Infection control failures in a dental surgery—dilemmas in incident management

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ABSTRACT

Three separate incidents involving failure of decontamination of dental instruments were reported to our Unit in less than one year. We describe the risk assessment we undertook for the likelihood of detecting transmission of a blood borne virus infection. Even where 4000 patients attended the same dentist for seven years, there was no certainty of detecting even one person infected by the decontamination failure, while several people who had acquired infection by other routes would be identified. We conclude that these findings suggest that notifying patients is not usually justified.

Keywords Dentistry, decontamination, blood borne virus, infection control, transmission

Introduction

Three separate incidents involving failure of decontamination of dental instruments were reported to our Unit in less than one year. Although there is guidance in the UK on managing patients exposed to healthcare workers infected with Hepatitis B (HBV), HIV and Hepatitis C (HCV) there is none covering patients possibly exposed to contaminated instruments except in circumstances where a patient infected with CJD is involved. We report the issues we considered when deciding whether or not to contact patients of the three dental practices involved in these incidents.

Background to the incidents

Incident one

A nurse reported to the local Primary Care Trust that the dental practice they had recently joined had a number of serious failures in infection control practice. These included: never autoclaving dental hand pieces; using a cold disinfectant solution for sterilization of all other instruments since the breakdown of the autoclave some time previously; the presence of dried blood on hand-mirror heads, on filling materials and on the dental chair. The nurse was concerned that the cold disinfectant may have been inactivated by heavy contamination.

Dental Practice Board figures showed that around 3000 National Health Service patients had registered with the practice since 1998. The practice also had 1000 private patients.

Incident two

A dental nurse gave a statement to the Primary Care Trust describing that the dentist for whom they previously worked re-used single use items between patients. Items included surgical blades, suture needles, latex gloves and anaesthetic cartridges. The nurse also stated that dental hand pieces were sometimes sprayed with disinfectant rather than autoclaved. Further investigation was unable to confirm this had occurred. However, a visit to the practice revealed the autoclave was poorly maintained and that records of temperature, pressure and holding times were not available as required by the British Dental Association. Surgical blades were in packaging labelled ‘non-sterile’ and were not manufactured for patient care. Once removed from the packaging they were immersed in a pot containing chemical disinfectant (alkyldiaminoethylglycine hydrochloride (‘Rusnon’) prior to use.

There were ~1000 patients on the list of whom 15% were private patients.
Incident three
Following an anonymous complaint, a dental practice inspection revealed that dental burrs were heavily contaminated with bone debris, which remained adherent following sterilization. It appeared that little if any manual cleaning of burrs took place before they were placed in the autoclave. In addition, there were no proper time or temperature records for each autoclave cycle.

No further information on the size of the practice was available.

The risk assessment
In all three incidents, there was a dilemma whether to contact patients and what to tell them of the level of infection-exposure risk. We had to balance the likelihood of identifying transmission of infection against the anxiety generated and the costs to the NHS of contacting and screening patients.

The risk assessments in each of the three incidents had factors in common. The problems had been occurring over several months and possibly years. While bacterial infections could be transmitted by improper decontamination procedures, any resulting disease is most likely to be an acute infection from which patients will have long since recovered. Even if there are long-term sequelae (for example rheumatic fever following a Streptococcus pyogenes infection) it is unlikely the infecting organism would still be colonizing the patient.

We therefore focussed on blood borne virus (BBV) infections. We attempted to estimate the likelihood that a patient could have become infected with a BBV through exposure at the dental practice.

The practice populations were drawn mainly from a white middle-class, middle-income group, with no high-risk populations for any BBV. In the absence of other data we decided to estimate the practice population seroprevalence from blood donor and other similar surveys of low-risk populations i.e. the risk of a patient having HBV was 1 in 1000 (of whom 10% are high-risk carriers), for HIV it was 1 in 1000, and for HCV it was 2 in 1000.\(^6\)–\(^9\)

We used a scenario to estimate transmission risks, in which an instrument used on an infected individual was inadequately decontaminated and used immediately afterwards on another person. We considered this to be the equivalent of a needle stick incident and based risk estimates on the approximate figures of 30% transmission risk for a high-risk HBV carrier, close to 0% for a low-risk carrier, 3% for HCV and 0.3% for HIV.\(^10\)

In the following calculation we have rounded up figures for simplicity.

For every 1000 patients seen, the risk that there might have been a transmission incident of any BBV was

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(0.001 \times 0.1 \times 0.3) + (0.002 \times 0.03) + (0.001 \times 0.003) = 0.000093
\]

i.e. nearly 1 in 10,000.

Even if we made a more pessimistic assumption that a BBV carrier made multiple visits to the practice or that a higher-than-expected transmission rate increased the risk 10-fold in a population of around 4000 exposed patients (as in Incident One), only four transmission incidents will have occurred, although \(\sim 12\)–\(13\) patients may already be carriers of HBV, HCV or HIV for other reasons.

Demonstration of transmission involves isolation of virus from the donor and recipient and showing that both had the same strain of virus. From previous experience of patient notification exercises (involving an HIV-positive dental healthcare worker) only \(\sim 65\%\) of those invited contacted health services with only 53% attending for screening.\(^11\) We made the following assumptions for Incident One in undertaking our calculation of the likelihood of finding one or more BBV, HCV or HIV-positive case pairs:

- All patients registered with the dentist were deemed ‘at risk’ (4000).
- All patients registered with the dentist had attended the practice each year for the duration of time of interest (between one and seven years).
- All patients can be contacted and invited to contact local health authorities and subsequently be offered counselling and screening.
- A dentist could see between 20 and 40 patients per day.
- The practice operated on every available working day during a year \((52 \times 5)\)–(8 public/bank holidays)–(252 days). This provided a total of 5040 visits per year for 20 patients per day and 10 080 visits per year for 40 patients per day, giving an average attendance of 1.26 or 2.52 respectively per year.
- Uptake of screening was between 53% and 65% based on previous experience, (for an HIV-positive healthcare worker)\(^11\) although we expected the actual take-up to be lower.
- The transmission risk would be low with a low probability of finding one or more transmission pairs based on previous experience where 30% of patients screened for HIV were all found to have a negative result.\(^11\)
Based on our calculations on the above assumptions, we found that the range of probability of finding one or more transmission pairs was between 12% and 33% for one year, rising to 60% and 94% for seven years (Table 1).

**Discussion**

We concluded that in the three incidents, the likelihood of detecting a transmission that could be matched to the practice population was very small given the practice sizes involved and was far lower than the likelihood of finding infections from other sources.

Reviewing each of our assumptions in light of normal practice:

- All patients registered with the dentist were deemed ‘at risk’ (4000).

As we found only 3.2% (191 of 5929 patients) were deemed to be in a zero risk category in a previous patient notification exercise in Essex,\(^{11}\) we felt this assumption was reasonable.

- All patients registered with the dentist had attended the practice each year for the duration of time of interest (between one and seven years).

We found reports on the Dental Practice Board website which indicate that many patients do not stay with the same dental practitioner.\(^{12}\) We also found an Office of Fair Trading report which indicated 16% of patients had changed their dentist within the 3.6 years prior to being questioned.\(^{13}\) If these figures are used to provide a crude average rate of patient change per year, we estimate 4.5% of patients will change their dentist each year. This would mean that over a seven-year period 955 patients would have left the practice. We had been advised that there has been a reduction in patient turnover within dental practices as a consequence of difficulties finding a dentist undertaking NHS work. Even so, we feel that our assumption will produce an overestimate of the number of transmission pairs occurring.

- All patients can be contacted and offered counselling and screening.

In our own experience\(^{11}\) 17% (1000 of 5929 patients) could not be found. This was in spite of writing to each person at their last known address and using the National Strategic Tracing Service.

- A dentist could see between 20 and 40 patients per day.
- The practice operated on every available working day during a year (52 × 5) – (8 public/bank holidays = 252 days). This provided a total of 5040 visits per year for 20 patients per day and 10 080 visits per year for 40 patients per day, giving an average attendance of 1.26 or 2.52 respectively per year.

Our experience\(^{11}\) showed that the 5929 patients identified for follow-up over a 12-year period had on record a total of

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**Table 1 Probability of detecting one or more transmission pairs (4000 patients, attending between one and seven years)**

<table>
<thead>
<tr>
<th>Screening uptake (%)</th>
<th>20 Patient per day scenario</th>
<th>40 Patient per day scenario</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Total expected transmissions</td>
<td>Total expected pairs detected</td>
</tr>
<tr>
<td>Initial assumption(^{11})</td>
<td>65</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>53</td>
<td>0.47</td>
</tr>
<tr>
<td>Glasgow experience(^{12})</td>
<td>40</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>0.47</td>
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<tr>
<td>Seven years</td>
<td>65</td>
<td>3.28</td>
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<tr>
<td></td>
<td>53</td>
<td>3.28</td>
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<tr>
<td>Glasgow experience(^{12})</td>
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26,179 procedures equating to an average of 4.42 procedures over 12 years (an average of 0.38 procedures per year). The dental healthcare worker involved worked on a part-time basis. If this had been for only one day per week multiplying the average number procedures by five would still only give a total of 1.84 per year.

Dental Practice Board online data indicates that the average list size of a principal dentist was 1483 in England and Wales. Data for a full year (October 2001–September 2002) indicates that almost 50% of adult claims were for courses that did not require a dental intervention. The average rate of treatment per 100 adult claims during this year was 136.5 per 100 adults. Although each patient will not have visited the dentist an equal number of times in a year using this data, we were able to estimate that this equated to \( \sim 273 \) visits per 100 adults per year i.e. 2.73 visits per adult per year—this equates to a daily throughput of 44 patients per day and is close to the estimate we produced after speaking to local practitioners.

- Uptake of screening was between 53% and 65% based on previous experience (for an HIV-positive healthcare worker).

We also searched the literature to determine whether there had been other similar incidents and found a dental patient notification exercise in Glasgow in 2001, undertaken in similar circumstances to Incident One. There, 4689 patients were identified as ‘at risk’ after a dentist admitted the periodic use of unsterilized equipment over a two-year period. Of the 4689 patients identified, 1969 individuals contacted health services and 1005 took up the offer of counselling and screening. This equates to rates of 40% and 21% respectively. Using these rates in Table 1, the probability of finding one or more transmission pairs fell to between 2% and 14% for one year and 14% and 65% for seven years.

- The transmission risk would be low with a low probability of finding one or more transmission pairs.

In the exercise in Glasgow, only one of the 1005 patients who came forward for testing had evidence of previous HBV infection and 13 had antibodies to HCV. Despite molecular investigations no associations were found between any of the isolates. The HCV prevalence among those tested was similar to that of the local population. This failure to detect a transmission pair lends support to our assumption that the likelihood of finding one is low. Another exercise notifying 1322 patients following a contamination failure in endoscopy also failed to demonstrate transmission of infection.

Another approach to estimating the risk of BBV infection is to compare dental practice lists against statutory notifications of hepatitis infection. There are difficulties: in obtaining a complete list of patients, particularly if the problem has been long term; in being confident there are no missing notifications; and in carrying out a match using surname, initials or first name and date of birth when any one of these may be subject to clerical error in either data set.

We attempted this for Incident One where a list of patients seen between April 1998 and February 2005 at the practice was compared against all notifications of BBV infections on the HPU database available since 1994 to detect any matches. One patient was notified with HCV infection in August 1997. The absence of available dental records prior to April 1998 made it impossible to exclude a link to the practice any earlier. However, the patient concerned also had lifestyle risk factors for the infection.

In the other two incidents, investigation had ended before a list of patients was made available.

In Incident Two, we did consider whether we should do a limited follow-up of patients seen immediately after those with identified BBV infections, assuming they were at greatest risk of transmission of infection. However, it would then be necessary to determine how many times and over what period an instrument could have been re-used. In addition, records of appointment times and dates, going back many years would have been necessary. As the re-use could not be confirmed and there were no appointments records this was not possible.

DH advice is that good decontamination procedures are the best protection against transmission of prions. The possibility of transmission from contaminated files and reamers used in endodontic procedures has been reviewed recently by the Spongiform Encephalopathy Advisory Committee, which suggested that disposable instruments may be necessary. In Incident Three, in particular, even if sterilization took place, the presence of visible debris on the burs does raise the possibility of an increased risk of transmission of prion infection. We felt that as we could not quantify the risk in any way and as there is no useful action which can be taken by those exposed, there was no benefit to be gained in notifying patients.

Other significant factors in the decision not to carry out a patient notification exercise included the large cost of the exercise (estimated at \( \sim £80 \) per patient contacting health authorities from a previous local exercise) which would divert resources from other patient care and the distress caused to those patients contacted and offered screening, while effectively looking for ‘a needle in a haystack’.
Conclusions and recommendations

In these incidents, we experienced difficulty in carrying out a risk assessment in circumstances where there was no identified 'source' but there was potential for cross-contamination. We concluded that the likelihood of detecting one of more transmission pairs was less than 1.00 but there was a good chance of discovering patients infected by other routes.

When calculating the risk estimates, there was uncertainty about the actual number of patient attendances and whether it was realistic to assume the transmission risk from a contaminated instrument would equate to a needle stick accident taking into account intervals between patient appointment and physical factors such as dilution by saliva. However, we had to take a pragmatic approach and decided on a ‘best guess’ scenario which included a margin of safety.

We would suggest that in most circumstances like these, notification of patients is not justified because it is unlikely that anyone infected as a result of poor decontamination practice will be found and it would divert resources that could be better spent on patient care. However, this should not detract from the need to ensure that all dental surgeons practice proper decontamination procedures as described in national guidance. ⁵ Although identifying affected patients may be difficult, this does not mean there is no risk.

It would be helpful if this matter was considered by a national body which could undertake the mathematical modelling necessary to provide a more definitive answer to the question.

Acknowledgements

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References