

INTRODUCING A 7-DAY BRIDGING PROGRAMME TO DEEPEN DENTAL RESIDENTS' LEARNING OF ORAL MICROBIOLOGY, IMMUNOLOGY, AND MOLECULAR BIOLOGY

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Background

In the Faculty of Dentistry at the National University of Singapore, the residency programmes are designed to provide specialty training for its postgraduate students in the various clinical disciplines. The curriculum includes a combination of clinical training, didactics which include basic oral sciences, and a research project. This emphasis on the integration of clinical dentistry with oral sciences is particularly apparent in the disciplines of endodontics and periodontics, which are dental specialties pertaining to the treatment of dental pulp and gum problems respectively.

Diseases of the dental pulp and gums arise primarily from bacterial infections and are the result of subsequent inflammation. As such, the principles and techniques of oral microbiology, immunology and molecular biology are widely used in current dental research literature to analyse the roles and mechanisms of oral bacteria and immune response in root canal and gum infections. Ideally, residents who complete the Master of Dental Surgery (MDS) programme should have sufficient knowledge of oral microbiology, immunology, and molecular biology to effectively critique advanced dental research literature. With this knowledge, they would be more effective in analysing and solving problems in clinical settings.

Pre-existing Curriculum

Prior to the introduction of the bridging programme, there was a lack of a structured curriculum to comprehensively address oral microbiology, immunology and molecular biology for residents taking the MDS programme. It has been noted that residents tend to have only a superficial knowledge and understanding of these topics as they were not covered in great depth in the undergraduate dental

curriculum. Hence, a common challenge educators encounter in teaching the MDS programme is that residents struggle to understand and critique dental literature effectively due to this knowledge gap in the oral sciences.

Introduction of the 7-day Bridging Programme to Residents

With reference to Bloom's taxonomy of learning domains (Krathwohl, 2002), the MDS programme was designed mainly to address the cognitive domain, in particular to equip residents with a deeper knowledge and understanding of the aetiology of these diseases. In the process, they experience a progression of learning from acquisition of core knowledge to understanding and application to the respective discipline. The educational philosophy behind this course is to provide the residents with a good foundation in these concepts, such that they become confident enough to critique and evaluate research, which would enable them to be more effective in solving treatment challenges they encounter with patients. They should also be able to effectively seek out and analyse currently available knowledge from the existing literature, and evaluate the validity and applicability of what they find. The ultimate goal is to develop residents to become dynamic clinicians who can create and innovate novel strategies for patient care.

Hence, in order to fill the knowledge gap in the pre-existing MDS curriculum and deepen residents' knowledge and understanding of oral microbiology, immunology and molecular biology, an intensive 7-day bridging programme consisting of full-day seminars and hands-on workshops was introduced in Academic Year (AY) 2012. The bridging programme aims to enable students to achieve the following:

- i. Apply the knowledge of oral microbiology, immunology and molecular biology covered during the seminars to execute the exercises during the hands-on workshops.
- ii. Appraise advantages and limitations of experimental techniques to answer specific research questions.
- iii. Design and execute experimental protocols for their MDS research dissertation.
- iv. Relate key principles learnt during the bridging programme to evaluate and critique current literature relating to their clinical practice.

The rationale for incorporating a hands-on workshop component was to allow residents to appreciate the advantages and limitations of research techniques, instead of merely equipping them with proficiency in laboratory techniques. It was hoped that gaining such competencies would enable them to evaluate data and conclusions in the literature, and compare the different methodologies in experimental design. For example, they should be able to recognise that different bacteria have different growth rates, culture conditions and nutritional requirements; hence, changes in experimental conditions such as media, supplements and culture incubation period can yield different data and conclusions in a paper.

Approach

The bridging programme has been held annually for Year 2 endodontics and periodontics residents since its inaugural launch in AY2012. A total of 8 residents participated in the first run of this bridging programme in AY2012. Each day consisted of a 2-hour seminar session comprising didactic lectures followed by question and answer sessions, and a 6-hour hands-on workshop session in the laboratory (see Table 1).

Table 1.
Topics Covered During the 7-day Bridging Programme

Topics for the Seminars	Topics for the Hands-on Workshops
<ul style="list-style-type: none"> • A Review of Basic Microbiology • Bacterial Virulence • Host-Pathogen Interactions in Oral Infections • Host Response • Endodontic Microbiology • Periodontal Microbiology • Applications of Molecular Biology in Dentistry 	<ul style="list-style-type: none"> • Microbiology Techniques • Anaerobic Culture • Polymerase Chain Reaction • Molecular and Biochemical Methods to Identify Oral Bacterial Isolates • Antimicrobial Susceptibility Testing • Immunoassays

A 20-page instructional handout was also prepared to guide the residents through the laboratory work. The concepts taught during the seminars were further demonstrated during the hands-on workshop sessions. For instance, one of the seminar topics covered host response¹, while in the workshop, the residents carried out various immunoassays² to detect cytokines typically produced during inflammation.

Challenges Encountered

The main challenge encountered while planning the bridging programme was designing the syllabus and deciding the content to be covered in the seminar and workshop sessions. The topics to be included in this programme would need to bridge the gap between what was taught in the microbiology and immunology, periodontology and endodontology modules offered in the dental undergraduate curriculum, and the in-depth knowledge residents require to better understand the advanced literature in their specialties. To determine the starting level of knowledge the residents already possess and identify topics that would require more in-depth instruction, reviews of related dental undergraduate modules were carried out in consultation with colleagues teaching the topics. The subject matter was carefully scaffolded to enhance residents' learning. For example, immunology concepts were presented to the residents through illustrations of the disease process in a sequential manner.

At the beginning of the bridging programme, some of the residents came in with the preconceived notion that being clinicians, learning these scientific concepts would not be applicable to them, thus affecting their level of participation and engagement. As such, special effort was made to always relate the concepts taught with relevant examples which highlight their clinical significance while giving the residents an appreciation of the experimental process. The hands-on activities were also geared towards engaging the residents' curiosity, for example, by having them identify oral bacteria from plaque samples freshly collected by the residents themselves.

Another challenge involved the practicalities of planning and allocating available equipment, laboratory space, and resources to carry out the workshop sessions. The workshops were conducted in a working oral microbiology research laboratory, and the schedule for the bridging programme had to be carefully planned to accommodate the workshops without interrupting the routine work of other laboratory users. The laboratory also faced working space constraints due to the fact that it is not a dedicated teaching laboratory. To ensure the smooth execution of the workshops, all experiments had to be optimised and tested prior to the commencement of the bridging programme.

Evaluating the Impact of the Bridging Programme in its First Year

We evaluated the effectiveness of this course by conducting a survey in which we collected and analysed student feedback. The survey consisted of a quantitative component where the residents indicated the usefulness of the seminars and workshops on a 5-point scale, ranging from “very positive” to “very negative”, and a qualitative component which consisted of 3 short questions where they indicated what they liked or disliked about the programme, as well as suggestions for further improvements.

All 8 residents who participated in the first run of the bridging programme in AY2012 responded to the feedback exercise. The quantitative feedback they provided for all 7 seminar sessions and 6 workshop topics was “very positive”. The presentation style of the seminars was found to be “clear and succinct”, with “good and sufficient content”, and allowed “easy understanding of complicated concepts”. In terms of qualitative feedback, they found the seminar topics to be “beneficial” and “not taught before elsewhere”. According to the residents, the hands-on session allowed them to “appreciate the methods used in literature and enhanced understanding”. The workshop sessions were also regarded to be “a very important complement to the seminars”. A particularly useful suggestion to improve the bridging programme was “to incorporate a literature discussion session” which would help the educators and residents consolidate the content covered during the seminars and workshop sessions.

Incorporating Journal Club Sessions

Based on feedback from the first cohort, subsequent iterations of the bridging programme were modified to include a Journal Club session, where participants read and discussed carefully selected journal articles on topics related to the course. This was important for relating what was discussed during the Journal Club with the intended learning outcomes of the MDS programme, in particular training participants to critique current literature. However, this had to be done within the given time constraints. To accommodate this new component, the introductory seminar sessions on “A Review of Basic Microbiology” and “Bacterial Virulence” were condensed from AY2013 onwards. The quantitative feedback (n=16) for the Journal Club session since its introduction has ranged from “positive” (19%) to “very positive” (81%). The following qualitative feedback, obtained from the AY2013-2015 resident cohorts who participated in the bridging programme, reflects what has been achieved using the combined approach of seminars, workshops and the Journal Club sessions.

- “The lectures are carried out systemically to gradually allow us to digest and understand the topics.”
- “The seminars covered relevant topics that are useful towards our understanding of our specialty. Enhances our knowledge of the techniques that were used in research papers and allows us to translate this knowledge into our research thesis.”
- “The seminars were very informative and well-taught. Delivery is clear and topics covered enabled us to understand the papers better.”
- “Comprehensive teaching, relevance to clinical dentistry especially through articles discussed during [the] Journal Club”.
- “Journal club consolidated the content learnt. Workshops are useful to actually give a feel of what is going on.”
- “I enjoyed the hands on workshop on DNA methods because it helped me to appreciate the hard work and limitations of the methods. I also better understood the subsequent papers.”

Planning Ahead

Given the rapid pace of research, one of the main challenges to anticipate when it comes to running this 7-day bridging programme in future would be ensuring that the programme design and content are up-to-date in order to keep pace with changes in undergraduate and postgraduate dental curricula, new techniques and emerging research. Based on analysis of the student feedback, the majority of the residents who have attended the bridging programme so far have suggested that it could be offered earlier in their postgraduate curricula, for example during their first year. This is so that the residents can reap the programme's learning benefits from the earliest possible stage. However, to successfully achieve the learning outcomes, the programme's content will need to be customised accordingly to fit their baseline level of knowledge. Ultimately, it is hoped that through this bridging programme, postgraduate dental students reading the MDS programme would be equipped with the necessary skills to become dental clinicians who are able to understand, critique and make use of new knowledge for improved care for their patients.

Acknowledgements

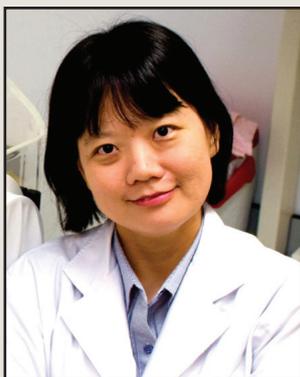
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Endnotes

1. According to Genco (1992), host responses, which are primarily directed to "defending the host against fulminating infections, also likely result in some of the local tissue destruction that we know as periodontal disease" (p. 338).
2. They refer to chemical tests used to "detect or quantify a specific substance, the analyte, in a blood or body fluid sample, using an immunological reaction" (Encyclopaedia of Surgery, n.d.).

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About the Author

Dr Tan Kai Soo teaches oral biology, endodontic and periodontal microbiology, and molecular biology to undergraduate and postgraduate dental students. She has a keen interest in exploring new ways to enhance dental students' learning of oral sciences, equipping them to be well-rounded dental practitioners.