Periodontal bio-repositories, which allow banking of clinically validated human data and biological samples, provide an opportunity to derive biomarkers for periodontal diagnosis, prognosis and therapeutic activities which are expected to improve patient management. This article presents the establishing of the Malaysian Periodontal Database and Biobank System (MPDBS) which was initiated in 2011 with the aim to facilitate periodontal research. Partnerships were established with collaborating centres. Policies on specimen access, authorship and acknowledgement policies were agreed upon by all participating centres before the initiation of the periodontal biobank. Ethical approval for the collection of samples and data were obtained from institutional ethics review boards. A broad-based approach for informed consent was used, which covered areas related to quality of life impacts, genetics and molecular aspects of periodontal disease. Sample collection and processing was performed using a standardized protocol. Biobanking resources such as equipment and freezers were shared with the Malaysian Oral Cancer Database and Tissue Bank System (MOCDTBS). In the development of the MPDBS, challenges that were previously faced by the MOCDTBS were considered. Future challenges in terms of ethical and legal issues will be faced when international collaborations necessitate the transportation of specimens across borders.

**Keywords:** biobanking; periodontitis; confidentiality; specimen access; partnerships

### Background

Periodontitis, a chronic inflammatory disease which results in irreversible attachment loss, bone destruction and ultimately tooth loss (Philstrom et al., 2005), is a major oral and public health problem. Various epidemiological studies on the prevalence of periodontitis have been conducted. Large-scale epidemiological studies, such as the National Health and Nutrition Examination Survey (NHANES), which was designed to assess the health and nutritional status of adults and children in the United States of America (USA), cover various medical conditions and health indicators, including oral health. The NHANES comes under the Centers for Disease Control and Prevention (http://www.cdc.gov/nchs/nhanes/about_nhanes.htm). To date, at least 22 publications on NHANES and periodontal disease as a topic are accessible in the literature based on the Medline and Web of Science electronic search. Moderate forms of chronic periodontitis afflict 40% of the total population, whilst about 8% of the population suffers from severe forms (Albandar et al., 1999; Eke et al., 2012).

Epidemiological studies comparing immigrant Asians from developing countries and Caucasians from industrialized nations have concluded that Asians are particularly susceptible to periodontitis (Corbet and Leung, 2011). In developing countries like Malaysia, severe forms of the disease have been identified in about 18% of the Malaysian population (Oral Health Division, Ministry of Health...
Malaysia, 2012). In Indonesia, a study conducted on tea workers without dental care demonstrated that 20% of these workers suffered from severe periodontal disease (van der Velden et al, 2006).

Periodontitis is a complex disease whereby multiple factors simultaneously play a role in the onset and progression of disease (Laine et al, 2012). Studies have demonstrated that a bacterial plaque biofilm is necessary but insufficient to cause disease (Offenbacher et al, 2008; Laine et al, 2012; Bartold and Van Dyke, 2013) and periodontal tissue destruction is ultimately caused by the host which responds to the plaque biofilm. Host susceptibility is determined by genetic, environmental and life style factors, and this combination determines disease expression and/or progression of an existing periodontal disease (Offenbacher et al, 2008). This understanding of disease aetiology and the information gathered from clinical (epidemiological, microbiological and immunological) studies provides an opportunity to derive biomarkers for periodontal diagnosis, prognosis and therapeutic activities. This may improve overall periodontal patient management which encompasses primary, secondary and tertiary prevention. This article describes the best practices for establishing a periodontal database and biobank in Malaysia with the aim to facilitate multicenter periodontal research.

The Malaysian Periodontal Database and Biobank System concept

One of the main limitations faced when conducting quality scientific research is adequate sample availability (Zain et al, 2013). This is especially relevant for genetic studies of complex diseases such as periodontitis where large case-control populations are required for any association study to overcome the inherent heterogeneity within populations (Schaefer et al, 2011; Vaithilingam et al, 2014). Despite the high prevalence of periodontitis in Malaysia, there remains a scarcity of clinical periodontal research which has thus far been mainly cross-sectional studies conducted on an ad hoc basis. When such research projects are conducted, they lack long-term planning which then results in wastage as bio-specimens and data are not banked, stored and defined systematically and in a standardized manner. These limitations can be a serious impediment in successfully translating research outcomes into clinical practice. However, this problem can be overcome by careful planning and organizing bio-specimen and clinical data collection systematically through a well-organized periodontal data and biobank. The availability of a biobank of patient-derived biospecimens in conjunction with complete clinical data, which uses standardized methodologies for sample procurement, processing and storage, becomes extremely important for conducting future analysis (Ennis et al, 2010).

Having realized the existence of this problem, and drawing from the experiences of the Malaysian Oral Cancer Database and Tissue Bank System (MOCDTBS; Zain et al, 2009), a group of academicians and scientists from the University of Malaya (UM) initiated in 2011 the Malaysian Periodontal Database and Biobank System (MPDBS), the first periodontal database and biobank in Malaysia. Working in partnership with experts from various fields, a systematic process, using best practices in biospecimen management, was devised. These experts comprised of periodontists, public health specialists, oral pathologists from dental faculties of collaborating universities, periodontists from public dental clinics and scientists from the UM. This process involves specimen collection, processing and storage, and data collection associated with periodontal status (ISBER, 2008).

Partnerships with other Malaysian institutions were then established. Ethical and regulatory issues such as informed consent, patient privacy and anonymity and intellectual property were agreed upon. This partnership is made up of several institutions and comprises academicians and scientists from the University of Malaya (UM), University Technology Mara (UiTM), Universiti Sains Islam Malaysia (USIM) and periodontists from the Ministry of Health (MOH) of Malaysia.

The MPDBS is managed by academicians from the Faculty of Dentistry, University of Malaya, with the assistance of staff from the Oral Cancer Research & Coordinating Centre (OCRCC), Faculty of Dentistry, University of Malaya. The MOCTDBS played a substantial role in the initial planning, setting up of procedures for specimen collection, processing and storage using evidence-based best practices and standard operating procedures which is a critical part of the success of a biobank (Moore et al, 2011).

Partnership building

In establishing this partnership, periodontal researchers and periodontists from various organizations were approached. The initial set-up thus consisted of researchers from UM, USIM, UiTM and clinicians from the MOH of Malaysia. The centres involved in the MPDBS are depicted in Figure 1. The primary aim of including centres from the various states in Malaysia was to allow for a better representation of periodontal disease throughout the Malaysian population. The team shared a vision to provide

Malaysian Periodontal Database and Biobank System

![Diagram of the various institutions which make up the Malaysian Periodontal Database and Biobank System (MPDBS): UM, University of Malaya; UiTM, University Technology Mara; USIM, Universiti Sains Islam Malaysia; MOH, Ministry of Health, Malaysia](image)
a framework for periodontal research in Malaysia through the shared collection of biospecimens and data. The research questions that formed the basis for the MPDBS are shown in Table 1. An initial mission of enhancing periodontal research strategies in areas of genetics, immunology and microbiology was thus established. Furthermore, information related to the impact of periodontitis on quality of life was also collected. Parameters collected for the study are shown in Table 2. As the MPDBS and the collaborative institutions did not represent a single entity, logistical challenges had to be addressed with regard to training of investigators and staff involved, calibration of periodontal examination and standardized procedures for collection and transportation of samples. Training workshops were thus conducted for researchers from each centre where the mission of the MPDBS was also explained to all participating members to ensure their commitment in making this partnership a success.

**Economic management**

The setting up of a data and biobank incurs a large initial investment in personal hours (salaries) and equipment and freezers required for the specimen banking process. In this context, the MPDBS was able to share facilities with the MOCTDBS and thus the costs were minimized. The management of these facilities with regard to freezer maintenance, space planning and utilization comes directly under the MOCTDBS whilst individuals within the MPDBS were responsible for periodontal specimen collection, processing and banking as well as up loading data into the biobank informatics system. In this case, the MPDBS was supported through a research grant under the Ministry of Education Malaysia which was obtained in 2011.

The number of samples required to come up with our initial objectives was 300 diseased and 300 controls (Table 1). These numbers were estimated to be sufficient for the oral health-related quality of life, microbiological and immunological aspects of the study. However, we expect the numbers to increase in view of the fact that the MPDBS is also biobanking for future research on genomewide association studies which requires a large sample size.

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### Table 1

Research questions used as basis for the initiation of the Malaysian Periodontal Database and Biobank System (MPDBS)

1. Does periodontal disease cause an impact on the quality of life of periodontal patients?
2. Are known single-nucleotide polymorphisms for periodontitis associated with periodontal disease in the Malaysian population?
3. Do any of these genetic polymorphisms correlate with clinical characteristics as well as immunological and microbiological parameters in patients with periodontal disease?
4. Are variations in genetic polymorphisms observed in the majority of patients with periodontal disease?

### Table 2

Parameters collected for biobanking

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Instrument used/data collected</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Parameters that were collected when the study was initiated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) Demographic</td>
<td>Age, gender and ethnicity</td>
<td></td>
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<tr>
<td>(iii) Socioeconomic status</td>
<td>Level of education</td>
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<tr>
<td>(iv) Medical history</td>
<td>Diabetes</td>
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<td></td>
<td>Cardiovascular disease</td>
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<td></td>
<td>Hypertension</td>
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<td></td>
<td>Arthritis</td>
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<td></td>
<td>Pulmonary disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>(v) Habits</td>
<td>Oral hygiene practice (frequency of brushing, interdental cleaning and mouth rinse)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smoking (current or former smoker, number of years of smoking)</td>
<td></td>
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<tr>
<td></td>
<td>Alcohol consumption</td>
<td></td>
</tr>
<tr>
<td>(vi) Anthropometric measurements</td>
<td>Height and weight</td>
<td>National Institutes of Health (1998)</td>
</tr>
<tr>
<td></td>
<td>Waist and hip</td>
<td></td>
</tr>
<tr>
<td>(vii) Clinical examination</td>
<td>Visible plaque index (4 sites per tooth)</td>
<td>Ainamo and Bay (1975)</td>
</tr>
<tr>
<td></td>
<td>Gingival bleeding index (4 sites per tooth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probing pocket depth (6 sites per tooth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clinical attachment level (6 sites per tooth)</td>
<td></td>
</tr>
<tr>
<td>(viii) Blood</td>
<td>Serum biomarkers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DNA</td>
<td></td>
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<tr>
<td></td>
<td>Plasma</td>
<td></td>
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<tr>
<td></td>
<td>Microbiological parameters</td>
<td></td>
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<tr>
<td>(ix) Plaque</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Smoking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of packs/sticks per day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Presence</td>
<td></td>
</tr>
<tr>
<td>(b) Parameters that were initially not collected but were found to be useful and subsequently collected</td>
<td>Removable/Fixed</td>
<td></td>
</tr>
<tr>
<td>(i) Habits</td>
<td>Saliary biomarkers</td>
<td></td>
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<tr>
<td>(ii) Prosthesis</td>
<td></td>
<td></td>
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<tr>
<td>(iii) Saliva</td>
<td></td>
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</tbody>
</table>
Periodontal examination and reproducibility

Validated phenotype classification, using a well-established case definition, was used for disease and control groups prior to sampling in order to recruit patients with a minimum of disease severity to standardize patient selection (Page and Eke, 2007). The inclusion criteria for severe chronic periodontitis subjects therefore comprised of Malaysians aged 35 years and above with two or more interproximal sites with clinical attachment levels (CAL) of 6 mm or more (not on same tooth) and one or more interproximal sites with probing pocket depths (PPD) of 5 mm or more. Healthy subjects were participants exhibiting <3 mm of CAL and not more than 3 mm of PPD.

For the MPDBS, prior to August 2013, data, blood and plaque samples of a total of 300 subjects with severe chronic periodontitis were collected. However, since August 2013, our inclusion criteria were expanded to include all stages of chronic periodontitis (Eke et al., 2012) as well as aggressive periodontitis. For aggressive periodontitis, the case definition given by van der Velden (2005) was used. Severe aggressive periodontitis subjects therefore comprised subjects below 35 years and these subjects should possess two or more teeth with 1/2 root length or more bone loss as detected in X-rays whilst, moderate aggressive periodontitis subjects should present with two or more teeth with bone loss >1/3 or ≤1/2 root length as detected in X-rays. Thus far, we have collected a total of 400 diseased and 100 control subjects from all centres (academic institutions and MOH) as shown in Figure 1. In view of the fact that our existing examiners are periodontists who mainly see diseased periodontal subjects, we will be expanding our examiners to general dental practitioners who will be able to assist us in increasing our control group numbers.

The 11 examiners from the various collection centres comprised of periodontists. From all patients who provided informed consent, the following information was obtained using a standardized form (Table 2):

1 Questionnaire form: A self-reported questionnaire was used in which the demographic data (age, gender and ethnicity) and socioeconomic status (level of education) of the participants, smoking behaviour (current or former smoker, number of years of smoking), alcohol consumption, oral hygiene habits (frequency of brushing, interdental cleaning and mouth rinse) and history of diabetes, hypertension, cardiovascular disease, arthritis and pulmonary disease were obtained. In addition, the Malaysian version of the Oral Health Impact Profile-14 questionnaire (Saub et al., 2007) was used to obtain information on oral health-related quality of life impacts.

2 Anthropometric measurements, that is, weight, height and waist/hip circumference, were also taken. Weight and height were measured using calibrated digital weighing scales and stadiometers, respectively. The waist and hip circumferences were measured with a circumference measurement tape. The waist was defined as the point midway between the iliac crest and the costal margin (lower rib), whilst the hip circumference was defined as being the widest circumference over the buttocks and below the iliac crest (National Institutes of Health, 1998).

3 Measurement of clinical parameters included full mouth (excluding 8’s) charting of visible plaque index (Ainamo and Bay, 1975) and gingival bleeding index (Ainamo and Bay, 1975) at four points per site, whilst PPD and probing attachment levels (to the nearest millimetre) were performed at six points per site. Third molars have been excluded on the basis that the wisdom teeth may be in various stages of impaction and the reproducibility of measurements is limited by the ongoing development of the third molars (Eng, 2009). On the other hand, inflammation around third molars (pericoronitis) has been implicated with multiple anaerobic bacteria (Blakey et al., 2002; Moss et al., 2009) and thus may overestimate periodontal disease.

In studies where periodontal examination and charting is required, many factors have to be controlled in order to reduce the inherent variability and to provide standardization across the study population (Polson, 1997). Variables such as examiner probing force, errors in visual assessment, angulation of probing and discrepancies in root anatomy may affect the accuracy of clinical measurement (Drucker et al., 2012). Thus, intra- and interexaminer calibration was carried out amongst all periodontal examiners for reproducibility of clinical parameters such as gingival bleeding index, PPD and probing attachment loss. Examination was performed on four different subjects. The intra- and interexaminer reproducibility for all examiners ranged between 75–92% and 73–91%, respectively, whereby Kappa values of 0.61–0.8 are considered as substantial agreement whilst Kappa values >0.8 are almost perfect agreement (World Health Organization, 2013). It has also been acknowledged that the level of agreement is more complex for diseased periodontal tissues. Depending on its availability in the centres, two different instruments were used for periodontal probing, that is, the Florida probe (which is a constant-force probe) and a manual periodontal probe (Hu-Friedy®). Silva-Boghossian et al. (2008) in their systematic review on manual vs electronic probes found that both probes showed a tendency to have similar reliability in the measurement of CAL in untreated periodontitis subjects when used by a calibrated examiner. During the calibration exercise, reproducibility between the two methods of periodontal probing was also consistently found to be good (Kappa score more than 80%).

Subgingival plaque sampling

Before subgingival plaque samples were obtained from diseased and healthy subjects, sampling sites were first isolated with cotton rolls and supragingival plaque was removed from the sample site with curettes and cotton pellets. The site was then dried before sampling of the subgingival plaque was performed with sterile curettes. In the diseased subjects, sampling was performed at four or more sites with the deepest probing depths which showed bleeding on probing. In the healthy subjects, sampling was
performed at interproximal sites that did not show any bleeding on probing. Subgingival scrapings were collected from the base of the pocket up to the gingival margin. Scrapings were then resuspended in sterile DNAse-free and RNase-free polyethylene tube containing 1 ml of phosphate-buffered solution and stored at $-80^\circ$C.

**Biospecimen management**

Standard operating procedures for collecting, processing, shipping and receiving protocols, and storage of samples were based on the best practices recommended by the International Society for Biological and Environmental Repositories (ISBER, 2008). The standards of the operating procedures with which the biospecimens are handled directly determine the quality of the biomarker result and its ultimate applicability. Samples were aliquoted before being stored at $-80^\circ$C. The workflow of the MPDBS from the time of sample collection and processing until it reaches the end-user is illustrated in Figure 2.

The laboratories built in UM where the final processing of the blood (serum, plasma and DNA) and plaque (DNA) samples have adequate quality assurance and quality control measures where safety and waste disposal criteria, and procedures to investigate, document and report on staff injuries and dangerous exposure are in place (Vaught and Lockhart, 2012).

**Biobank informatics management**

The informatics needs for the MPDBS which includes biospecimen tracking, data collection (clinical and demographic) and the identification of data elements, data security and protection of privacy was addressed using the existing MOCTDBS system. A bank manager has been appointed to handle all data entered in the MPDBS. The bank manager is responsible for data encryption and coding of biospecimens and data. Mishandling of personal information which ultimately leads to a breach of confidentiality remains an important issue in biobanking of samples. When it comes to genetic research, the personal, familial and social nature of genetic information available may lead to stigmatization and discrimination of subjects when such confidentiality is breached (Joly et al., 2005). For the MPDBS, clear policies for protecting the confidentiality of participant information have been followed as only authorized personnel had access to the system.

**Ethical, legal and social issues**

Ethical approval for the collection of samples and data for the MPDBS was obtained from the Medical Ethics Committee, Faculty of Dentistry, UM, as well as the institutional ethics review board of each participating university. As for the MOH, ethical approval was obtained from the Medical Research Ethics Committee, MOH. Policies on specimen access, authorship and acknowledgement policies were agreed upon by all participating centres before the initiation of the periodontal biobank (Yassin et al., 2010). Memoranda of Agreements were also drawn up with USIM and UiTM. Permission to conduct the ongoing research in the Ministry of Health was obtained after registration with the National Medical Research Registry.

**Informed consent**

Informed consent is important for its adherence to the principles of respect for individuals and autonomy (Vaught and Lockhart, 2012). In Malaysia, informed consent is required for government-funded research and is adminis-
tered through institutional ethical review committees for approval before investigators are allowed to obtain data, specimens or identifiable personal information from research participants (Malaysian Guidelines for Good Clinical Practice, 2011). Studies have demonstrated that preferences for research participants have been split between a one-time consent and those who would prefer individual consents for each potential use of their data and/or specimens (Kaufman et al, 2009; Simon et al, 2011; Vaught and Lockhart, 2012). Due to the very high turnover of potential research that may be conducted in areas of genetics, it becomes very difficult to predict future uses of the banked data and samples (Caulfield et al, 2003). In the MPDBS, a broad-based approach for informed consent was used which clearly states that the specimens will be used for a variety of research projects related to quality of life, genetics and molecular aspects of periodontal disease.

Discussion and conclusion

Biorepositories have been created at the national level in various countries such as the United Kingdom (UK Biobank, https://www.ukbiobank.ac.uk), United States (McCarty et al, 2008) and the Pan-European BBMRI (http://bbmri.eu.home). These biorepositories are research banks for population-based epidemiological cohort studies that collect biospecimens from all individuals in a defined geographical region or translational research banks that collect disease-specific biospecimens from affected individuals in a defined catchment area (Vaught et al, 2011).

Challenges faced by these national biorepositories such as sustainability, standardization of data and processes, clearly defined access policies and intellectual property concerns ultimately define the long-term survival of these biobanks (Vaught et al, 2011). Issue of sustainability of biobanks is also of concern as most biobanks, despite having the initial funding to launch their biobanks, however, fail to procure sufficient funds to sustain the life cycle of a biobank over the long term (Olson et al, 2014). The Singapore Biobank (formerly known as the Singapore Tissue Network) closed down in 2011 due to factors related to under-utilization of their specimens and the high costs involved in maintaining their facility (http://www.academia.edu/2357156). Biobanks, such as the Personalised Medicine Research Project (PMRP) from Marshfield Clinic, WI, USA, which is population-based but working on specific diseases, have, however, been successful in establishing their biorepository which among others is involved in studying the impact of improved dental care on low-income populations with high prevalence of periodontal disease and diabetes mellitus (Glurich et al, 2013).

Biobanking has been used extensively in many other systemic diseases such as diabetes and cardiovascular disease. Patient cohort data such as the General Practitioners Research Database (GPRD) from the United Kingdom (Mulnier et al, 2006; Azoulay et al, 2010), the Swedish National Diabetes Register (Eeg-Olofsson et al, 2009), the China Kandoori Biobank (Chen et al, 2011) and the Diabetes Pearl Research Group (van’t Riet et al, 2012) have played a major role in facilitating research concerning diabetes. Studies, such as the Maastricht study (Schram et al, 2014), looking at the worldwide population enriched with type 2 diabetes have also reached cohort numbers of up to 10 000 individuals and is one of the most extensive studies on the type 2 diabetes phenotype and its co-morbidities.

Very large biorepositories such as the electronic MEdical Records and GEnomics (eMERGE) Network, which is a National Human Genome Research Institute (NHGRI)-supported consortium of five institutions in the United States, have been created to explore the use of genomic repositories coupled to electronic medical record (EMR) systems to determine how genetic variants influence susceptibility towards chronic conditions such as diabetes, Alzheimer’s disease and cardiovascular disease (McCarty et al, 2011). The five biorepositories under this network are the Marshfield Clinic Personalized Medicine Research Project (McCarty et al, 2008), the Northwestern University biorepository, NUGene (http://www.nugene.org; Wolf et al, 2003), the Mayo biobank which is a peripheral arterial disease-specific biobank (McCarty et al, 2011), the Group Health biobank looking mainly at patients with Alzheimer’s disease and dementia (Larson et al, 1990; Kukull et al, 2002) and the Vanderbilt biobank (Roden et al, 2008).

With the majority of the Malaysian population being afflicted with some form of periodontal disease, it is of utmost importance that periodontal research in this country, and indeed globally, is conducted in an efficient, cost-effective manner which will reflect the true nature of the disease. Thus far, the MPDBS has contributed samples for studies on oral health-related quality of life impacts on moderate to severe chronic periodontitis subjects as well as obese subjects with chronic periodontitis (currently being written up for publication). The bank is also contributing samples for ongoing studies on microbiological and immunological aspects of chronic periodontitis in healthy and obese subjects. Once the MPDBS acquires sufficient samples for genetic studies (Schaefer et al, 2011; Vaithilingam et al, 2014), we will be embarking on genomewide association studies in identifying potential genetic polymorphisms in aggressive and chronic periodontitis and also to look into validating known genetic polymorphisms in this group of subjects. To date, a total of five research projects have been initiated because of the MPDBS. The continuous development of the MPDBS will enable investigators in the academic and government institutions to provide optimal evidence-based care to the general Malaysian population afflicted with periodontal disease and ultimately improve their oral health-related quality of life.

Future challenges

The MPDBS has been running for the past 2 years with the collaborative effort of all investigators and staff.
Although at an early stage, measures need to be taken to foresee future challenges in the biobanking of periodontal data and biospecimens. International research collaborative efforts bring along further challenges for biobanking. The need for international collaboration for periodontal research is especially important when dealing with genetic periodontal research where sample sizes for genomewide association studies can involve tens of thousands of subjects (Vaithilingam et al., 2014). Proper coordination between different countries needs to be performed especially in terms of case definition for chronic periodontitis and aggressive periodontitis subjects. Ethical, legal and social issues will also need to be addressed by collaborators before the transportation of these samples is performed across borders. Guidelines such as ‘The Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations’ (www.cehd.umn.edu/olpd/Mon treal.Statement.pdf) which has set out common principles and responsibilities for research integrity in managing collaborative research as well as its outcome need to be observed in order to ‘advance knowledge for the benefit of humankind’ (Editorial, 2013).

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Author contributions

RD Vaithilingam researched and authored the topic background, compiled the initial draft, revised late drafts and edited the final draft. RB Zain initiated the idea and provided guidance throughout the setting up of the biobank and edited the text. SH Safii, NA Baharuddin, R Saub and SC Cheong contributed to the initial conception and design of the biobank, were involved in the initial draft, revised late drafts and edited the article. PM Bartold provided guidance, contributed to the text, revised and edited the article. LP Karen-Ng, F Ariffin, H Ramli, A Shariifuddin, MFH Hidayat, R Raman, YK Chan, NA Rani, P Rahim and N Shahruddin made substantial contributions to the conception and design of the biobank, revised and edited the final manuscript.

Conflict of interest

The authors in the study have no conflict of interest to declare.

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