe use of injecting equipment and other

infection control breaches,[50, 51] but there have also been transmissions from infected HCWs to patients, typically cardiothoracic surgeons and obstetrician-gynaecologists.[49, 52] To date, there have been no reported transmissions from infected dental professionals to patients.

There remain some uncertainties about routes of transmission of HCV in the healthcare setting, which explain the continuing EPP restrictions in the UK of HCV RNA-positive HCWs.

The impact of advances in anti-viral drugs on management of the infected health care worker

Dramatic advances in the development of antiviral drugs have been made since the approval in 1963 of the first antiviral agent, idoxuridine, for use in humans. At the time of writing, 90 antiviral drugs have been approved for human use and there is an excellent recent review of the progress made over the past 50 years for the interested reader.[53] It is fortunate that among the group of nine viral infections of humans for which effective antivirals have been developed, HBV, HCV and HIV are included. A summary of the current position for each virus follows below.

HIV

The advances that have been made in both development and use of antiretroviral drugs in recent years have been highly significant.[54] These drugs have had a positive impact on both the treatment of established infection and in prevention, although it is important to recognise that none are curative.

The clinical efficacy of combination antiretroviral chemotherapy became evident in the mid-1990's, resulting in the first set of published treatment guidelines in 1996.[55] There are now multiple antiretroviral drugs available, with a variety of modes of action, rendering the management of HIV disease a highly specialised area of medicine. The complexities of drug types and clinical situations have resulted in a need for clear recommendations on how and when to use antiretroviral drugs, with a pace of change which is so fast that very regular updating is required. For example, the recommendations of the International Antiviral Society-USA Panel published in 2016[56] replaced those published as recently as 2014,[57] whilst the equivalent documents from the British HIV Association published in 2015 required an interim update for 2016 (http://www.bhiva.org).

Discovery of one of the newer classes of antiretroviral drugs known as integrase strand transfer inhibitor agents (InSTIs) has been a major step forward and regimens based on this class of drug are currently viewed as optimal for initial therapy.[56] These drugs are highly effective at virological

suppression in comparison with other classes of antiretroviral drugs[58, 59] and are extremely well tolerated.[60]

In addition to the new drugs themselves, clinical trials have shown the benefits of beginning antiretroviral therapy early after infection,[56] benefiting not only the individual patients but also making them significantly less infectious to their partners,[61] thereby integrating treatment and prevention.

These drugs have highly significant relevance to HIV-infected HCWs who wish to undertake EPPs, by virtue of their ability to reduce the viral load to a level which poses no risk of transmission to patients,[23] as described below. They are also, of course, the basis of HIV post-exposure prophylaxis following inoculation injuries.[62]

HBV

The antiviral drug treatment of patients with chronic hepatitis B infection has improved significantly in recent years, although a cure remains elusive.[63] There are currently seven antiviral drugs that have approval for the treatment of chronic hepatitis B.[64] These include immunomodulatory agents (interferon-alpha and pegylated interferon), oral nucleoside analogues (lamivudine, telbivudine and entecavir) and nucleotide analogues (adefovir and tenofovir). The nucleoside and nucleotide analogues are now the mainstay of treatment for chronic hepatitis B. Their efficacy has been demonstrated in normalising ALT, HBV DNA suppression, HBeAg seroconversion, reducing progression of liver fibrosis and reducing the rate of decompensation.[64] These drugs, which are very effective at suppressing viral replication in the long term, appear to be safe and largely free of side-effects.[64] As with any antiviral treatment that is taken in the long term, resistance is a concern, but tenofovir and entecavir have both so far demonstrated low rates of resistance.[65-67] The value of these drugs in supporting dentists who are chronic hepatitis B carriers and who wish to return to undertaking EPPs in dental practice is described later in this paper.

HCV

The transformational progress that has been made recently in the development of new antiviral drugs for hepatitis C has been remarkable, but accompanied by controversies regarding the costs of the medication which have been reported widely in the media.[68, 69] It was not long ago that the only treatment available was a combination of pegylated interferon and ribavirin, which was administered for 24 or 48 weeks depending on the genotype of the infecting strain.[70] Since then, understanding of the replication cycle of HCV has improved, allowing the development of direct acting antiviral agents (DAAs), which target HCV-encoded proteins that are essential for viral

replication.[71] In 2011, the first generation protease inhibitors boceprevir and telaprevir were licensed for treatment of genotype 1 HCV infections and since then second generation protease inhibitors such as sofosbuvir and ledipasvir, with even better efficacy against multiple genotypes, fewer drug-drug interactions and with excellent tolerance and safety profiles have emerged.[70] The proportion of patients receiving the new oral antiviral regimens who achieve a Sustained Viral Response (SVR), which equates to a cure, is increasing constantly,[71] with data from both clinical trials and real world use indicating SVRs in excess of 90%.[72, 73]

Current management of BBV infected healthcare workers

The previous two sections of this paper have outlined advances in our understanding of the risks of transmission of BBVs from healthcare workers to patients and the mitigation of risk that is possible as a result of the massive advances in antiviral drug discovery and approval for clinical use in humans. Table 1 summarises the current UK health clearance criteria that must be satisfied before a healthcare worker can undertake EPPs.

In order to appreciate the steps forward that have been made, it is important to recall that until 2014 no HIV-infected HCWs were permitted to undertake EPPs in the UK. A combination of antiretroviral drug treatment and regular occupational / medical health surveillance, including measurement of HIV viral load every three months to ensure that it remains < 200 copies/ml, now provides an opportunity for those who respond to the medication to return to undertaking EPPs. Similarly, antiviral drugs active against HBV now provide an opportunity for chronic HBV carriers who satisfy the criteria around e-antigen status, viral load and regular monitoring to return to performing EPPs.

Despite the major advances in HCV anti-viral drug development described earlier, HCWs who are HCV RNA-positive are still not permitted to undertake EPPs. However, with arrival of the new oral antiviral regimens described above, treatment and cure have become realistic expectations, providing a way forward for HCV-infected HCWs who are required to undertake EPPs.

Re-classification of exposure-prone procedures in dentistry

The risk of transmission of a BBV from an infected HCW to a patient is related ultimately to the infectivity of the virus, the viral load of the HCW and the volume of blood that is transferred during the incident. Whilst the first two of these criteria can be determined scientifically, this is more

difficult for the latter. The approach taken has been to determine the risk of so called 'bleed back' from a HCW into the tissues of a patient should an injury occur during specific medical or dental procedures.

Traditionally this has been managed by determining whether individual clinical interventions satisfy the Department of Health definition of an EPP, as defined earlier.[2] Those that are defined as EPPs are then sub-divided into Categories 1-3 in order of increasing risk of bleed-back. This categorisation, which depends largely on expert opinion, is undertaken by groups of experienced clinicians and experts for each clinical specialty on behalf of UKAP, which administers the process.

The first classification of dental procedures was undertaken in 2001, by an expert group which included significant input from the British Dental Association. Those involved followed closely the DH definition, which includes the phrase '*These* (EPPs) *include procedures where the worker's gloved hand may be in contact with sharp instruments, needle tips or sharp tissues (eg spicules of bone or* ***teeth****) inside a patient's open body cavity, wound or confined anatomical space, where the hand or fingertips may not be completely visible at all times*'.[2]

By definition, therefore, all intra-oral procedures in the fully or partially dentate mouth were classified as exposure-prone. The only dental procedures classified as not being EPPs were: the taking of extra-oral radiographs; visual and digital examination of the head and neck; visual and digital examination of the edentulous mouth; prescription of antibiotics or other drugs; and intravenous sedation. Clearly, the impact on dentists who were excluded from performing EPPs by virtue of their BBV status was absolute, since it was impossible to deliver the vast majority of care that is normally offered in dental practice and, in effect, impossible to work as a dental practitioner.

When dental EPPs were reviewed in 2015, knowledge from patient notification exercises since 2001 provided valuable information on the level of risk to patients from infected dentists. Furthermore, it was agreed that injuries to dentists' gloved fingers from patients' teeth and which may result in bleed-back are essentially non-existent. For that reason the word 'teeth' was removed from the definition of EPPs. The effect was to allow re-categorisation of a significant number of procedures from Level 1 EPPs to non-exposure prone activities. Thus, in March 2016, the UKAP specialist dental working group published a revised categorisation of EPPs and non-EPPs carried out in general dental practice, according to the revised definition: '*EPPs include procedures where the worker's gloved hands may be in contact with sharp instruments, needle tips or sharp tissues inside a patient's open body cavity, wound or confined anatomical space where the hands or fingertips may not be completely visible at all times'.* The full details can be accessed at:

https://www.gov.uk/government/publications/general-dentistry-exposure-prone-procedure-categorisation

This re-categorisation of EPPs in dentistry is summarised in Tables 2 and 3. It will potentially allow currently EPP-restricted dentists to perform a wider range of duties as many procedures have now been downgraded to non-exposure-prone, including routine oral examination.

Conclusions

The highly vocational nature of a dental degree and the sparse opportunities for entering sub-specialities in dentistry, such as dental public health, which do not require the performance of EPPs have resulted in disastrous career-ending situations for a significant number of BBV - infected UK dental practitioners in the past. The personal impact on the dentist, his/her family, not to mention the practice staff and patients, is devastating.[3] For some of those professional colleagues, the changes described in this paper have come, sadly, too late but the authors are aware that some have now been able to return to work, and in future the change will facilitate a degree of continuity for those who choose a career in dentistry.

The outstanding protection provided by the hepatitis B vaccine, with protection lasting for up to 30 years,[74] was the first important step in reducing the number of HCWs infected with HBV and therefore reducing risk of onward transmission to patients. The impact of new antiviral drugs represents a second wave of progress in relation to all three BBVs and the future does look increasingly bright as even more effective regimens become available, a view reflected by experts in the field.[75, 76]

Whilst it may be a fanciful, optimistic view, there is every possibility that by the end of the next decade, no dental professionals, or any other HCWs for that matter, will be required to cease undertaking EPPs long term on the basis of their BBV status – truly an end to being 'written off'.

Table 1 Blood-borne virus status and summary of criteria to be met for exposure prone procedure clearance in UK healthcare workers	
Virus	**Infective status**
Hepatitis B	*HBeAg negative healthcare workers may perform EPPs if they:* *a)* have a viral load <300 IU/ml (either from natural suppression or 12 months after cessation of antiviral therapy), **and** *b)* be subject to annual plasma viral load monitoring, **and** *c)* be under joint supervision of a consultant occupational physician and their treating physician,
	HBeAg negative healthcare workers with a pre-treatment viral load of 300 IU/ml – 30,000 IU/ml may perform EPPs if they: a) have a viral load <300 IU/ml whilst on continuous antiviral therapy, **and** b) be subject to plasma viral load monitoring every three months, **and** c) be under joint supervision of a consultant occupational physician and their treating physician,
Hepatitis C	*Must be HCV RNA negative:* a) as a consequence of natural clearance, **or** b) at 6 months after cessation of antiviral therapy,
HIV	*Must either:* a) be on effective combination antiretroviral therapy (cART), **and** b) have a plasma viral load <200 copies/ml, **or** c) be an elite controller[1], **and** d) be subject to plasma viral load monitoring every three months, **and** e) be under joint supervision of a consultant occupational physician and their treating physician, **and** f) be registered with the UKAP-OHR

[1] An elite controller is defined as a person living with HIV who is not receiving antiretroviral therapy and who has maintained their viral load below the limits of assay detection for at least 12 months, based on at least three separate viral load measurements

Table 2 Dental procedures that are NOT exposure prone
Procedure
The taking of intra and extra-oral radiographs
Visual and digital examination of the head and neck including soft tissue palpation
Prescription of antibiotics or other drugs
Intravenous sedation
Routine oral examination, using mirror and any necessary probes
All work associated with the construction or replacement of complete or partial dentures - excluding any prior surgical preparation of the hard or soft tissue
Preventive procedures: oral hygiene instruction, fissure sealing, topical fluoride applications, saliva samples
Taking impressions
Topical application of, or irrigation with, therapeutic agents
Suture removal where the hands or fingertips are completely visible at all times
Supra-gingival or sub-gingival scaling of teeth using an ultrasonic/piezo-sonic scaler
Polishing of teeth or restorations using a slow-speed hand piece with flexible polishing discs, polishing cups or brushes.
Electro-cautery
Use of laser when administered external to oral cavity
Placement of dressings and temporary restorations not requiring tooth preparations
Orthodontic procedures using removable appliances or aligner techniques e.g. Invisalign®, except where interdental stripping with an abrasive strip is required
Re-implantation of tooth/teeth following trauma (F0830) without bone removal
Bleaching of teeth, excluding the use of any rotary instrument to provide access required for internal bleaching
Botox or fillers for modification of facial aesthetics administered external to oral cavity

Table 3 Categorisation of exposure prone procedures in dentistry	
EPP Category	**Procedure**
Level 1 (Lowest risk of bleedback)	Local anaesthetic injections
	Interdental stripping with a rotary device or abrasive strips for orthodontic purposes
	Biopsy of lip (F0620)
	Suture of lip (F0530)
	Polishing of teeth or restorations using finishing burs in high-speed handpieces
	Suture removal where the hands or fingertips are not completely visible at all times
	Supra-gingival or sub-gingival scaling of teeth using hand instruments
Level 2 (Intermediate risk of bleedback)	Use of high-speed hand pieces for procedures such as intra-coronal restorations and crown and bridge work
	Polishing, finishing or removing overhangs from restoration
	Periodontal surgery
	Root canal therapy
	Root end surgery e.g. apicectomies
	Extractions of teeth including packing and suturing of sockets
	Orthodontic procedures with fixed appliances
	Placement of temporary anchorage devices in the context of orthodontic practice
	All other dento-alveolar surgery including: • "Surgical removal of impact/buried tooth/teeth (F0910)"; • "Surgical removal of complicated buried roots (F0950)"; • "Enucleation of cyst of jaw (F1810)"
	Surgical removal of intra-oral soft tissues, including biopsies
	Frenotomy/frenectomy of tongue (F2620)
	Suturing of intra-oral soft tissue injuries
	Surgical placement of dental implant
Level 3 (Higher risk of bleedback)	NONE
More extensive oral and maxillo-facial surgery is outwith the present consideration of "general dentistry". Those procedures are considered as general surgery.	

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