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An audit of the quality of periodontal referrals to specialist periodontists in National Dental Centre, Berakas

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INTRODUCTION

Periodontal disease is prevalent in most human populations with chronic periodontitis being the common form of periodontitis seen in the adult population; majority suffering from chronic periodontitis have a relatively low risk of tooth loss, but approximately 10 per cent may develop a more rapidly progressing form of the disease that can lead to premature tooth loss (Williams *et al.*, 2001). General dental practitioners should be competent to treat periodontal diseases and if it is beyond the scope of general dental practice, they should be able to make timely and appropriate referrals to specialist periodontists when necessary. Referral letters are often a standard method of communicating information about the patients from the general dental practitioners to the specialists. Furthermore, a referral letter is an important medico-legal document since professional liability claims are most commonly directed against general dental practitioners for failure to diagnose, failure to inform, failure to refer and failure to treat (CNA HealthPro, 2005). There has been evidence through research that, there needs to be an improvement in the quality of information present in referral letters (Newton, Eccles and Hutchinson, 1992). A poorly written referral letter may not communicate necessary patient information and may result in delay of patient being diagnosed and treated, leading to a poorer prognosis outcome. It is vital that referral letters contain essential administrative and clinical information for specialists to prioritise patients appropriately and to allocate cost, time and resources efficiently.

The referring dentist should ensure that the information in the referral letter is adequate, appropriate and can be fully understood by the receiving specialist. On 30th September 2013, the General Dental Council, United Kingdom published 'Standards for the Dental Team' which states that dental professionals should only accept a referral or delegation if one is trained and competent to carry out the treatment and, the professional receiving the referral believes that what was being asked to be done is appropriate for the patient (GDC, 2013). Referral letters can be handwritten, typed or filled in on pre-constructed proformas and those that do not contain the necessary information may be rejected. Within the National Health Service (NHS) in the United Kingdom, failure to include important patient details will render the referral unsuitable and it will be returned to the referring dentist (NHS Sheffield, 2010).

At present, standards on periodontal referrals in Brunei Darussalam is lacking and currently these referrals are done through written letters or noted down within patient records by the referring clinician to specialist periodontists in National Dental Centre, Berakas. A study by Snoad *et al.* (1999) found that quality of periodontal referrals was significantly improved when standardised periodontal referral proforma were used compared to conventional letters whereas Navarro *et al.* (2002) reported that referral proforma contain more relevant information and are quicker and simpler to fill and complete when compared to typed or written letters.

AIM AND OBJECTIVES

This retrospective audit was carried out to assess the quality of periodontal referrals to specialist periodontists in National Dental Centre, Berakas.

The objectives of this audit were to:

- Assess the completeness of periodontal referrals to specialist periodontists in National Dental Centre, Berakas.
- Determine the proportion of patients who were inappropriately referred.

MATERIALS AND METHODS

Following the approval of the audit proposal on 16th October 2013, the main auditor obtained the periodontal referral waiting list book; periodontal referrals from January 2012 to October 2013 were included in this audit. A total number of 148 referrals were listed within this time period and attempts were made to retrieve all patient records so that systematic sampling could be conducted to achieve a target of 50 records for auditing. In the end, there were a total number of 104 patient records that were recovered and these formed the sample group. The remaining 44 patient records were not found despite several efforts. At National Dental Centre, patient records can be in the form of treatment cards or file folders; periodontal referrals to specialists were written directly in clinical entries of these treatment cards or file folder sheets. In contrast, periodontal referrals from outside National Dental Centre were in the form of handwritten letters or on pre-constructed outpatient referral proformas.

With the sample group of 104 patient records arranged chronologically, patient records were further selected in a systematic order by every 2nd patient from this sample group i.e. 2nd, 4th, 6th, 8th and so on until a total target of 50 patient records was reached. These 50 patient records containing the periodontal referral were photocopied. Patient records were then returned back to their original source. Subsequently, data collection sheet* was used to capture information from the photocopied periodontal referrals. The following information collected from each periodontal referral was divided into two sections: Section A: Administrative details and Section B: Clinical details.

Section A contained:
(A1)- Patient details such as name, identification [IC] number, date of birth, address and contact number;
(A2)- Referring dentist details such as name, location of clinic, contact number and signature;
(A3)- Date of referral;
(A4)- Urgency of referral stated.

Section B contained:
(B1)- Medical history noted (if relevant), medications names listed and allergies noted;
(B2)- Smoking history, non-smoker or smoker, and pack-years being noted;
(B3)- Reason for referral or chief concern of the patient and/or referring dentist;
(B4)- Basic Periodontal Examination [BPE] noted;
(B5)- Other periodontal findings (if relevant);
(B6)- Provisional diagnosis stated;
(B7)- Radiographs enclosed;
(B8)- Details of any periodontal treatment already carried out (if relevant).

The collected data were then entered into Microsoft Excel 2007 for analysis for the number of YES responses for each item. The quality of each items for Section A: Administrative details and Section B: Clinical details were calculated and then obtained as percentages by dividing number of YES responses by the TOTAL of YES and NO responses, then multiplying it by 100% respectively for both sections.

Quality of item: $\frac{YES}{(YES+NO)}$ X 100%

Total quality is the average of each individual quality in the respective sections.

Total quality: $\frac{Sum\ of\ `Quality\ of\ item'}{No.of\ items}$

Further clarification for:
Section B1: Medical history noted, (if relevant)
A ***Yes*** response was given:

- If patient had no medical history and it was noted `clear', `nil relevant medical history' or its abbreviation NRMH, `nil relevant' or words with equivalent meaning.
- If patient had medical history and it had been noted e.g. Hypertension, Diabetes.

A ***No*** response was given:

- If referral had no mention of patient's medical history at all.

Section B1: Medication names listed

A ***Yes*** response was given:

- If patient had no medical history and it had been noted as `clear', `nil relevant medical history' (NRMH), `nil relevant' or words with equivalent meaning.
- If patient had a medical history and the list of medication names were written down e.g. Atenolol, Metformin etc.

A ***No*** response was given:

- If the patient had a medical history and the list of medications names were not written down.

Section B1: Allergies noted

A ***Yes*** response was given:

- If the patient had no allergies and it had been noted down e.g. `no known drug allergies' or its abbreviation `NKDA', nil allergies or words with equivalent meaning.
- If the patient had an allergy and it had been noted down e.g. allergy to Amoxicillin.

A ***No*** response was given:

- If referral had no mention of patient's allergies at all.

Section B2: Smoking History

A ***Yes*** response was given:

- If there was mention of patient being a smoker or non-smoker.

A ***No*** response was given:

- If there was no mention at all within the referral of patient being a smoker or non-smoker.

Section B2: Pack-years

A ***Yes*** response was given:

- If patient was a smoker and the pack-years noted.
- If patient was a non-smoker and hence pack-years not noted.

A ***No*** response was given:

- If there was no mention of patient's smoking history of being a smoker or non-smoker.

Inappropriate referral

In this audit, inappropriate referral was defined as referrals:

- without BPE scores noted or with BPE scores less than 4 noted; and
- without relevant radiographs provided.

STANDARDS

There is currently no universal standard or guideline on periodontal referrals to specialist periodontists. Guidance for this audit will be based on the referral proforma* from `Young Practitioners Guide to Periodontology' published by British Society of Periodontology (BSP) in November 2012. In this audit, all referrals (100%) should have all administrative details recorded and all referrals (100%) should have all clinical details recorded except for item (B5) and (B6). With regards to these two items, they are useful information in periodontal referrals but are not deemed essential in comparison to the other information required.

RESULTS

Sample Size

Altogether, there were 34 referrals from National Dental Centre (NDC) and 16 referrals from dental clinics outside NDC; which consisted of Sungai Hanching, Muara, Pengkalan Batu, Sungai Assam, Sengkurong, Temburong, Police, RIPAS Oral Surgery and private clinics. Among the 50 periodontal referrals, about half of the periodontal referrals that were addressed to specialist periodontists were found written on the clinical entry sheets contained in file folders. About a quarter of the referrals were written on the clinical entry of treatment cards and the remainder of the referrals were individual hand-written letters solely from clinics outside National Dental Centre, Berakas.

Percentage quality of Administrative details

Figure 1 shows administrative data collected from all 50 periodontal referrals. The total quality of administrative details recorded is 78%. All referrals had patient's name, IC number and location of clinic recorded. Eighteen percent of the referrals did not include patient's contact number and 44% did not include the referrer's or dentist's name. No referrals were marked as `urgent'.

Table 1. Sample size.

	Number (Percentage)
NDC	34 (68.0%)
Peripheral Clinics	
Sungai Hanching	4 (8.0%)
Muara	2 (4.0%)
Pengkalan Batu	2 (4.0%)
Sungai Assam	2 (4.0%)
Police	2 (4.0%)
Sengkurong	1 (2.0%)
Temburong	1 (2.0%)
RIPAS	1 (2.0%)
Private Clinics	1 (2.0%)
All combined	50 (100.0%)

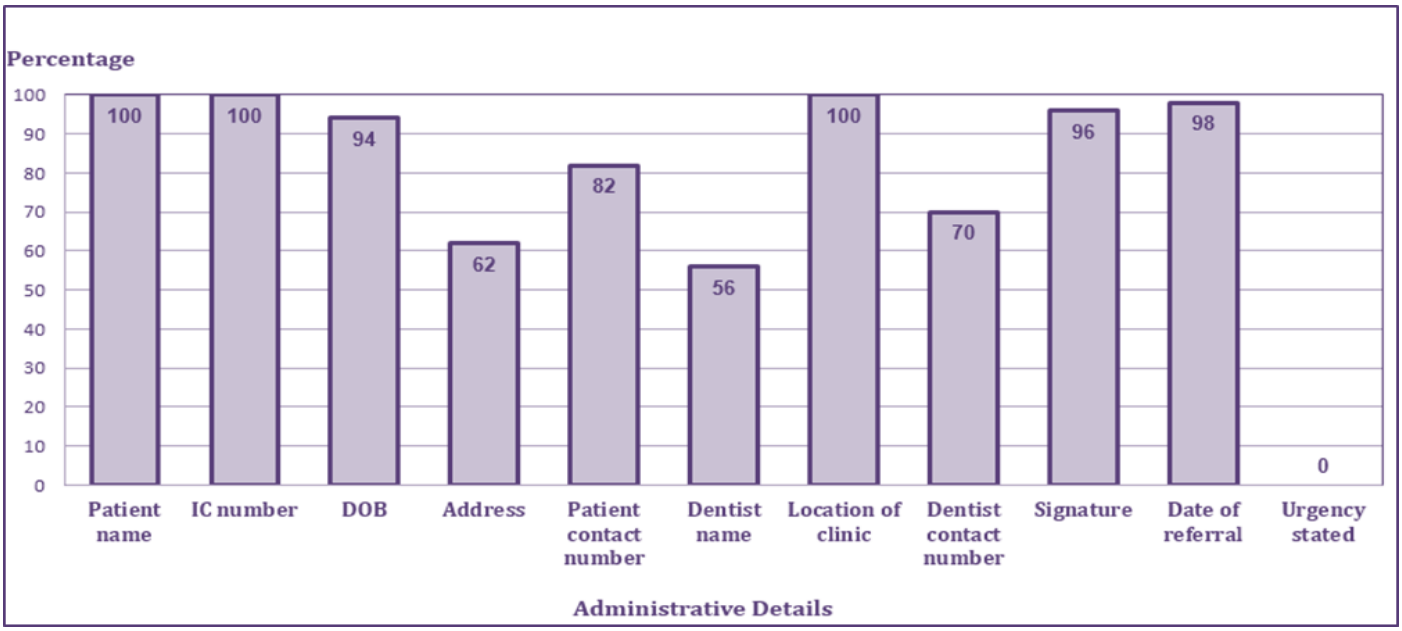

Figure 1. Percentage quality results for Administrative details.

Percentage quality of Clinical details

Figure 2 shows clinical data collected from all 50 periodontal referrals. The total quality of clinical details recorded is 53%, whereas the total quality excluding item B5 `other periodontal findings' and B6 `provisional diagnosis' is found to be 56%. Majority of the referrals include reason for referral (98%) and BPE charting (96%). Fifty-six percent of the referrals included names of medication and only 16% had allergies stated. The majority (90%) did not include any smoking information within the referral.

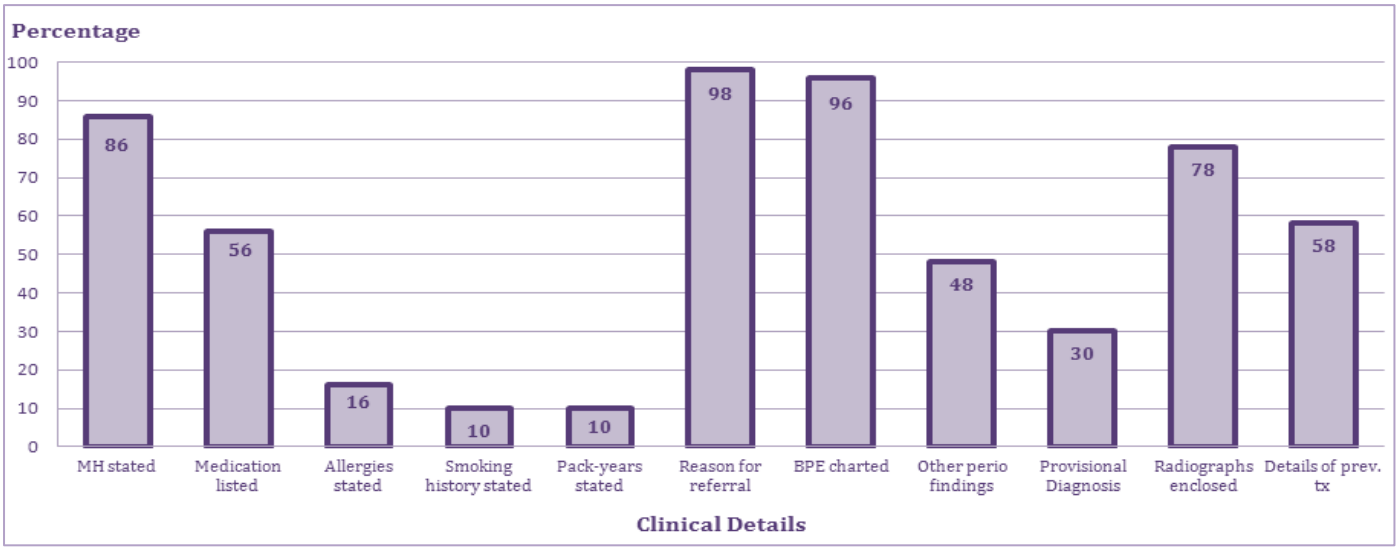

Figure 2. Percentage quality results for clinical details.

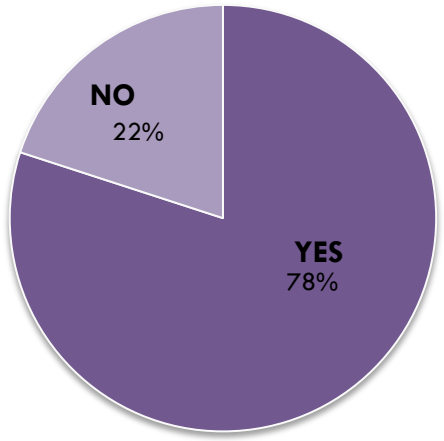

Figure 3. Percentage of appropriate referral to specialist periodontist in National Dental Centre, Berakas.

DISCUSSION

Before discussing the findings, it is appropriate to consider the strengths and limitations of the audit. The weakness of this audit is that there is no universal `gold standard' on what should be included in periodontal referrals to specialist periodontists. Hence, standard for this audit is based on the referral proforma derived from `Young Practitioner Guide to Periodontology' by British Society of Periodontology, United Kingdom, 2012.

The strength of this audit is that a systematic ordered sampling method was used to enable a uniform sample of referrals from the periodontal waiting list. There was a total of 148 patients listed in the periodontal waiting list book and ultimately 104 (70.2%) patient records were located and retrieved; whereby 50 from the retrieved records were used for data collection. The audit can thus reflect a good representation of referrals received during the period January 2012 to October 2013. The high percentage of records retrieved was a result of team effort on the part of the main auditor and dental surgery assistants.

There will be two main parts to this discussion, which focuses on the quality of administrative and clinical details. Each will be discussed under appropriate headings.

Administrative details

Patient details

Patient information such as name, age, gender, address and contact number are useful for dental staff to readily identify the patient and enables them to contact the patient for appointment purposes.

All referrals had patient's name and identification number written down; this information is necessary to track patient records. Nine referrals (18%) did not include patient's contact number, making it difficult to reach the patient by phone. At the

time of referral, this was perhaps less of a concern for the referrer from outside NDC because in Brunei, it is common practice for the patients themselves to personally deliver their referral letter to the Periodontic Unit. Upon receipt of referrals, the dental surgery assistants will automatically obtain from the patient their contact number and record these into the periodontal referral waiting list book.

Patient information such as date of birth (6%) and address (38%) were also lacking. Information on age of the patient is important; patients aged under 35 years old with BPE score of 3 ,4 or * are considered as high risk of severe periodontal disease (BSP, 2012). Residential address is useful in scheduling patient's appointment, taking into consideration patient's travel time.

Referrer's or Referring dentist's details

All referrals from outside NDC included both the referrer's name and signature. In contrast, almost half of referrals (44%) from within NDC did not include the referrer's name and there were a few referrals without the referrer's signature (4%). Identity of the referrer is important so that the specialist is able to refer the patient back for further treatment, if required. Furthermore, both signature and name of the referrer are important as it validates information written in the referral. Signature must be legible together with the referrer's first and last name included so as to allow the referrer to be clearly identified. According to `Good Medical and Dental practice' code of conduct published by Brunei Medical Board, Ministry of Health, Brunei, the referrer "must be identifiable to the patients and colleagues" so the referrer should use their Brunei Medical Board registered name when signing statutory documents such as patient records.

Location and contact number of the referrer's clinic becomes important should the specialist need to discuss or refer the patient back for further management such as initial periodontal management, preventive dental management, long-term maintenance of periodontal treatment or for necessary restorations or dentures. All referrals outside NDC provided the location of the clinic and there were referrals (30%) that did not provide the clinic's contact number. Location and contact number of referrals within NDC is not of a great concern as the specialists and referrers are located together within the same building.

Urgency

None of the referrals were marked `urgent' as the current practice here is the referrer would contact the specialist in person or via phone of an urgent case to which the specialist will schedule the earliest appointment available for the patient.

Clinical details

Medical History

According to the UK General Dental Council `Standards for the Dental Team', paragraph 4.1.1, the dental professional `must make and keep complete and accurate patient records, including an up-to-date medical history, each time that you treat patients.' There were a number of referrals (14%) which did not have an updated medical history stated. It is well known that a coexisting medical factor such as diabetes and period of major stress can directly affect the periodontal tissues and that patient's medical history may significantly affect clinical management (Mealey, 2006). Furthermore, almost half (44%) did not provide the list of medication names. Studies have shown that certain medications have been associated with gingival overgrowth (Seymour and Heasman, 2005). Majority of referrals (84%) did not take into account 'allergies'. It is important to record any allergy as it can develop at any age, with up to 2% of worldwide population estimated to have an anaphylaxis or a serious allergic reaction at some point in life, and the rates appear to be increasing (Simons, 2010).

Smoking History

An overwhelming majority of referrals (90%) did not consider the smoking status of the patient i.e. non-smoker, former smoker or current smoker and if the patient had ever smoked, the pack-years recorded. Pack-years is used to quantify the amount a person smoked over a period of time. It is important to investigate a patient's smoking history because smoking is a known significant risk factor in the development and progression of periodontal disease (Genco and Borgnakke, 2013). Smokers are six times more likely to show periodontal destruction than non-smokers (BSP,

2012). Furthermore, there is a dose-related effect. Smoking more than 10 cigarettes a day is considered as having a higher risk of severe periodontal disease (BSP, 2012). Persistent smokers are expected to have greater tooth loss and reduced response to periodontal treatment, whereas patients who have stopped smoking for 3 years show improved response to treatment (BSP, 2012).

Basic Periodontal Examination (BPE) Charting

Majority of the referrals had BPE charted, with only a few referrals (4%) that had failed to include a BPE score. BPE was developed by the British Society of Periodontology as a simple screening tool to identify periodontal status of patients and provide guidance on periodontal treatment needs. A patient with BPE score of 4 or * may be considered for specialist periodontal referral. BPE together with radiographs is practical for the preliminary assessment of need for further periodontal investigation during the screening of a patient's oral health status.

Radiographs

About ¾ of the referrals had included radiographs for the specialists' perusal. Radiographs are necessary to aid in the diagnosis of patient's periodontal disease and to visualise the loss of bone from the alveolar crest. In BPE scores of 4 or *, individual radiographs will need to be taken to provide views of teeth with sites where probing depth exceeds 5.5 mm (indicating pocket depth ≥6mm) or where furcation involvement is detected (BSP Basic Periodontal Examination Guidance, 2011). For this audit, all the radiographs included as part of the referrals were orthopantomograms (OPG). The method of performing BPE together with appropriate radiographs forms the basis of a suitable screening examination for use in primary oral care.

Details of previous treatment

About half of referrals (58%) had included details of previous periodontal treatment carried out, mainly in the form of full mouth scaling and oral hygiene instruction. 'Referral policy and Parameters of care' by BSP advised `even where referral for further treatment is considered, initial therapy including oral hygiene instruction, and supra & subgingival scaling should normally be carried out in the primary care setting by the general dental practitioner or dental hygienists.' Referrers should present to the patients their periodontal findings following clinical examination and the patients should be given at least oral hygiene instructions, including supra- and subgingival scaling prior to referral for specialist care.

Inappropriate referral of patients

Inappropriate referral in this audit was defined as (i) referrals without BPE scores noted or referrals with BPE scores 0, 1, 2 or 3 and (ii) referrals without relevant radiographs provided. This clinical information is necessary for the specialist to differentiate a simple periodontal case from the more complex.

Only 78% of referrals in this audit were found to be appropriate. Majority of referrals that were inappropriate was attributed to not having radiographs enclosed with the referral. One referral was considered `inappropriate' because it provided an outdated radiograph from six years ago. A recent radiograph obtained not more than 1-2 years ago is required for referral, as it provides a more accurate means of assessing and diagnosing the patient's periodontal disease.

Basic Periodontal Examination Guidance (2011) states that patients with BPE 4 and/or * may be considered for specialist referral whereas BPE score 1-3 may be treated in general dental practice. In this audit, there were two inappropriate referrals with BPE scores of 3; the first was to seek a second opinion because the referrer's clinical findings did not match the patient's dental complaint, and the second was due to the patient's relentless requests to be seen by a specialist. These inappropriate referrals had been made in accord with General Dental Council 'Standards for Dental Professionals' paragraph 1.3 which states "Work within your knowledge, professional competence and physical abilities. Refer patients for a second opinion or further advice when it is necessary or if the patient asks. Refer patients for further treatment when it is necessary to do so."

Essential details such as recording BPE charting and providing relevant radiographs allow the

specialists to have an insight of each patient's periodontal problems and to prioritise them accordingly for consultation. Furthermore, it is also the referrer's professional and legal duty to practise good record keeping as fellow colleagues rely on the recorded information when taking over a patient's care.

The Government of Brunei Darussalam offers free or subsidised dental care to its population. Based on the Oral Health Survey conducted in 1999, there was a huge periodontal disease burden among the population of Brunei Darussalam where it was estimated that about 21% of adults were recorded with BPE code 4 and/or *. In accordance with Basic Periodontal Examination Guidance (2011), this group of patients would need to be assessed for possible complex treatment and specialist referral may be indicated. With only two specialist periodontists available to a sizable proportion of the Brunei population suffering from periodontal disease, it becomes necessary to screen, prioritise and manage the patients more efficiently.

High priority should be given to younger patients with aggressive periodontitis as it may result in significant amounts of attachment loss occurring at an earlier age. For patients with aggressive or more severe forms of periodontal disease, early diagnosis and management are important to improve the prognosis. Within the National Health Services, Liverpool, the specialist accepts referrals of patients with aggressive or severe periodontitis that persists despite concerted efforts with initial periodontal treatment and patient achieving good oral hygiene. Also, the referrals require periodontal charting and radiographs, otherwise it will be returned back to the referrer for completion.

CONCLUSION

At present, the set standard of `all referrals (100%) should have all administrative details recorded and all referrals (100%) should have all clinical details recorded except for item (B5) and (B6)' have not been met. Referrers should be made aware that all periodontal referrals must include a BPE score, recent relevant radiographs and other required information. Inappropriate referrals may take away specialist clinical sessions from patients who need periodontal treatment the most. The quality of periodontal referral may be improved by the distribution of referral guidelines and/or use of a proforma and may help to ensure appropriate allocation of time and resources for the Periodontics Unit.

RECOMMENDATIONS

The following are future recommendations:-

1. Use a standardised periodontal referral proforma/form* that can benefit both referrers and the specialists. Proforma will be quicker, easier, and user-friendly. It will also serve as a cue to ensure all necessary information is gathered. Referrers should fill in essential information that would allow specialists to prioritise certain patients e.g. those with aggressive periodontitis.
2. Future re-audit on quality of periodontal referral based on the new form.

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An audit of the quality of secondary impressions for removable dental prostheses received by dental laboratory in National Dental Centre

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INTRODUCTION

In response to changing philosophies in dental practice, better access to dental treatment and a general increased awareness in dental health, one significant trend since 1968 highlights a decline in the number of edentulous patients (Fuller *et al.*, 2009). In spite of this fact, according to the UK Adult Dental Health Survey (2009), more than 40% of adults over the age of 65, as well as many younger adults, are still edentulous and in need of complete denture therapy. The use of other treatment modalities such as fixed dental prostheses (e.g. bridges) or implant supported dentures to replace missing teeth may not be suitable for all patients due to medical, physiological, or financial constraints. Therefore, conventional removable dental prostheses remain an important and essential tool for the restoration of the oral function of partially and completely edentulous adults.

There are many factors that contribute to good quality removable dental prostheses. They include clinician's experience and skills, type of impression materials and trays, and quality of secondary impressions. The production of a good quality secondary impression is considered as an important milestone in the fabrication of complete and partial dentures. According to The British Society for the Study of Prosthetic Dentistry (BSSPD), the secondary impression should record the entire functional denture-bearing area to ensure maximum support, retention, and stability of the denture during use (BSSPD Guidelines, 1994). The objective of secondary impression for complete dentures is to record the potential denture-bearing surface available so that a resulting denture with good support, retention, stability, and aesthetics can be fabricated. Whereas, the objectives of secondary impression for partial dentures (acrylic and chrome-cobalt) are to record the anatomic form of teeth and their surrounding supporting tissues so that the resulting dentures can be surveyed for a suitable path of insertion and removal, as well as for the provision of good support, stability, and retention.

According to a study done by Al-Ahmar *et al.* (2008) in the evaluation of the quality of 144 secondary impressions and related materials for fabricating complete dentures in the UK, 11% of impressions examined were judged to have errors of which: 10 cases related to areas of under extension, 4 cases related to 'drags' or distortions in the impression and in 2 cases, the impression material had lifted away from the underlying tray. In a study of fixed partial denture secondary impressions by Samet *et al.* (2005) 89.1% had 1 or more detectable errors which consisted of voids or tears, air bubbles, and inadequate retention of material to tray. According to Beier *et al.* (2007), secondary impressions for fixed dental restorations with voids or bubbles up to 2 mm in diameter not involving the preparation finish line that could be corrected by the technician on the casts were considered acceptable; whereas, impressions with bigger voids or bubbles, that is more than 2 mm in diameter were categorised as unacceptable. In terms of dimensional accuracy, Petrie *et al.* (2005) stated that dimensional accuracy of secondary impression materials for complete denture prostheses is usually time-dependent with varying degrees of accuracy being reported after the impressions have been stored for a period of time.

Based on the above studies, it is important for dentists to critically evaluate impressions routinely before sending them to the laboratory as the resulting cast from the impression is used by the dentist/technician to design and construct a removable dental prosthesis. A dentist should be able to identify and analyse defects in impressions, and understand how to avoid these defects. It is also important for both dentists and technicians to be aware of the tolerable delay period for selected impression materials to ensure dimensional accuracy is maintained in order to achieve successful prosthodontic treatment.

AIM AND OBJECTIVES

The aim of this audit was to examine the quality of secondary impressions for removable dental prostheses received by dental laboratory in the National Dental Centre (NDC).

The objectives of this audit were:

- to assess the quality of secondary impressions made using acrylic custom trays for fabrication of complete and partial acrylic dentures
- to assess the quality of master casts poured from the secondary impressions
- to identify the types of defects on the secondary impressions
- to determine the most frequent material used for secondary impressions
- to assess the time taken for the secondary impression to be poured upon receipt at the laboratory.

MATERIALS AND METHODS

This was a cross-sectional study of all secondary impressions for removable dental prostheses received by dental laboratory in NDC. The data collection was conducted by the main auditor, from 1st April to 21th May 2013. The inclusion criteria for this audit were secondary impressions received by dental laboratory in NDC, made with acrylic custom trays with requests for complete and partial acrylic dentures only. Secondary impressions received by other dental laboratories, made with stock and shellac trays, and with requests for fixed dental prostheses and chrome-cobalt removable partial dentures were excluded from this audit.

For each impression, data referring to which unit/clinic, material used, time of impression received and poured, and types of discrepancies were recorded. The impressions were numbered prior to evaluation so that the identities of the dentists were unknown to the auditor. Photographs of the secondary impressions and master casts were taken using the same camera at a fixed setting. The co-auditor (Naimah Hj. Chuchu) was responsible in informing the main auditor of any secondary impressions received to facilitate immediate evaluation. The co-auditor (Dr. Kamsiah Binti Kasah) evaluated the secondary impressions from the photographs taken, if immediate evaluation with the main auditor was not possible. The findings from both main auditor and co-auditor were compared and discussed before recording the data.

All impressions were visually and physically evaluated for the following discrepancies immediately upon receipt at the laboratory:-

- Voids (Definition: Irregular defects in the impression material with a glossy surface)
  - $\geq$ 2 mm in diameter at denture bearing areas
- Air bubbles (Definition: A globular or half-globular space caused by air entrapments in the impression material)
  - $\geq$ 2 mm in diameter at denture bearing areas
- Inadequate retention of material to tray (Detachment of the impression material away from the tray)
- Visibility of the acrylic tray through the impression material
- Tears around the impression
- Rough or uneven surface of the impression

The master casts were poured by co-auditor (Naimah Binti Chuchu) using standardised methods* of pouring and evaluated for defects and discrepancies by the main auditor and co-auditor (Dr. Kamsiah Binti Kasah) in the same manner as the secondary impressions. The master cast was evaluated for the presence of anatomical features of the denture-bearing area. The data for defects and discrepancies in the secondary impressions and master casts was manually recorded in the data collection sheet*, entered and analysed for descriptive statistics using Microsoft Excel Spreadsheet.

The % Quality of secondary impressions was obtained by dividing the number of YES responses with respect to data on impressions in the proforma* by the TOTAL of YES plus NO responses. The value obtained for secondary impressions of the maxillary and mandibular arch were recorded separately and multiplied by 100 for percentage value.

$$\%\ \text{Quality of maxillary Impressions} = \frac{\text{YES}}{(\text{YES+NO}) \text{ of maxillary impression only}} \times 100\%$$

$$\%\ \text{Quality of mandibular Impressions} = \frac{\text{YES}}{(\text{YES+NO}) \text{ of mandibular impression only}} \times 100\%$$

The % Quality of master casts was obtained by dividing the number of YES responses with respect to data on casts in the proforma* by the TOTAL of YES plus NO responses. The value obtained for master casts of the maxillary and mandibular arch were recorded separately and multiplied by 100 for percentage value.

$$\%\ \text{Quality of maxillary master casts} = \frac{\text{YES}}{(\text{YES+NO}) \text{ of maxillary master cast only}} \times 100\%$$

$$\%\ \text{Quality of mandibular master casts} = \frac{\text{YES}}{(\text{YES+NO}) \text{ of mandibular master cast only}} \times 100\%$$

The quality of secondary impressions and master casts was categorized separately using the following criteria:
Unsatisfactory - < 50%
Satisfactory - 50-65%
Good - 66-79%
Very Good - 80-90%
Excellent - ≥ 91%

STANDARD

Making acceptable secondary impressions for fabrication of Removable Dental Prostheses is an important requirement for the successful treatment of partially or completely edentulous patient. However, there is currently no international or national standard available related to quality of secondary impressions of removable dental prostheses. Hence, it was proposed that the quality of secondary impressions for complete and partial acrylic dentures should be 80% or above. Likewise, it was proposed that the quality of master casts for complete and partial acrylic dentures should be 80% or above.

RESULTS

A total of 60 cases of secondary impressions collected over a period of 7 weeks were included in this audit. Of the 60 impressions examined, 29 (48.3%) were maxillary impressions and 31 (51.7%) were mandibular impressions. From the 60 impressions made, 29 (48.3%) were for complete acrylic dentures and 31 (51.7%) were for partial acrylic dentures.

Percentage quality

As shown in Figure 1, none of the maxillary or mandibular secondary impressions meet the author's proposed standard for quality of secondary impressions for complete and partial acrylic dentures (≥80%). However, the quality of master casts poured from maxillary and mandibular secondary impressions met the proposed standard. The quality of maxillary casts was excellent (98.2%), whereas the quality of mandibular casts was very good (90.0%).

Types of defects

The most frequent defect in mandibular impressions was the visibility of tray and the least frequent defect was inadequate retention of impression material to the tray (Figure 2). Whereas for maxillary impressions, the most frequent defect was the presence of voids and the least frequent defects were rough surfaces and inadequate retention of impression material to the tray.

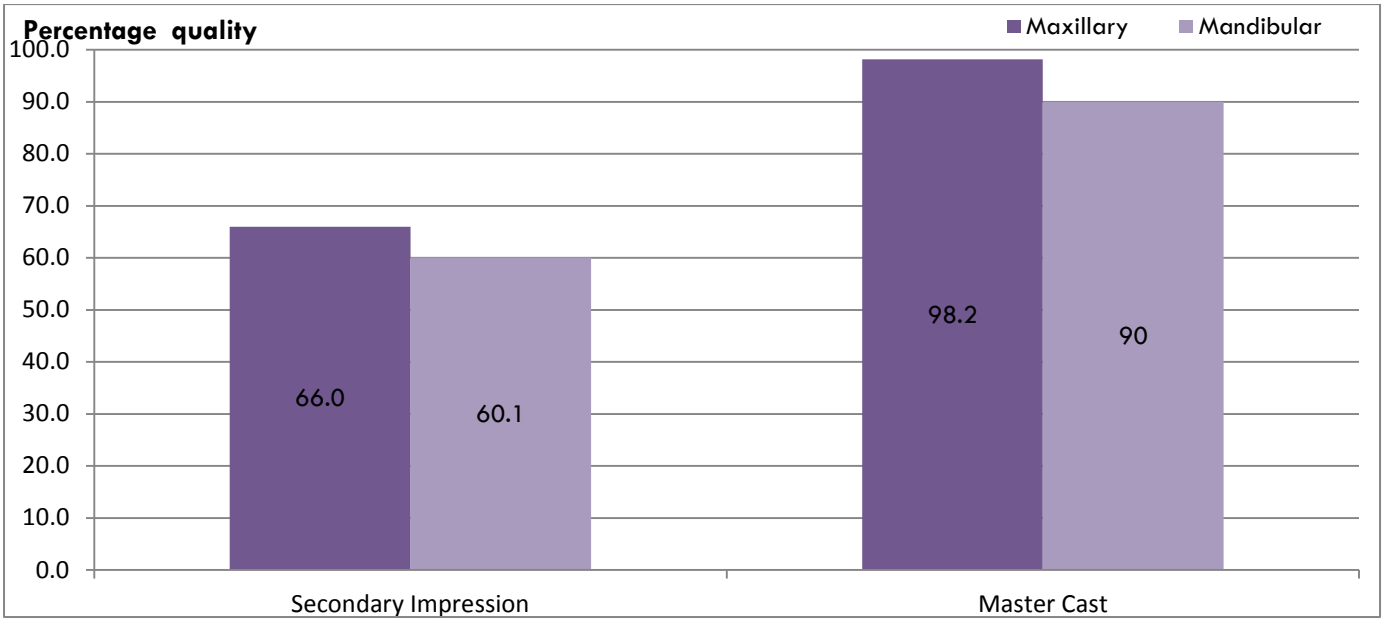

Figure 1. *Percentage quality of secondary impression and master cast.*

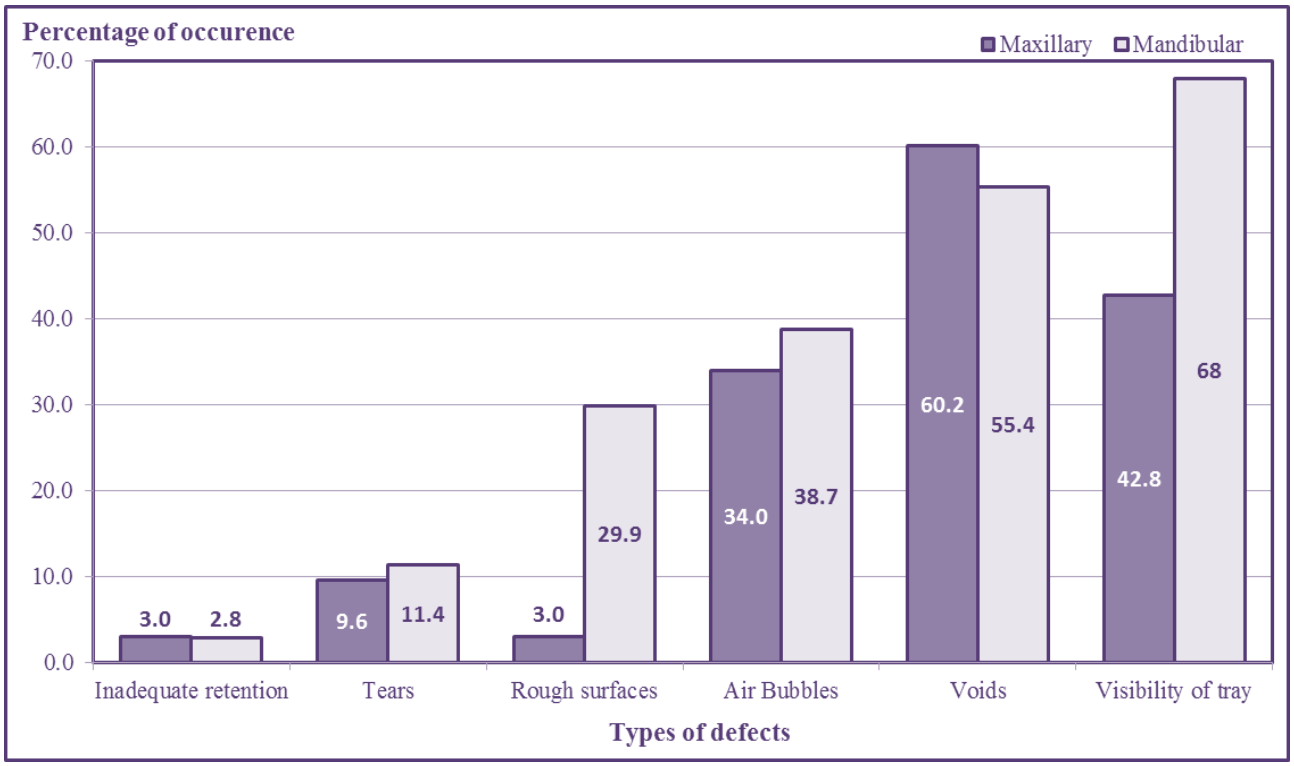

Figure 2. *Types of defects on secondary impressions.*

Types of impression materials and time taken for secondary impressions to be poured

The scores in percentage for different types of impression materials and the time taken for secondary impressions to be poured are provided in Table 1. The most frequently used materials were PVS Monophase Examix (76.7%), followed by PVS Aquasil UltraMonophase (16.7%) and Polysulphide (6.7%).

As shown in Table 1, the impressions were never poured immediately upon receipt at the laboratory. About two-fifths (36.7%) of the impressions were poured within 17-24 hours after the impressions being received in the laboratory.

Table 1. Scores in percentages for different types of impression materials and the time taken for secondary impression to be poured.

	Number of cases (%)
Types of Impression materials	
PVS	
Monophase Aquasil	10 (16.7)
Monophase Examix	46 (76.7)
Polysulphide	4 (6.7)
Time taken for secondary impression to be poured in hours	
< 1	0 (0.0)
1-8	9 (15.0)
9-16	7 (11.7)
17-24	22 (36.7)
25-32	0 (0.0)
33-40	6 (10.0)
41-48	8 (13.3)
49-56	0 (0.0)
57-64	0 (0.0)
65-72	8 (13.3)
>73	0 (0.0)
Total	60 (100.0)

DISCUSSION

This audit aimed to examine the quality of secondary impressions for removable dental prostheses received by dental laboratory in NDC, as determined by the absence of air bubbles, voids, visibility of acrylic custom tray, tears and any partial recording of denture-bearing areas and abutments in the secondary impressions.

Before discussing the findings, it is appropriate to consider the strengths and weaknesses of this audit. The strength of this audit is that secondary impressions and master casts were examined by prosthodontist, which is comparable to a study by Beier *et al*., 2007. All the cases were evaluated by the same evaluators in which criteria in data collection proforma was discussed beforehand to ensure data was collected and interpreted using the same methodology. However, a relatively small sample size is probably one of the weaknesses of this audit. Although a larger sample size would have made some of the results more informative and more representative, this audit had time constraints which prevented data collection period to be extended further. Another weakness was that the quality of acrylic custom trays used in making secondary impressions were not standardised that they were made by different technicians. According to Chee and Donovan (1992), silicone, polysulphide rubber, and polyether impression materials can only record the shape of the soft tissues accurately if they are adequately supported by an accurately fitted tray. Poorly contoured acrylic custom tray may hinder the making of good quality secondary impressions as a properly contoured acrylic custom tray is required to facilitate the making of a good quality secondary impressions and the formation of a well-extended and durable master casts.

The findings of the audit will be discussed according to the 5 main objectives of the audit.

Quality of secondary impressions

None of secondary impressions met the set standard for quality of secondary impressions. However, maxillary secondary impressions recorded a higher percentage for quality compared to mandibular secondary impressions. This is to be expected as majority of cases in this audit used PVS as secondary impression material which is hydrophobic in nature, thus require a dry

field for better reproduction of surface details. It is easier to maintain a dry field in the maxillary arch than in the mandibular as maxillary arch is not subjected to pooling of saliva. According to a study by Petrie *et al.* (2003), best surface details of PVS impressions (100%) were obtained only under dry conditions for both PVS materials (Aquasil and Reprosil), in which surface details of impressions of Aquasil and Reprosil dropped significantly (47.1% and 11.8% respectively) under wet conditions. The lower quality of mandibular secondary impressions may also be explained by the difficulty to stabilise the acrylic custom trays on the mandibular arch as compared to the maxillary arch. This could be explained by the presence of the tongue and the height of mandibular ridge. The mandibular arch tends to have a shorter ridge as a result of ridge resorption. Such cases would benefit from border-moulding prior to impression making for better stability of the tray. Another finding that emerged from the audit was the inadequate recording of denture bearing areas. This was found to be caused by under-extended acrylic custom trays which consequently resulted in unsupported impression material. This can be avoided by standardizing the fabrication of acrylic custom trays.

Quality of master casts poured from the secondary impressions

Master casts poured from secondary impressions for both maxilla and mandible meet the set standards although none of the secondary impressions met the standard set. This could have been biased, as pouring of all impressions was done by the co-auditor technician who knew that her works was being audited. Another possible reason was the presence of non-visible errors; by which errors in secondary impressions may not be evident on the master cast until the denture is completed. An example of non-visible error is the distortion of impression materials which may occur when the impression material is seated too late in the mouth that polymerization has started. As noted by Chiayi (2003), an increase in seating pressure is required to overcome the stiffness of the impression material. This subsequently causes distortion because of excessive elastic deformation. This error may not be evident on the master cast but will arise subsequent to the insertion of the prostheses such as areas of painful to pressure or rocking denture under finger pressure. As mentioned above, the quality of maxillary secondary impressions is higher than the quality of mandibular secondary impressions. In the audit, the quality of maxillary master casts was higher than the quality of mandibular master casts as the availability of anatomical features of the denture-bearing areas on master casts depends on whether the landmarks were captured on the secondary impressions. However, in a study done by Lepe *et al.* (1998), some impression materials did reproduce detail on the impression surface but failed to transfer the detail on the cast. This depends on the compatibility of impression material and dental stone. An impression material should be compatible with the dental stone in order to obtain acceptable casts. In this audit, type III gypsum product was used, an alpha hemihydrate, commonly used for casts used to process dentures because the stone has adequate strength for that purpose and the denture is easier to remove after processing. In a study done by Patel *et al.* (2010), they concluded that gypsum compatibility varied with the brand of gypsum used, with the best compatibility identified between Silgimix (PVS) and Microstone (Type III dental stone). There are frequent cases that the stone teeth fractured from the master casts for fabrication of removable partial denture. This is because the cast does not have a high tensile strength, and often breaks at the cervical aspect of the stone teeth when being separated from the relatively rigid silicone impression material, which is common in cases with isolated teeth, excessive tissue undercuts, advanced gingival recession and teeth with class V (abrasion) cavities. The risk of tooth fracture can be avoided by sectioning of the acrylic custom tray and impression material.

Types of defects on the secondary impressions

The least frequent defect in the mandibular impressions was inadequate retention; only 2 out of 60 cases were shown to have inadequate retention. This error can be readily avoided by using the proper removal technique and appropriate adhesive. According to a study of retention of elastic impressions in trays by Jorgensen (1979) and Viohl and Nolte (1983), adhesives were recommended to be used on all trays, even those with perforations. Rapid removal of the impression from the mouth also improved the retention between the tray and the impression

materials, as did removal in a vertical rather than oblique direction. Another factor that affects the bond strength of impression material to a custom tray is the time required to leave the adhesive on the tray to dry prior to loading impression material. According to Cho *et al.* (1995), the application of adhesives on custom trays at least 7 to 15 minutes prior to impression making allows formation of adequate bond strength.

Visibility of tray was the most frequent defect in mandibular secondary impression, whereas it was the second most frequent defect in maxillary impression. The reason for this could be because most of secondary impressions that required border-moulding, were not border-moulded. Only 10 out of 46 cases were border-moulded in this audit. Border-moulding allows optimal adaptation of the tray to the foundation area; prevent uneven pressure on tissues and aids in retention of impression tray. Therefore, border-moulding may reduce the frequency of inadequate retentions and visibility of tray. According to Al-Ahmar *et al.* (2008), 59% of master impressions had evidence of recording the functional peripheries of the denture-bearing area, through the use of border-moulding technique. Of these, the technician reported that 69% of master impressions had employed greenstick-tracing compound, 26% employed PVS putty and 5% had been border-moulded using alginate.

The presence of voids was the most frequent defect in maxillary impression. This was found to be caused by insufficient material being used for impression making. It is important to dry the mucosa and teeth prior to impression making and to load enough impression materials to the tray ensuring the impression delivery tip is submerged in extruded materials at all times during loading to avoid voids.

Most frequent material used for secondary impressions

It is generally acknowledged that a broad range of impression materials are available for recording the edentulous denture-bearing areas. There is little information in the dental literature to demonstrate the superior properties of one impression material over another, provided that the material is handled appropriately. According to a study done by Al-Ahmar *et al.* (2008), the most commonly used impression material was zinc oxide-eugenol, followed by polyvinylsilicone (PVS) and irreversible hydrocolloid. In this audit, the most common impression material used was PVS. PVS is a type of addition-reaction silicone that has superior tear strength. However, wearing latex rubber gloves may inhibit the setting time of PVS as demonstrated by a study done by Neissen *et al.* (1986). The limited use of Polysulphide by dentists could be attributed to the non-availability of this material in Primary Oral Care clinics or the fact that dentists are less familiar with this type of material. Another possible reason our clinicians may have chosen PVS over alginate for secondary impression could be attributed to that impressions were either taken towards the end of the day, or the clinicians were concerned the impressions would not be cast immediately upon receipt. Clinicians from peripheral clinics may have chosen PVS over alginate for the same reason, for fear of delay in casting as impressions need to be transported to the dental laboratory, at NDC which can be some distance from the clinic.

Time taken for the secondary impression to be poured upon receipt at the laboratory

Tolerable time delay for the secondary impressions to be poured depends on the materials' dimensional stability. Impression material that demonstrated the greatest dimensional stability is addition silicones, followed by polyethers, polysulphide and condensation silicones in decreasing order. In this audit, 36.7% of the impressions were poured within 17-24 hours after impressions being received in the laboratory. However, the time delay for the secondary impressions to be sent to the laboratory after they were made was not taken into consideration. It was assumed that all secondary impressions were sent to the laboratory in NDC immediately after impression making. However, secondary impressions made in peripheral clinics (33.3% of all cases) may have taken a longer period to be transported. Although all secondary impressions received from peripheral clinics were made from PVS, a dimensionally stable material, time delay could affect the dimensional stability of the impressions. According to a study by Al-Ahmer *et al.* (2008), there was a minimum delay of 4 days for the secondary impressions to be poured. In this audit, the most frequent impression material used is PVS which is dimensionally stable. Addition-type

silicones allow for a longer delay period between making the impression and pouring it. This dimensional stability is due to the fact that the materials are not affected by humidity, and they do not produce any by-products or undergo further chemical reactions after setting. This characteristic makes a PVS impression dimensionally stable for up to 7 days. On the other hand, Polysulphide impression materials have acceptable dimensional accuracy only if poured immediately, or within approximately 1-2 hours after the impression is made (Petrie *et al.*, 2005). However, in this audit, secondary impressions made using Polysulphide were poured more than a day after impressions were received by the laboratory. The choice of impression materials varies according to the preference of the clinician. A clinician may prefer using polysulphide over other types of impression materials because of its longer working time. However, it is not advisable for dentists particularly in peripheral clinics to use polysulphide impression material if pouring of secondary impressions could not take place immediately or within 1-2 hours.

CONCLUSION

There is currently no international or national standard and very little information available in relation to the quality of secondary impressions that can be used as guideline and comparison in this audit. At present, the proposed standard of quality at 80% and above has not been met for both maxillary and mandibular secondary impression. Thus, it is important to reinforce to dentists the need to maintain good quality of secondary impressions for fabrication of prostheses. However, this audit's objectives only examined the quality of secondary impressions and its outcome on the resultant master cast. Further audits are needed to evaluate the outcome of impression and the resultant casts on the quality of partial and complete acrylic dentures produced.

FUTURE RECOMMENDATIONS

Continued efforts should be made to produce better quality of secondary impressions through CPD lectures or workshops for dentists and technicians that would highlight the following recommendations:

- To increase awareness among primary care dentists concerning the availability of different materials for border-moulding and impression making.
- To ensure border-moulding is performed for all complete denture cases and free-end saddle cases.
- To use adhesives and provide sufficient time for the adhesives to dry on the acrylic custom trays in order to ensure adequate retention of secondary impressions in the custom tray.
- To pour the secondary impressions as soon as possible and to take into account the dimensional stability of different types of impression materials with acceptable period of delay of pouring.
- To carefully separate the impression from the master cast by sectioning acrylic custom tray when necessary to prevent fracture of stone teeth from master cast.

RE-AUDIT

Aside from addressing the limitations mentioned previously, there are other suggestions for future audit as part of the audit cycle. An increased sample size should be considered by probably increasing the duration of audit. Secondary impressions received by other dental laboratories should be involved to make the results more representative. Another area of concern that should be taken into consideration is the experience of the dentists which can influence the quality of secondary impressions made. A re-audit can be conducted soon after CPD lectures or workshops have taken place and a year after that to assess if dentists and technicians follow the recommendations highlighted in the lecture.

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An audit to determine the appropriate use of bitewing radiographs for new patients by dentists at the National Dental Centre (NDC) in Brunei Darussalam

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BACKGROUND

The rate of caries in Brunei Darussalam is alarmingly high and caries remains a significant problem. In the National Dental Survey 1999, decayed, missing and filled teeth(DMFT) of 14.4 for 35-44 year olds was recorded.

Dental caries rates must be addressed as a priority within the dental services. The irony is that dental caries is a preventable condition as long as appropriate educational and oral hygiene advice together with sensible dietary habits are adhered to. It is well known that bitewing radiographs are an essential adjunct to clinical examination and can be used to identify lesions especially interdental caries which may not be visible clinically (Kidd and Pitts 1990).

Bitewing radiographs (B/W) can be useful as a diagnostic tool for both preventive and operative dentistry. It can also give information about caries progression, periodontal support/bone levels, calculus, unerupted teeth and other diseases (Kidd and Pitts, 1990).

The Faculty of General Dental Practitioners [FGDP] (UK) has published Selection Criteria in Dental Radiography guidelines since 1998 to aid the practitioner in selecting the appropriate radiographs for various clinical situations. It advises taking bitewing radiographs (more accurate than Dental Panoramic Tomograph (DPT) at a frequency that patient caries risk assessment indicates.

AIM AND OBJECTIVES

The aim of this audit was to determine if dentists are taking bitewing radiographs on new dentate patients attending for routine dental examination in accordance with the FGDP (UK) (2004) recommended guidelines.

The objectives of this audit were:

- To identify factors which may affect dentists adherence to guidelines on taking bitewing radiographs
- To quantify the number of bitewing radiographs taken compared to the number of new dentate patients

"….posterior bitewing radiographs are an essential part of the assessment of a new adult dentate patient"

As there appears to be no formal guidance on the use of dental radiographs in Brunei, the guidelines from FGDP (UK) 2004 as outlined below will be applied. These are similar to the American Dental Association (ADA) & US Food and Drug Administration (2012) guidelines:

- High caries risk - Posterior bitewing radiographs at six-month intervals until no new or active lesions are apparent and the individual has entered another risk category
- Moderate caries risk - Annual posterior bitewings unless risk status caries risk alters
- Low caries risk - Posterior bitewing radiographs at approximately:
    - 12-18 months in the primary dentition
    - Two-year intervals in permanent dentition
    - More extended radiographic recall may be employed if there is explicit evidence of continuing low caries risk.

STANDARD

From the guidelines set by the FGDP (UK), it is ideal that all new dentate patients attending for examination should have posterior bitewing radiographs taken according to their caries risk assessment. However, since dentists working with the Ministry of Health, Brunei Darussalam come from a variety of training backgrounds, there may be some who are not familiar with the FGDP (UK) or the American guidelines.

Thus, the standard for this audit shall be that at least 70% of new dentate patients attending for examination (without any acute conditions) should have bitewings taken as part of their initial assessment based on their risk assessment in accordance with the guidelines above.

MATERIALS AND METHOD

Data was collected from patients attending Primary Oral Care Unit at NDC from 13h January to 6th February, 2014, on consecutive workdays until the target sample size (100) was reached

Information from the clinic regarding details of the examinations gathered from the day-list in Dental Reception Block A of the NDC, from dentists (working at NDC during the audit period) personal logbooks and patient records included the following:
exam date

- gender
- age
- whether caries risk was recorded and if so what it was?
- whether selection criteria were applied when taking bitewing radiographs?
- whether bitewing radiographs were taken and findings recorded in notes?

Sample size: One hundred records of patients attending for examination at NDC with Primary Oral Care Unit, whom were without acute conditions were assessed to check if bitewing radiographic examination were taken in accordance with the above guidelines.

Inclusion criteria –
All new dentate patients above 16 years old attending Outpatient Clinic at NDC for routine dental examination/check-up (not requesting filling or extractions).

New patient was defined as a patient who turns up at NDC for examination who was last seen at least six months previously. If patient was attending the Outpatient clinic after having missed a previous appointment, this was included as a new patient for the purposes of the audit.

Exclusion criteria –

1) patients aged 16 years and below
2) the large numbers of patients with acute conditions requiring urgent attention e.g. in pain,infection etc.
3) edentulous patients
4) pregnant patients
5) patients seen on days when there are no bitewing radiographs facilities available
6) patients unable to tolerate bitewing radiographs e.g. patients with strong gag reflex
7) Patients seen by the main investigator (in order to reduce bias)

Concurrently a questionnaire* (emailed) was distributed online to all (primary care) dentists within government clinics in Brunei Darussalam.

The data from dentists who were working at the NDC during the period of audit was analysed separately to ascertain possible factors affecting dentists' adherence to recommended guidelines. Results were collated on Excel and analysed.

RESULTS

During the audit period, from the sample , fifty seven females attended compared to forty three males, the ages of patients attending were between 17 and 77 years old. None of the patients had caries risk recorded in their notes. There were eight patients whom had bitewing radiographs taken as part of their initial assessment in accordance with the guidelines. During the same period, 488 patients attended with acute dental problems.

Thus 8% of new dentate patients attending for examination (without any acute conditions) had posterior bitewings taken as part of their initial assessment based on their risk assessment in accordance with guidelines. The standard was not met.

The survey was sent to 47 primary care dentists via email. They were invited to respond on three separate occasions, as only a few responses were received after initial invitation. In the end, 31 responses were recorded equating to a 65.9% response rate with 16 surveys unanswered. Most questionnaires were fully completed, but some respondents chose not to answer all the questions. Thus for any one question the total responses may not equal 31.

Demographics

Table 1: Distribution of respondents by year of qualification.

Year of qualification	Responses		No. of respondents with Postgraduate qualifications
	No.	(%)	
Pre 1970	0	0	0
1970-1979	1	3.2	1
1980-1989	3	9.7	1
1990-1999	4	12.9	3
2000-2009	17	54.8	9
2010-2011	6	19.4	0
Total	31	100	14

Twenty two (70.9%) of respondents were female with nine (29.1%) male and the distribution of respondents whom reported having postgraduate qualifications. There were insufficient responses to determine whether there was a correlation between having postgraduate qualifications and being familiar with radiographic guidelines.

Radiographic data

Five respondents out of twenty seven respondents (18.5%) reported having no access to any radiographs at their place of work and needed to refer these patients to other clinics, i.e. - National Dental Centre, RIPAS Hospital Radiology Department, the PAPHMWHB dental clinic (Rimba) and the PMMPHAMB Hospital Dental clinic (Tutong). Out of those with access to radiographs all had access to intraoral radiographs and 48.1% (thirteen out of twenty seven respondents) had access to DPT radiographs as well.

Of the respondents with access to intraoral radiographs, the majority were conventional film [seventeen out of twenty two (77.3%)]. Five out of twenty two respondents (22.7%) had access to phosphor plate or direct sensor digital intraoral radiographs.

Familiarity with FGDP guidelines on bitewing radiographs

Familiarity with selection criteria for dental radiography guidelines (United Kingdom FGDP or US American Dental Association) guidelines was investigated in the survey. Half of the respondents were familiar with the guidelines.

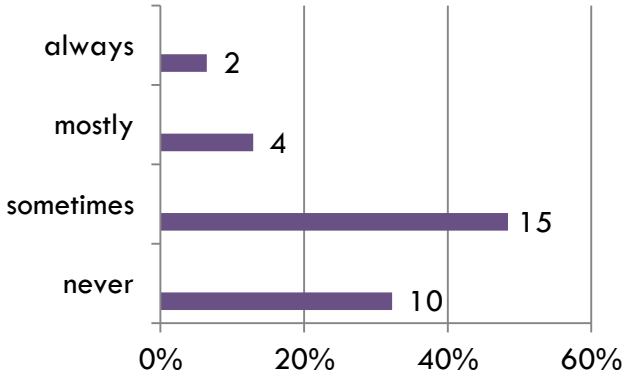

Figure 2. Do you carry out caries risk assessments in adult patients and record this for future assessment? (Number of respondents indicated)

As shown in Figure 2, two dentists (slightly over 5%) reported that they always checked caries risk and recorded it in the notes for future reference. If the "mostly" category is also included from these results then nearly 20% of responders "always" or "mostly" record caries risk in the patient notes.

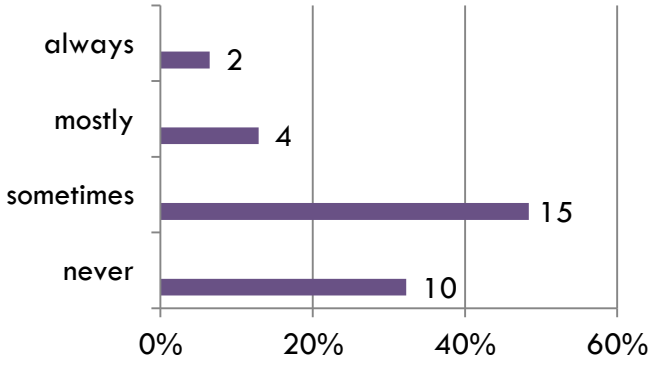

Figure 3 Do you routinely take bitewing radiographs at intervals that correspond to the patients disease risk? (Number of respondents indicated)

In Figure 3, two (6.5%) of respondents reported always taking radiographs at intervals according to disease risk. However if "always" and "mostly" is combined, then slightly over 19% (6) of the respondents reported taking bitewings at appropriate intervals.

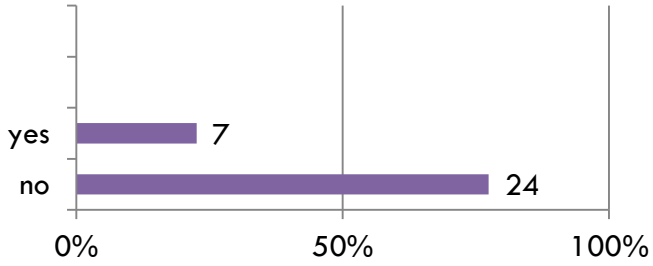

Figure 4 Do you routinely take bitewing radiographs for new patients with posterior teeth present? (Number of respondents indicated)

In figure 4, seven (22.6%) of the dentists reported taking bitewings for new patients.

Factors affecting the decision to take bitewings radiographs were analysed.

The respondents in the emailed questionnaire cited following reasons affecting the decision to take radiographs.

1. Practicalities
    - time constraints (insufficient time to take radiographs)
    - availability of film and radiographic equipment
    - problems with processing of radiographs
    - commonly radiographs are lost in storage
    - lack of auxiliary staff to take radiographs
    - No radiographic equipment on site
2. Patient factors
    - recent caries
    - existing fillings
    - patient motivation
    - dental symptoms
    - irregular attendance patterns of patients

The vast majority of respondents stated that guidelines for use of bitewings would be useful.

DISCUSSION

Many of the dentists working within Brunei qualified from the UK, Australia or New Zealand dental schools so they might be aware of these guidelines for dental radiography. Brunei currently does not have any official guidelines for the use of dental bitewing radiographs, but the United Kingdom FGDP or US American Dental Association guidelines sometimes may be followed with limitations. It would be helpful to promote recognised written guidelines on dental radiography for Brunei and to have a consensus about when and how often radiographs should be taken.

Since the publication of the *Selection Criteria in Dental Radiography* in 1998, dentists may be increasingly aware of the importance of taking bitewing radiographs as part of clinical examination. Even well-known caries experts such as Kidd and Pitts in 1990 described the value of having bitewings taken prior to treatment planning. Most of the dentists whom replied to the questionnaire qualified between 2000- 2009, with very few respondents (less than 15%) qualifying prior to 1990 and therefore would be aware of the importance of posterior bitewings. Nevertheless it seems prudent in order to provide a comprehensive and thorough examination to supplement clinical information with radiographs.

The awareness amongst all dentists of guidelines for taking bitewing radiographs during initial examination was low. This was reflected both in the questionnaire with 22.6% of responding dentists would take bitewings for new patients and this clinical audit showed eight out of one hundred new dentate patients having bitewings radiographs taken. Previous studies undertaken to assess levels of bitewing radiographs taken in general practice in UK show they are often under-prescribed. Mauthe *et al.* reported that 63% of GDPs in southern England took bitewing radiographs for new adult patients (2011).

In Brunei, high numbers of patients attending mainly for acute conditions can put high demands on the dental practitioners especially within primary dental services. The vast majority of patients are attending for acute problems which require emergency treatment. For these patients it may not be possible to take bitewing radiographs

on this initial visit. As mentioned by some respondents in the survey the decision to take bitewing radiographs was weighed up, balancing patient factors such as the condition of the mouth, previous fillings, caries experience as well as practical considerations such as time and availability of radiographic facilities. Furthermore, if patients were to travel to neighbouring clinics or districts in order to have radiographs taken, this also impacted the decision to take radiographs. The motivation of patients to attend for subsequent treatment was at times low, and often patients were unwilling to have radiographs taken when asymptomatic, which made consent for radiographs difficult. Patients who attended for examination without any acute conditions were very much the minority (around 20.5%) compared to the number of patients who attended with acute problems. Ideally it would be better to see all patients again for examination after the acute condition has been remedied; however in practice this is not achievable.

When a new patient attend the clinic, slightly above 20% (n=7) of dentists in the Brunei questionnaire reported they would take bitewing radiographs. This compares to a recent study from the UK which found that 78.5% of respondents taking them for all new adult patients (Drage *et al.,* 2013). Nineteen percent of the Brunei respondents stated that they would take "always" or "mostly" take bitewings at intervals corresponding to patient's disease risk. According to a UK study, over 90% of the respondents noted they would take bitewings corresponding to patient's risk (Mauthe and Eaton 2011). Comparing UK figures and those from Brunei Darussalam, this study's findings show that more bitewings are reported to be taken in the UK compared to Brunei Darussalam.

The value of assigning caries risk for patients in Brunei may aid in indicating a recall period for the patient. Not all patients should be attending every six months, some will require less frequent examination, whilst others perhaps may benefit from being seen every three months. By categorising patients in terms of caries risk and with the use of bitewing radiographs to aid in the identification of caries risk, those patients whom are more caries prone and perhaps in need of greater dental education and intervention can be highlighted and identified.

This audit focuses on adult patients within Primary Oral Care Unit. However the benefits of bitewing radiograph in children and young adults below the ages of 17 are well recognised (Pooterman *et al.*, 2010). Currently the majority of these patients are under the care of dental nurses both in school clinics and in primary care clinics whom may have limited training and facilities to take radiographs, develop and interpret the radiographs. It is not known how many bitewing radiographs are being prescribed from those involved in the recently established dental hygiene therapist programme.

RECOMMENDATIONS

Due to factors such as time constraints, dentists reported often having insufficient time to take bitewing radiographs. The introduction of digital radiographs in all clinics could be useful in these circumstances as they are potentially capable of reducing the time to take and process radiographs compared to conventional systems (Wenzel *et al.*, 2010).

Consideration to be given to implementing guidelines within Primary Oral Care Units, which would have to be agreed and may be adapted for the local climate.

Dentists are advised to follow guidelines on taking bitewing radiographs in order to utilise their benefits as a diagnostic tool.

Once formulated clear written guidelines should be accessible to all dental practitioners perhaps on an online format.

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The use of Personal Protective Equipment (PPE) during clinical procedures at the National Dental Centre

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INTRODUCTION

In dentistry, both patients and health care professionals are inevitably exposed to aerosol and splatter in the form of visible spray through the use of air-water syringes, rotary dental handpieces, ultrasonic scalers and surgical instruments. This visible spray primarily consists of a large-particle splatter of water, saliva, blood, microorganisms, and dental plaque with a diameter of greater than 100 microns. Splatter travels only a short distance, often within a radius of 1 metre from the source) landing either on the floor, nearby equipment and operatory surfaces, dental health-care personnel, or the patient and settles out quickly. The spray may also contain some aerosols that are typically not visible to the naked eye and of respirable size. Unfortunately, they can remain airborne for extended periods and can be inhaled. However, they should not be confused with the large-particle splatter that makes up the bulk of the spray from handpieces and ultrasonic scalers (Centre for Disease Control and Prevention [CDC] 2004).

The CDC (United States) Infection Control Guideline in Dental Health-Care Settings (2003) stipulates that standard precautions should be practiced in dentistry to limit the spread of infectious diseases. These precautions are based on the assumption that **all blood and other body fluids, secretion and excretions, non-intact skin and mucous membranes, should be treated as infectious because patients with infections can be asymptomatic or unaware they are infected.** Hence, the same infection control precautions will need to be applied to **all** dental patients regardless of their health status.

Transmission of infections can potentially be spread through air instead of direct contact. Therefore, wearing personal protective equipment (PPE) should not only be limited to during treatment, but also for handling of contaminated equipment and materials. This has to be done to minimise potential spread of infections such as colds, flu, cold sores, tuberculosis, hepatitis, HIV and others between patients and operators as well as to the public.

CDC has defined PPE as equipment 'designed to protect the skin and the mucous membranes of the eyes, nose, and mouth of dental health-care personnel from exposure to blood or other potentially infectious material'. They have also recommended that dental health care workers should wear **gloves, surgical masks, protective eyewear,** and **protective clothing** in specified circumstances to reduce the risk of exposure to blood borne pathogens.

Table 1 shows the types of PPE involved in dental setting based on King's College London (KCL) and Infection Control Services (ICS Ltd) guidelines (2008)

Table 1. The types of PPE involved in dental setting

Personnel	Patient
Gloves	
Uniform/Apron/Disposable gown	Disposable bib
Face Shields	
Safety glasses	Safety glasses
Mask	
Footwear	

The Ministry of Health (MoH) in Brunei Darussalam has published a Guideline for Health and Safety of Healthcare workers (2nd edition). Precautionary measures for prevention of transmission of blood-borne infections in dental clinics, dental laboratories and dental radiology were included. Although this guideline is accessible to public through the MoH's website, it is unknown if all of the dental workforce have access to it, or adhere to these guidelines. Dentists and Dental Nurses, however, have been exposed to infection control

practices during their undergraduate/diploma courses. Dental Surgery Assistants undergo basic training that includes aspects of infection control given in the form of lectures, workshops, demonstrations and assessments. These are organised by the Infection Control Unit of Department of Dental Services.

AIM AND OBJECTIVES

The aim of this audit was to assess the practice in the usage of PPE during clinical procedures at the National Dental Centre (NDC).

The objectives of this audit were:

1. To assess the appropriate usage of PPE donned on patients
2. To examine whether PPE was used optimally by dental personnel (clinicians and their assistants) for procedures
3. To assess the availability of PPE in individual dental surgeries at NDC.

MATERIALS AND METHODS

This audit was carried out over two Tuesday mornings in the month of November 2014. All dental personnel and their patients who were present while the audit was carried out in Block A, B and C in NDC were included. Clinicians performing basic brief dental examination for medical check-up were excluded as this does not always involve patient sitting on the dental chair and most of the time, it only involves the use of dental mirror.

Clinicians who were assessed included primary oral care dentists, dental specialists, dental nurses, dental hygienists and therapists and cohort 4 trainees undergoing the dental hygienists and therapists diploma programme as well as one dental assistant who was tasked with taking radiographs; and was therefore classed as a 'clinician' for the purposes of this audit. Dentists and dental specialists always have an assistant to assist them while dental nurses, hygienists and therapists usually work unassisted.

The total number of dental surgeries operating in Block A, B and C were checked on the day of data collection and this was divided equally between the auditor and co-auditor prior to data collection. Data collection utilised the proforma* and involved three parts:

1. Direct observation on the use of PPE by dental personnel and patient during a single clinical procedure. The procedure carried out was recorded to determine whether that particular procedure was aerosol or non-aerosol procedure. (The use of PPE in dental procedures would depend on whether aerosol or non-aerosol contaminants are involved).
2. Clinical inspection to assess the availability of PPE in each surgery.
3. Objective questionnaire to identify the reasons for not wearing PPE and the frequency of changing disposable aprons worn by dental personnel.

For each surgery being assessed, all three parts of the audit were carried out at the same time.

Data was entered and analysed using Microsoft Excel 2010. Data analysis was carried out as follows:

Availability of PPE in the dental surgery

Using data collection sheet*, availability of 7 different PPEs were assessed. As certain items such as safety glasses or face shields are needed by boththe clinician and assistant or patients, a minimum requirement of at least 2 numbers of these items was deemed necessary be present for each surgery. For example, if 2 pairs of safety glasses were available in a surgery, it was considered as having 'Met' the criteria in question; whereas, if only one was available it was considered as having 'Unmet' the criteria. Different sizes of gloves were also deemed essential to cater for both the clinician and the assistant.

The availability of PPE was calculated as follows:

$$\frac{\text{Total number of Met}}{\text{Total number of Met and Unmet}} \times 100\%$$

PPE usage by dental personnel or patient was calculated as follows: Each individual PPE was assessed for clinicians, assistants and patients. Score 1 was given if the dental personnel or patient wore that particular PPE and was considered as having 'Met' the criteria in question. Score 0 was given if the dental personnel or patient did not wear that particular PPE and was therefore considered as having 'Unmet 'as the criteria. Separate scores were recorded for clinicians, assistants and patients.

The final scores on PPE usage by dental personnel or patient were calculated as:
Total score for each PPE met X 100%
Total number of participants

Complete appropriate usage of PPE according to aerosol and non-aerosol procedures
The usage of different types of PPEs depends on the procedures to be carried out. If a complete set of PPE was used by clinician/ assistant/ patient for a particular procedure (either aerosol or non-aerosol involved), that particular personnel was given a score of 1. If not, a score of 0 was given.

*Questionnaire**
This was used to find out three main issues:
1. Which PPE was not being used, by whom and the reason for not wearing that particular PPE
2. Whether disposable apron/gowns was changed for every patient
3. The reason(s) for not changing the disposable apron/gowns after every patient

These questions were asked verbally by directly questioning the clinicians and assistants and the answers given were noted on the data sheet.

STANDARDS
As there are many standards available with regards to infection control practices, the following two guidelines were used in setting the standards for this audit.
1. King's College London (KCL) guideline (2008)
2. Infection Control Services (ICS) Ltd guideline (2006)

A similar audit was carried out in University College London Hospital in 2011, in which compliance was assessed with regard to the use of PPE in the Eastman Orthodontic Department. The target standard was set for 100%, as there was a policy on Infection Control already established. The outcome of this particular audit showed compliance on the usage of PPE by personnel and students to be 48% among the 272 operators assessed. The results of compliance for the PPE were: masks (33%), operator eye protection (73%), patient eye protection (96%) and gloves (98%). Poor compliance by operators was noted in wearing of facemask and operator eye protection.
Although there are no formal guidelines in place for the use of PPE in dental clinics in Brunei Darussalam, clinicians and assistants are assumed to have been exposed to infection control practices during their training or as part of their post qualification courses, hence **target standard for this audit was set to 80% for the use of each different PPE on dental personnel and patients as well as the overall complete appropriate usage of PPE.**

RESULTS
A total of 44 procedures were assessed with regards to availability of PPE and compliance of wearing PPE when attending to patients. PPE donned on patients during these procedures were also assessed. 116 participants were assessed, which comprised of 44 (37.9%) clinicians, 28 (24.2%) assistants and 44 (37.9%) patients.

Availability of PPE
Results on availability and appropriate usage of PPE are shown in Figure 1 and 2 below. Out of these 44 procedures, 16 (36.4%) were carried out without assistants and only 2 (4.5%) did not involve aerosol. PPE usage among dental personnel was also assessed in regards to whether the procedures were aerosol or non-aerosol involved.

Appropriate usage of PPE among patients
Out of 44 patients, almost three-quarter of the patients (70.5%) were recorded wearing eye protection and 38 (86.4%) had disposable bibs placed on them during dental procedures (figure 2). Only 17 (38.6%) patients were recorded as wearing complete with appropriate usage of PPE. The target standard for each of the PPE was achieved for disposable bib; however, not for eye protection.

Appropriate usage of PPE among dental personnel
Similarly, only 17 (38.6%) clinicians were found to be compliant with the complete appropriate usage of PPE. The compliance of appropriate usage of PPE by clinicians were as follows: gloves (100%), face mask (97.7%), eye protection (63.4%), disposable gown (50.0%), clinical gown/tunic (61.4%), appropriate footwear (97.7%), inappropriate jewellery not worn (88.6%) and hair kept neatly (97.7%). The standard for this part of objective was achieved for gloves, face mask, appropriate footwear and absence of inappropriate jewellery.

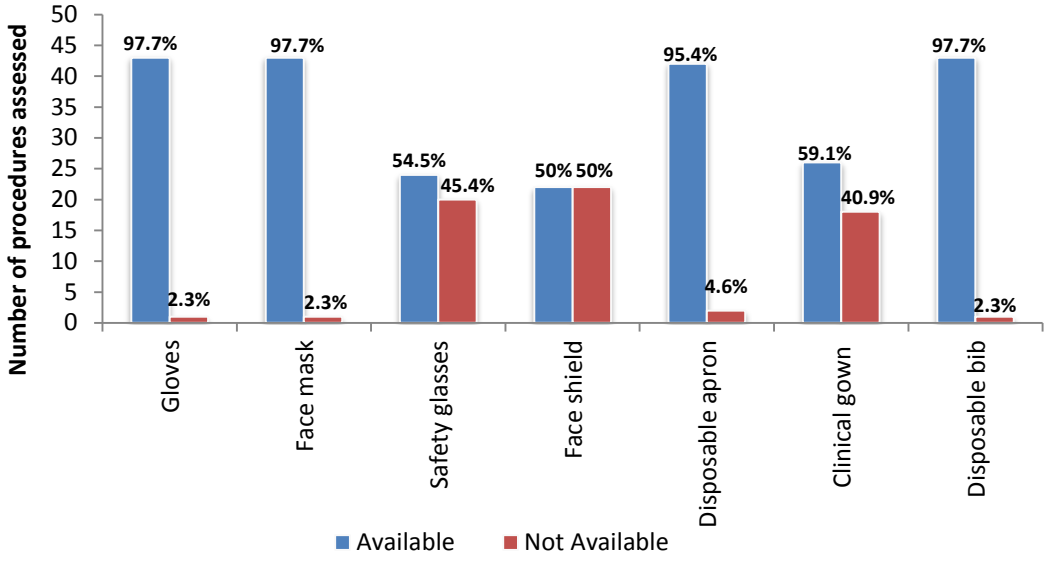

Figure 1. Availability of PPE in dental surgery units.

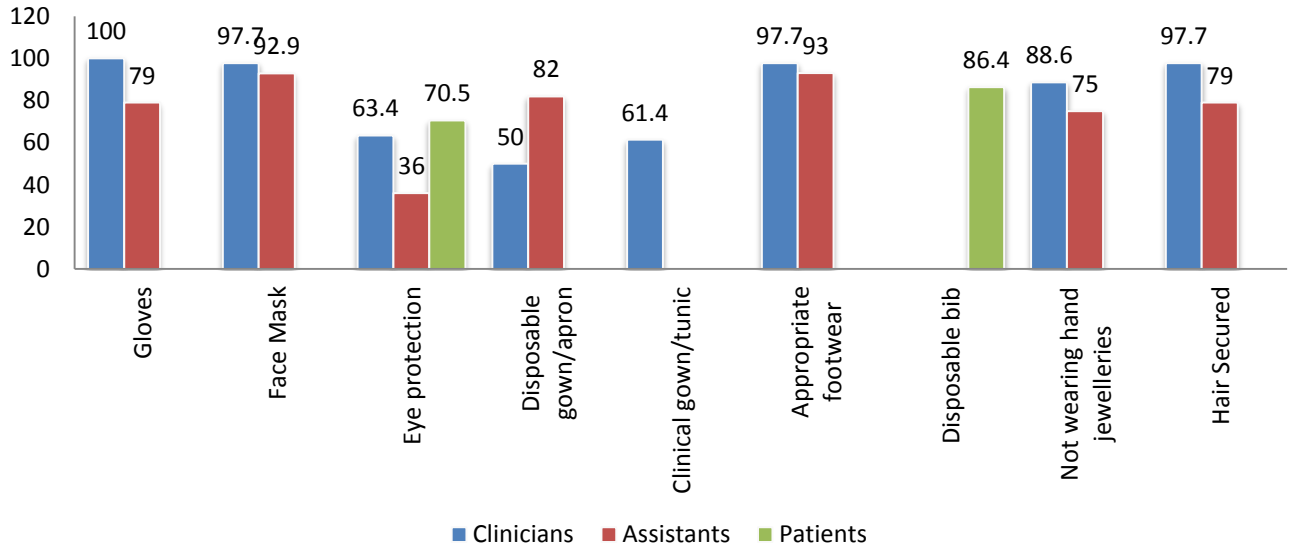

Figure 2. Appropriate usage of PPE among dental personnel and patients.

Among the 28 assistants, less than half (42.9%) were compliant with complete appropriate usage of PPE. The compliance by assistants were as follows: gloves (78.6%), face mask (78.6%), eye protection (35.7%), disposable gown/apron, (82.1%), appropriate footwear (92.8%), jewellery not worn (75.0%) and hair secured (92.9%).

The standard (80%) was achieved for disposable gown/apron, appropriate footwear and hair secured.

The complete appropriate usage for all participants is shown in the figure 3 below.

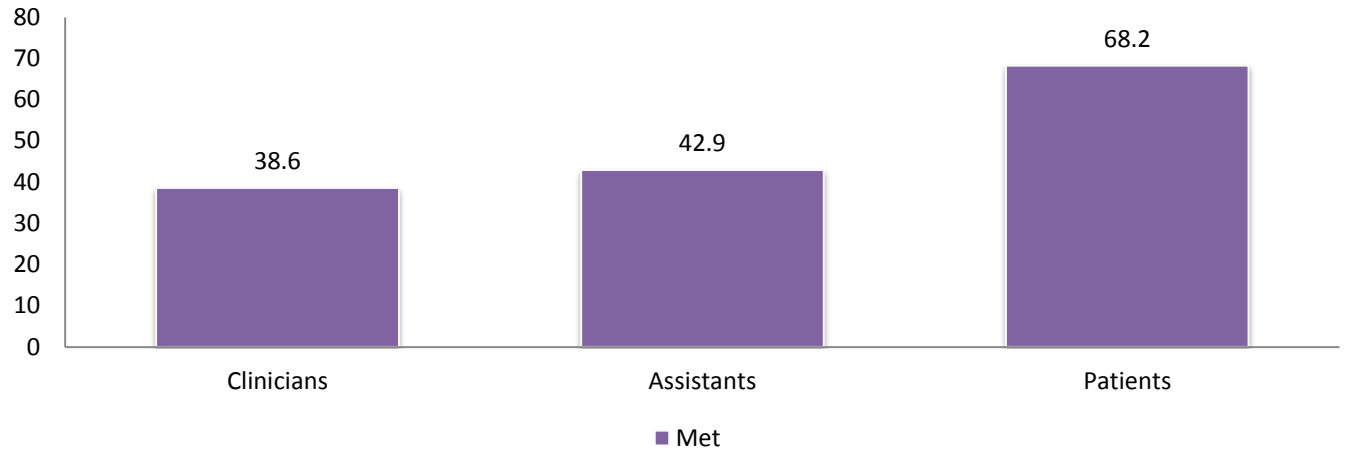

Figure 3. Complete appropriate usage of PPE among dental personnel and patients.

Questionnaire data

Out of 44 questionnaires filled, about four-fifth (79.5%) were filled completely by the assessors. The reason for this incompleteness was due to the busy nature of clinics as well as action taken to cause minimal interruption to the clinical session between the attending dental personnel and patients.

Out of the 9 (20.5%) questionnaires that were not completed, 5 (11.4%) did not answer the first part of the question completely, as to which PPE was not being used and reasons as to why it was not being used. Seven questionnaires (15.9%) regarding the second question and 5 (11.4%) regarding the third question were not filled in. These questions pertained to whether the apron was worn for the entire clinical session or changed between each patient-session.

Table 1. Reasons for not wearing PPE.

PPE	Reasons : No (%)			
Gloves	Incorrect size: **1 (3.7%)**			
Face Mask	None answered			
Eye Protection	Prescription glasses is enough: **10 (22.7%)**	Not available: **7 (15.9%)**	Depends on procedures: **5 (11.4%)**	Forgotten to wear: **1 (3.7%)**
Disposable gown or apron	Wearing tunic is enough: **13 (29.5%)**	Not in practice: **1 (3.7%)**	Depends on procedure: **1 (3.7%)**	Rushing in between patients: **1 (3.7%)**
Appropriate footwear	None answered			
Appropriate Jewellery	None answered			
Hair secured	Not aware that it needs to be secured: **1 (3.7%)**	Long hair: **1 (3.7%)**		
Clinical gown	Not available: **1 (3.7%)**	Only wear it for hospital setting: **1 (3.7%)**	Uses disposable gown: **2 (4.5%)**	

Out of the 44 clinical procedures assessed, half (52.3%) of the dental personnel wore only one disposable apron/gown for the entire day, i.e. no change between each patient. 20 (86.3%) did not change due to insufficient stock while 1 (3.7%) reported that it was difficult to change in between patients and another 1 informed that this was his/her usual practice.

DISCUSSION

PPE is considered as an important part of infection control in dentistry, as it helps protect the health and safety of patients and dental personnel. With this in mind, this audit was carried out to assess the appropriate usage among the dental personnel as well as on patients. Results were then compared to international guidelines extracted from KCL and ICS Ltd.

There were a number of limitations in this audit. Firstly, due to the busy nature of the clinics as well as the presence of patients while the data was collected, the auditors did not have the opportunity to interview all the dental personnel regarding the reasons why certain PPE were not worn. This can only be carried out when the clinical session for the patient is complete; and it was with good intention that the reasons for not wearing PPE were not discussed in front of the patients. Lastly, as the audit was conducted only in NDC, the results may not be an accurate representation of the practice of PPE usage by other government dental personnel in the outlying government dental clinics in Brunei Darussalam.

Most dental personnel are assumed to have been trained with regards to practice of infection control, however they were from diverse training backgrounds such as the United Kingdom, United States, New Zealand, India, Malaysia, Singapore and Brunei Darussalam. Taking into consideration that there is no published guideline on the infection control in the dental settings in Brunei Darussalam, the target standard for dental personnel and patients was set to 80% on complete appropriate usage.

The results from this audit have shown that appropriate usage of PPE by dental personnel and on patients has not attained the target standard. It was surprisingly low for both clinicians (38.6%) and assistants (42.9%) with respect to the complete appropriate usage of PPE. These will be further discussed according to the main objectives of this audit.

<u>Appropriate usage of PPE on patients</u>

According to standards set by KCL and ICS Ltd, eye protection and disposable bibs need to be used on all patients as there is always a potential for aerosol and splatter generated during procedures. Out of 44 patients, only 30 (68.2%) patients were recorded to have had both proper protective eyewear and disposable bibs placed prior to treatment. This result falls short of the target standard.

CDC (2003) has outlined the importance of wearing protective eyewear for patients and dental personnel so that their eyes can be protected from splatter or debris generated during dental procedures. As prescription eyeglasses usually lack side protection, such eyeglasses are not considered as appropriate eye-protection. Less than three-quarter (70.5%) of the patients in our audit were recorded as wearing appropriate eye protection although there were only 8 (18.1%) who reported that no safety glasses were available in the surgery. 5 (11.4%) dental personnel commented that whether eye protection was used depended on the procedure that was being done. In comparison, a study conducted by Farrier *et al.* in 2006, reported that more than half of the adult and child patients wore eye protection during clinical procedures. However, personal glasses worn by patients were considered as eye protection. This was not based on the guidelines set by KCL and ICS Ltd as personal glasses were not considered to offer adequate eye protection.

It was reassuring to note that only 6 patients (13.6%) were recorded as not wearing disposable bibs at the time of a dental procedure. The purpose of patients wearing disposable bibs is to prevent patients' clothing from being soiled as well as to minimise splatter and debris from saliva or blood produced during a procedure on to a patient's body. Unfortunately, there was no reason recorded for the 6 patients who did not wear the disposable bibs, although disposable bibs were available during the assessment of 5 procedures.

<u>Availability and Appropriate usage of PPE by dental personnel</u>

Two main aspects that were examined when assessing the appropriate usage of PPE were the different types of PPE worn during the dental

procedures as well as personal items and hygiene related to PPE. As part of cross infection control guidelines dictated by KCL and ICS Ltd, it is important for gloves, face mask, eye protection, disposable gown or apron, clinical gown or tunic and appropriate footwear to be worn by dental personnel during procedures that involve aerosol, splatter or debris. For procedures that does not involve generation of aerosols; such as taking radiographs, protective eyewear and disposable gown or apron need not to be worn.

Gloves are used to prevent soiling of hands when treating patients, handling instruments as well as organising the clinical area. Appropriate glove sizes were available in 43 (97.7%) of the procedures assessed. Out of 28 assistants, six (21.4%) were found not using appropriate gloves. One assistant wore the wrong-sized gloves at the time of data collection; however, this corresponded to the non-availability of the appropriate-sized gloves during the procedure. Additionally, others were seen handling clinical notes as well as handling non-sterilisable dental equipment and materials with gloves on. All clinicians were found to be wearing gloves since they were doing clinical procedures on patients at the time of assessment.

Masks were found to be available in most (97.7%) of the procedures assessed. However, 1(2.3%) clinician and 22 (79.0%) assistants did not wear facemask at the time of inspection. Masks protect face, mouth, nose from projected particulate matter that may be produced during clinical procedures. According to KCL guidelines, facial hair needs to be concealed underneath the mask to prevent splatter from soiling it. In this audit however, one clinician and two assistants did not secure their hair appropriately while performing dental procedures. The clinician mentioned that he was unaware of the need to secure facial hair and one assistant was found to have his long hair not secured.

The use of eye protection among dental personnel is an important part of PPE practice as it helps to protect the eyes from bacterial and viral infections arising from patients' saliva or blood. There are two PPE included as part of eye protection: face-shields for those who wear prescription glasses (as such glasses do not provide side protection from aerosol), and safety glasses for those who do not wear prescription glasses. During data collection, 28 (63.4%) clinicians and 10 (35.7%) assistants were found to wear appropriate eye protection. However in terms of availability, it was found that there were not enough safety glasses and face-shields in 20 (45.4%) and 22 (50%) procedures involving aerosol splatters respectively. This reflected onto the low percentage of usage of eye protection among the participants. These dental personnel reported that it was sufficient to wear only their prescription glasses in 10 (22.7%) procedures. Non-availability of either face-shield or safety glasses was reported by dental personnel in 8 (18.2%) procedures. Dental personnel in 5 (22.7%) clinical sessions reported that use of proper eye-protection depended on procedures carried out by them such as those that produced a lot of aerosols. In the same study conducted by Farrier *et al*. in 2006, compliance of dental personnel in wearing eye protection was assessed. This study was conducted as a survey where questionnaires were posted to the participants to be filled and returned within a period of time. The outcome of the study showed 120 (87%) general dental practitioners, 66 (48%) dental nurses and 109 (79%) dental hygienists reported wearing eye protection routinely during clinical procedures involving aerosols. This also included the use of prescription glasses which may provide inadequate protection for the eyes although one fifth of the dentists reported of wearing prescription glasses with the appropriate additional side-shields attached. However it is likely that this study showed an over-reporting as this relied mainly on the responses from the survey forms rather than direct observation. A cross-sectional survey was also done in Southern Nigeria by Azodo and Azeja in 2014, whereby 47 out of 148 respondents (31.8%) reported non-availability (non-provision by hospital authority) of goggles, 30 (20.3%) did not have their own personal goggles and 27 (18.2%) reported disturbance of clarity as the main impediment to regular use of goggles.

In our audit, 27 (61.4%) clinicians were found to be wearing clinical gown/tunic. As mentioned before, dentists and specialists working in Brunei come from diverse training backgrounds; hence infection control practices were expected to vary. 18 (40.9%) clinicians reported that clinical tunic was unavailable in their surgery at the time when the procedures were being assessed. One (2.3%) clinician wore disposable gown without wearing a

clinical tunic underneath although he had a clinical tunic available during the clinical procedure.

Both KCL and ICS Ltd guidelines have stated that disposable aprons/gowns need to be additionally worn over the tunic in procedures that involves aerosol and splatter of patients' blood and saliva as tunic is not water-resistant. During the assessment, 22 (50%) clinicians and 23 (82%) assistants were found to be wearing disposable aprons. 12 (29.5%) clinicians reported that the wearing of clinical tunics on their own without the disposable gowns/aprons were sufficient as PPE. Two dental personnel (4.5%) reported wearing of disposable gowns/aprons as not being part of their practice during their under/post graduate training. Besides this, one dental personnel (2.3%) also reported that the practice of wearing disposable gown/apron was procedure dependant (i.e. non-aerosol or aerosol producing procedures). This might explain the different practices of dental personnel based on what they have been taught in their previous institutions.

As opposed to clinicians, clinical tunics were not provided to assistants and they donned uniforms as it was the official attire for them to report for work. Due to this, disposable aprons/gowns were made compulsory attire for them to wear during clinical procedures. Despite disposable aprons being made available during (95.5%) the assessment of the clinical procedures, 8 (18.2%) assistants were not wearing disposable aprons when dental procedures were being performed.

It is also interesting to note that despite the availability of disposable gown/apron during inspection, 23 (52.3%) dental personnel wore it for the entire clinical session rather than changing after every patient. Reasons given included a) perceived insufficient stocks of disposable gown or apron, b) difficulty of changing disposable apron due to rushing in between patients and c) it was their usual practice.

Furthermore, 1 (2.3%) clinician and 2 (7%) assistants were found to be not wearing appropriate footwear. Appropriate footwear means that all of the toes need to be covered to minimise any possible percutaneous injuries to the feet due to falling sharps.

Based on KCL guidelines, plain wedding bands and stud earrings are the only jewellery allowed to be worn during any procedures. Plain wedding bands are allowed as opposed to rings with stones and wrist-watches or jewellery as the latter may interfere with glove-wearing and results in tear of gloves. In this audit, it was found that 5 (11.4%) clinicians and 7 (25%) assistants wore inappropriate jewellery such as hand-watches. Reasons as to why these dental personnel are wearing inappropriate hand jewellery were not recorded in the questionnaire.

Overall complete appropriate usage of PPE among dental clinicians, assistants and patients were 38.6%, 42.9% and 68.2% respectively. This shows that the results were far below the target standard set for this audit. As there were many clinicians trained from diverse backgrounds, it is likely that the methods of infection control, especially in the form of wearing of PPE, varies between schools of training. The other possible reason is that there are no proper guidelines on infection control in Brunei Darussalam and this may have contributed to the low compliance of usage of PPE as people may not be aware of the repercussions of not adhering to proper infection control.

CONCLUSION

In conclusion, complete appropriate usage of PPE among dental personnel as well as on patients in NDC was below the target set for this audit. However taking into consideration the fact that there were no infection control guidelines available for dental personnel in Brunei Darussalam, it was expected that the compliance with appropriate usage of PPE would fall below the target standard. This audit has therefore highlighted the need to improve in the following areas.

RECOMMENDATION

1. To establish guidelines. The Infection Control Unit under Health and Safety division of the Dental Department is currently finalizing the infection control manual.

2. Workshops to be organised by the infection control unit for dental personnel highlighting appropriate usage of PPE.

3. To ensure adequate availability of PPE for the Dental Services to enable better compliance. This might prove to be challenging due to budget constraints.

4. To reassess the usage of PPE at least a year after infection control manual has been published and implemented. This should preferably include all dental clinics in Brunei Darussalam.

5. Future questionnaire on similar audits should find ways to ensure that the collection of data is systematic and accurate. Methods need to be identified to allow all questions to be answered by both assessors/participants so as to reduce the likelihood of missing data.

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Audit on the Rolling Toothpaste Programme – compliance with given advice in the period up to one month after first contact

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BACKGROUND

Dental caries remains a significant problem for many young children in Brunei. According to Brunei National Oral Health Survey in 1999, the mean dmft for 5-6-year-olds was 7.1, while percentage caries-free was 11.3% (Oral Health Agenda, 2008). In 2012, 119 children aged 5 years and younger experienced dental treatment under General Anaesthesia in Brunei (Oral Health Information Booklet, 2012). Most of the treatment rendered were dental extractions and restorations. Majority of these children had experienced rampant caries which is often a consequence of on-demand and prolonged bottle feeding, including poor dietary and oral hygiene habits (Febres *et al.*, 1997; Mohebbi *et al.*, 2008).

To reduce the rate of rampant caries, it is important to instill good oral health habits among toddlers and their parents. Professor Anthony Blinkhorn from Manchester University introduced the "Rolling Toothpaste Programme (RTP)" during his visit to Brunei Darussalam in 2007 as part of the task force initiated by Deputy Minister of Health. RTP represents a multistage intervention programme that occurs at the different stages of the child's development. This is a 3-in-1 programme which includes toddler programme, oral health counselling session for parents, and fluoride varnish application to all the children at 6-months intervals.

RTP is linked with changing social behavior on oral hygiene through health promotion. Based on the study done in Manchester, United Kingdom in 2004, the prevalence of early childhood caries in children who had received the interventions in Primary Care Groups was 16.6% compared with 23.5% of children in the control area, a reduction of 29.0% (Davies *et al.*, 2005). The parents who received this multistage intervention were also more likely to report cessation of bottle use (33.0% *vs* 18.0%); use of sugar-free drinks (49.0% *vs* 24.0%); commencement of brushing before first birthday (45.0% *vs* 27.0%); and brushing twice daily (52.0% *vs* 34.0%).

This programme was first introduced in May 2011 at Sungai Asam Dental Clinic of Pengiran Anak Puteri Hajah Rashidah Sa'adatul Bolkiah Health Centre. The aim of the programme was to improve the oral health of 0-5-year-old children through the implementation of a health promotion programme based in Maternal and Child Health (MCH) clinics. In September 2011, the programme was extended to nine other health centres in Brunei-Muara district, namely, Silver Jubilee Health Centre, Sengkurong; Bunut Health Clinic; Mata-Mata Health Clinic; Gadong Health Clinic; Lambak Kanan Health Clinic; Anggerek Desa Health Clinic; Berakas 'B' Health Centre, Sg Hanching; Subok Health Clinic; and Muara Health Centre.

The MCH clinics at the participating Health Centres refers 9-month-old toddlers to the nearest dental clinics, where the parents would be provided with Oral Health Education talk and a care package which consists of a toothpaste, toothbrush and feeder cup. Among the information provided includes advice on the appropriate usage of the toothpaste, discontinuing bottle feeding for these toddlers, and to replace this with a cup or feeder cup. A month after the first visit, the parents of these toddlers were contacted by telephone when a dental nurse utilised a questionnaire to monitor compliance with the RTP, and also to reinforce the oral health education information provided at the first visit.

AIM AND OBJECTIVES

The aim of this audit was to evaluate parental compliance with the Rolling Toothpaste Programme and advice given.

The objectives of the audit were to determine the:

1. Percentage of:
    a. parents participating actively in their child's oral hygiene;
    b. usage of the toothpaste;
    c. toddlers using the feeder cup to drink.
2. Frequency of toothbrushing among toddlers.

MATERIALS AND METHODS

This was a retrospective audit of all monitoring questionnaires collected during January to December, 2012 at the participating Health Centre in Brunei-Muara District, Brunei Darussalam.

Monitoring was via telephone interviews conducted by the dental nurses one month after Oral Health Education talk and the care packages were given to the parents. The designated dental nurses had been previously advised on how to conduct the phone interview utilising a questionnaire* designed by the Oral Health Promotion division. A Malay language version of the questionnaire* was utilised for those who preferred this language medium. Incomplete questionnaires were excluded from this audit.

The data collected was entered into Microsoft Excel 2010 spreadsheet and analysed. During data entry, where more than one option was ticked to accommodate for the multiple answers, new categories were added. Compliance with the advice given as part of the programme was evaluated by the percentage of parents participating actively in the child's oral hygiene/usage of toothpaste/toddlers using feeder cup and the frequency of toothbrushing among toddlers, and comparing this against the standard set out below.

STANDARD

Currently, there is no existing standard for the outcomes measured; hence, for this audit 80% was taken as a reasonable measure of a desirable outcome, i.e.:

- 80% of the parents participated actively in the child's oral hygiene;
- 80% of the parents used the distributed toothpaste to brush their toddler's teeth;
- 80% of the toddlers used feeder cup to take his/her milk; and
- 80% of the parents brushed their toddler's teeth 2 times a day.

RESULTS

One thousand, two hundred and ninety seven 6-19-months-old toddlers enrolled in RTP during January to December 2012, but only 235 monitoring questionnaires were collected. Incomplete questionnaires were excluded; and as a result 103 questionnaires were analysed giving an overall participation rate of 7.9%.

About two-thirds (64.1%) of the toddlers had their teeth brushed by their mothers only; whereas the least participation was by the maids and grandparents, each of which were only at 1.0% (Table 1). Almost 85% of the toddlers had some of the distributed toothpaste remaining at the time of the telephone interview. It appears that family members in a third (34.0%) of the audit sample were sharing the distributed toothpaste. When the distributed toothpaste was finished, almost all (98.1%) parents stated that they were willing to purchase the recommended fluoridated toothpaste.

More than half (54.7%) of the toddlers participating had their teeth brushed twice a day, while a third (33.0%) had their teeth brushed only once a day. Almost all the parents (95.1%) brushed their toddler's teeth with the recommended amount of a smear of toothpaste, whereas the remainder (3.9%) used a pea-sized amount of toothpaste.

Half of the toddlers (49.5%) were reported as continuing to feed by bottle only, whereas 7.8% had been successfully weaned off the bottle and were using a cup to feed. About one-third (34.9%) toddlers were bottle fed all day.

Figure 1 presents the percentage of mothers, fathers, maids and grandparents participating in toddler's toothbrushing. The total percentage is extrapolated from the individual and combination categories. The highest participation in toddler's toothbrushing was among the mothers, where at least nine out of every ten mothers were actively involved in their child's toothbrushing. This was followed by fathers, maids and grandparents.

Table 1. Frequency distribution of toddlers for each parameter monitored (brackets contain percentages).

Parameter	Number (%)
Utilisation of toothpaste given	97 (94.2)
Person brushing toddler's teeth	
Mother only	66 (64.1)
Father only	2 (1.9)
Maid only	1 (1.0)
Others (grandparents)	1 (1.0)
Mother and father	11 (10.7)
Mother and maid	9 (8.7)
Mother and grandparents	9 (8.7)
Mother, father, and maid	4 (3.9)
Toothpaste shared with family members	35 (34.0)
When distributed toothpaste has finished, will purchase:	
Flavored toothpaste	1 (1.0)
Fluoridated toothpaste	101 (98.1)
Other types of toothpaste	1 (1.0)
Frequency of tooth brushing	
Once a day	34 (33.0)
Twice a day	56 (54.7)
Three times a day	12 (11.7)
More than three times a day	1 (1.0)
Quantity of toothpaste used	
Smear	98 (95.1)
Pea-sized	4 (3.9)
Whole length of toothbrush	0 (0.0)
Others	1 (1.0)
Method of feeding milk	
Bottle	51 (49.5)
Cup	8 (7.8)
Bottle and cup	31 (30.1)
Others (breastfeeding or spoon)	11 (10.7)
Bottle and others	2 (1.9)
Time of bottle feeding	
Morning	13 (12.6)
Evening	26 (25.2)
Morning and evening	14 (13.6)
All day	36 (34.9)
Not bottle feeding	14 (13.6)

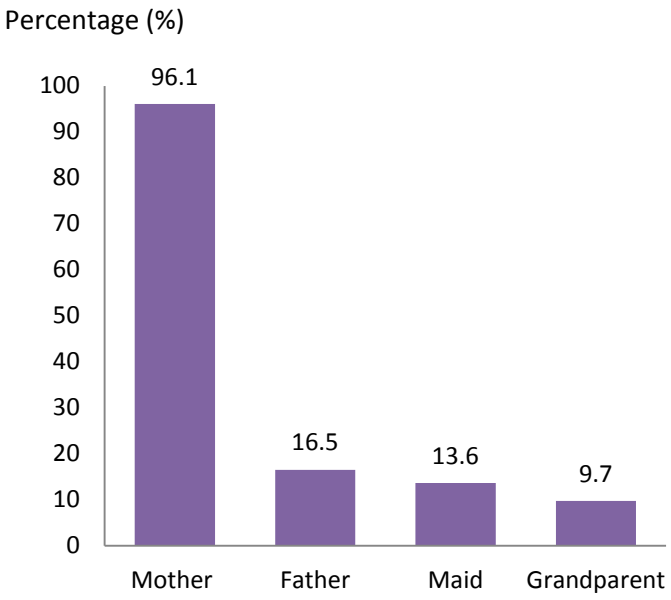

Figure 1. Percentage of mothers, fathers, maids and grandparents participating in toddlers' toothbrushing.

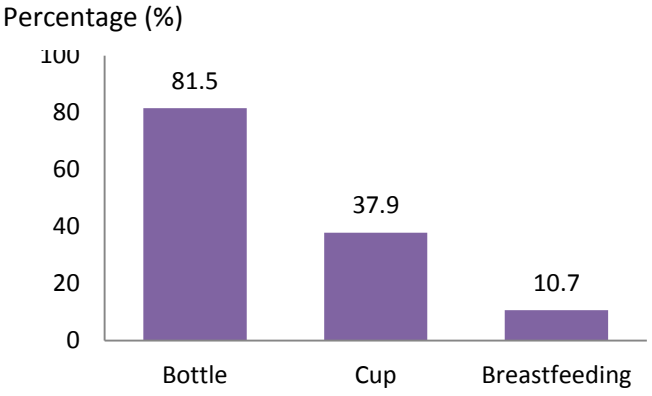

Figure 2. Percentage of toddlers using bottles, cups, and breast feeding.

Figure 2 presents the percentage of toddlers using bottles, cups, and breast feeding one month after the first visit with the dental nurse (for oral health education talk and distribution of the care package). The total number of toddlers was extrapolated from the singular and combined categories. Despite advice to cease bottle feeding, four out of every five (81.5%) toddlers were still bottle feeding, about a third (37.9%) were using the cup to feed, and about one-fifth (10.7%) of the toddlers were breast feeding.

DISCUSSION

This audit was carried out to evaluate parental compliance with the RTP and advice given. This is the first time the programme has been audited since the launching of this programme in 2011.

The study's weaknesses

Before discussing the findings, it is appropriate to consider the weaknesses of this audit. Each will be discussed under appropriate subheadings.

Differences in meanings and interpretation between English and Malay version

Firstly, there was a discrepancy in the meaning of the questions and answers between the English and Malay versions of the questionnaire which could have led to differences in interpretation. There were also some differences between the advice given in the English and the Malay versions of the questionnaire. The ambiguity in the meaning or purpose of some of the answer options could have led to differences in the responses with different interviewers. A set of standardised questions which are designed to collect the required information would have been better to ensure that there would not be any misinterpretation of the questions or answers. Forwards and backwards translation of the questionnaire between Malay and English language by two independent individuals not directly involved in the programme would help to ensure both versions would convey similar meaning.

Questionnaire not piloted/tested

Secondly, the questionnaire which was utilised in this programme was not pilot-tested. Pilot study is important as it allows for specific pre-testing and validation of a particular research instrument such as a questionnaire or interview schedule. They can increase the likelihood of success in the main study (that can then follow) and can provide valuable insights for other researchers (Van and Hundley, 2001). The pilot testing of this questionnaire would have helped to indicate areas for improvement in the questionnaire.

No standardised interim period from the time of initial first contact to the time when the interview was conducted

Additionally, the questionnaires should have also indicated the date the toddler was given the care package, and when the interview was conducted. This would have ensured that the interviews conducted about one week after the care package has been given in order to focus on just monitoring the usage of the items given- toothbrush, toothpaste and feeder cup.

No baseline data pre-start of programme
To allow proper evaluation of the RTP, baseline data should have been collected at the first appointment and then again in subsequent follow-ups at set periods (ideally at appointments which coincide with the toddler and parents subsequent appointments at the MCH clinics).

Problems associated with telephone interviews/ collection of data
Furthermore, the study was conducted by phone interview. Despite having greater coverage by phone interview as compared to face-to-face interview, it had some drawbacks such as difficulty in reaching parents, the parent and interviewer may not be able to hear each other clearly, and the absence of eye-to-eye contact makes it difficult to tell whether the parent is telling the truth. There was also a large portion of parents who were not interviewed due to difficulty reaching them. Most parents would be reachable through their cellular phones. However, the dental nurses had to use the office lines which could only be used by one person at any one time for making calls to cellular phones. This was further exacerbated by parents not picking up their phone calls. This could have resulted in non-response bias. Nevertheless, there is still a need to monitor the programme whether by phone calls or face-to-face interviews as during this contact time, advice can be repeated to reinforce positive oral health habits for the toddler as well as ensure that the given toothpaste, toothbrush and feeder cup are being used as instructed.

Information bias
As with any interview, this audit was also prone to information bias because parents could choose to provide the socially acceptable answers rather than tell the truth, thus this audit actually reports parental claimed compliance as actual compliance could not be confirmed.

No standardisation of the interviewers
Moreover, the interviewers in this audit were not calibrated which resulted in inconsistent filling of the questionnaires. Some questions had vague answers written rather than an option being ticked, and different styles of interviewing may have resulted in variable answers .

Sample representativeness
Although getting 103 questionnaires for analysis was good for the audit study, the overall participation rate of 7.9% was very low (103 questionnaires out of 1,297 toddlers enrolled in RTP). Therefore, data reported may not be representative of the sample.

Design of the study
The study's findings must be viewed cautiously due to the methodological limitations of retrospective data (self-reported child's oral hygiene practices and use of distributed toothpaste and feeder cup) which meant all the above problems could not be addressed.

The study's findings
The results of the audit will be further discussed in the order of the objectives of the audit.

Parents' participation
It was encouraging to see the reported participation of mothers in their toddler's tooth brushing was 96.1% during the period of the interview. However, there was much less reported participation by fathers (16.5%). This could possibly due to the Malay culture where mothers are seen more as the carers and fathers as the providers, even though these roles may have interchanged over the turn of the century. Cheong (2004) found that 1.9% fathers and 14.9% mothers supervised their child's toothbrushing, in her master's thesis on 5-year-old schoolchildren. This audit found a much higher percentage claim of maternal involvement for toddlers aged 6-19-months. As this is a different age group to that studied by Cheong (2004), a direct comparison cannot be made. Additionally, there is a chance that there is information bias in the form of over-reporting in this audit. The questionnaires did not mention who answered the phone call, and there is a possibility that mothers answered the phone most of the time and hence, would provide a more socially acceptable answer.

A smaller proportion of toothbrushing was reportedly carried out by grandparents and the maids. It is not uncommon for extended families to live under one roof in Brunei Darussalam and majority of the households hire live-in maids to help with the housework and to take care of the children especially when both parents are out at

work. So, it is not unusual that a proportion of the toddlers had their grandparents or maid brush their teeth for them.

Emphasis has to be put on the importance of improving parental oral health knowledge since they would be the ones ensuring the child develops good habits. According to the 'life course approach', throughout the course of an individual's life, adverse exposures gradually accumulate by way of ill health episodes (Kuh and Ben-Shlomo, 1997). Through the resultant chain of risk, certain experiences or exposures in early life, such as tooth decay or intraoral infections, increases the likelihood of future events which, in turn, lead to greater or lower risk of adult disease. Therefore, parent participation is essential in developing good oral health behaviour for the child.

Usage of toothpaste

In terms of usage of the toothpaste given, the report was that 94.2% parents were using the distributed toothpaste to brush the toddler's teeth. The toothpaste distributed in this programme was one of the brands available in the market, which was previously independently tested and found to contain the recommended fluoride levels of between 1,100-1,450 ppm (as stated in the packaging). Research has shown that only fluoride levels above 1,000 ppm is beneficial in preventing dental caries (Rasines, 2010; Walsh *et al.*, 2010). In addition, almost all the parents claimed their willingness to purchase the same type of toothpaste when the one distributed through the programme has finished.

Fluoride has been found to be protective against dental decay by encouraging remineralisation of the demineralised tooth structure and making the surface less vulnerable to demineralisation by forming a protective fluoroapatite layer during remineralisation. Fluoroapatite is more resistant to acid attack compared to hydroxyapatite (Wong *et al.*, 1987). Topical application of fluoride has been recommended compared to systemic administration because what appears to be important in reducing the solubility of the enamel is fluoride ion activity in the oral fluid (topical) rather than a huge content of fluoride in the enamel (systemic) (Fejerskov *et al.*, 1981). Because the caries preventive effect of fluoride is almost exclusively posteruptive, topical fluoride application in the form of fluoridated dentifrices should be encouraged (Hellwig and Lennon, 2004).

Frequency of toothbrushing among toddlers

Twice daily brushing with fluoride toothpaste has been widely promoted by the dental profession for many years since it plays a pivotal role in the prevention and control of dental caries and periodontal diseases. In this audit, more than half (54.7%) of the toddlers reportedly had their teeth brushed twice a day which is the recommended frequency. This findings is similar to a study done in Great Britain in which 55.0% of children aged 1.5-4.5 years were reported to have their teeth brushed more than once a day (Hinds and Gregory, 1995). Whilst it is generally accepted that such behaviour is the most important contributor to the improvement in the dental health of the nation, a sizeable proportion of the toddlers (33.0%) in this audit had their teeth brushed only once a day.

The effectiveness of brushing twice daily with fluoride toothpaste on caries is supported by data on reported behaviour obtained from surveys and clinical trials. For example, among children aged 3.5-4.5 years, 24.0% of those whose teeth were brushed more than once a day had caries experience compared with 38.0% of those whose teeth were brushed only once a day, and 48.0% of those whose teeth were brushed less often (Hinds and Gregory, 1995). In clinical trials, the 3-year caries increments in participants who reported brushing only once a day were 20–30% more than those who brushed twice a day (Chesters *et al.*, 1992). Whilst the above data need to be interpreted with some caution because of associations with other confounding factors, such as social class and sugar consumption; the weight and consistency of available evidence supports the recommendation that toothbrushing, with a fluoride toothpaste, should be performed twice daily (The Scientific Basis of Dental Health Education: A Policy Document, 2001).

Toddlers using feeder cup to drink milk

It was claimed that about one out of ten (7.8%) toddlers was being fed with a cup. This result is much lower than the standard set at 80%. Many parents reported they were unsuccessful in getting their children to feed with the cup only, especially

at night when they would then use the bottle to calm their children or encourage them to fall asleep. Unfortunately, nearly 80% of the toddlers were reported to still using the bottle to feed, with 49.5% using this exclusively and the remainder would use the bottle as well as the cup or were also breastfed. Switching from bottle to cup can be challenging, as it is common for toddlers to become attached to their bottles because they spend so much time using them. In addition to providing food, bottles can provide a sense of security or comfort for a child, making it more difficult when it is time to wean them off bottles. There is a dire need to reduce this number since evidence has linked bottle feeding to early childhood caries. Febres *et al.* (1997) reported that those infants weaned only after 14 months of age were more likely to have early childhood caries. It has been shown that night bottle feeding represents a burden to oral health often resulting in early childhood caries (Mohebbi *et al.*, 2008). Nevertheless, it was encouraging to see that a portion of the mothers breastfed their children. In Brunei Darussalam, the Ministry of Health has been proactive in encouraging mothers to breastfeed their children up to two years of age.

CONCLUSION

In conclusion, the proposed standard of 80% and above has been met for parent involvement in toddler's toothbrushing and usage of toothpaste, in that 94.2% reported using the distributed toothpaste to brush the toddler's teeth and 96.1% reported participation by mothers in their toddler's toothbrushing during the period of the interview. However, the percentage of toddlers drinking from the cup and the frequency of toddlers having their teeth brushed at least twice a day was much below the 80% standard as set in this audit. As mentioned earlier, Davies *et al.* (2005) found that the 33% who received intervention advice ceased bottle feeding as compared to 18% who did not receive intervention but who had ceased bottle feeding, so perhaps future audits can look instead at percentage improvement after intervention to show if such intervention actually works. There are some flaws in the current monitoring questionnaire which needs to be addressed before continuing with the monitoring and extending participation. Without robust baseline data collection, it is not possible to assess the effectiveness of the RTP on influencing parents behaviours with respect to improving their toddlers' oral health. A revised evaluation questionnaire is suggested to allow better evaluation of the efficacy of the programme for the Rolling Toothpaste Programme.

RECOMMENDATIONS FOR IMPROVEMENT OF FUTURE AUDIT

With the findings of this audit, the following points are suggested for improvement of future audits:

1. Re-audit using prospective study design should be conducted. The standards can be based on percentage improvement of measured parameters (after intervention has been given).

2. Future data should be more representative of the sample by better participation rate. This can be increased by offering incentives, contacting potential participants multiple times, communicating clearly, and using user-friendly forms with minimal respondent burden.

3. Changes to the existing questionnaire are required to reduce ambiguity and differences in interpretation. Use of standardised questions can better assess knowledge and habits.

4. To decide on what needs to be measured, design a suitable questionnaire to allow capture of required information, to discuss the draft questionnaire with a 'focus group' comprising both dental professionals and lay persons (non-dental) for correct interpretation, then follow up with pilot-testing of the questionnaire with a small group of participants. Amendments must be made to address any ambiguity in meanings or interpretations, and to ascertain that required data can be collected appropriately. Only then, the questionnaire can be used to collect baseline data and consequently evaluate the effectiveness of the programme.

5. To conduct the interviews/questionnaires during suitable MCH appointment visits – if these are at suitable time intervals to coincide with the dental team's visits to the health centres. This method can do away with the telephone interviews.
6. More staff needs to be assigned and trained to conduct the interviews, if the decision is to have our staff conduct the questionnaire.

7. To conduct the interviews/questionnaires before providing oral health education in order to get a baseline data of existing knowledge and behaviours, and then repeating the interview at one month after the first intervention to assess how much information the parents have actually assimilated, and another at 6 months to assess the retention of information given.

8. Provide proper training to the interviewers (if applicable) and have them calibrated in order to standardise and hence increase reliability of the results obtained.

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