DENTAL THERAPISTS' PROFESSIONAL ROLE AND POSSIBLE FUTURES WITHIN THE MALAYSIAN DENTAL WORKFORCE

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PERANAN PROFESIONAL JURUTERAPI PERGIGIAN DAN KEMUNGKINAN MASA DEPAN DI DALAM TENAGA KERJA PERGIGIAN MALAYSIA

ABSTRAK

Pengenalan: Akta Pergigian Malaysia 2018 yang menggantikan Akta Pergigian 1971, telah mensyaratkan juruterapi pergigian mendaftar di bawah Bahagian Juruterapi Pergigian. Mereka dibenarkan untuk bekerja di amalan swasta dan merawat individu berumur sehingga 18 tahun tetapi mestilah hanya di bawah penyeliaan langsung doktor pergigian. Menilai persepsi di kalangan pihak berkepentingan adalah penting mengenai perubahan ini dan bagaimana ia mempengaruhi dinamik tenaga kerja juruterapi pergigian di seluruh sektor pada masa akan datang. **Objektif:** Untuk meneroka dinamik tenaga kerja juruterapi pergigian di masa hadapan dalam pelbagai sektor (awam-swasta) di Malaysia. **Kaedah penyelidikan:** Pada fasa pertama, tiga kaji selidik kuantitatif dijalan di kalangan juruterapi pergigian, pengamal pergigian swasta, dan ibu bapa pelajar sekolah (sebagai proksi). Analisis deskriptif, univariat dan multivariat dibuat menggunakan SPSS Versi 20. Penemuan ini disepadukan dengan data yang berkaitan untuk memodelkan bekalan, keperluan dan permintaan dalam sistem dinamik (SD) menggunakan perisian Vensim Versi 7.3.5. yang berfungsi sebagai senario garis dasar sehingga tahun 2030. Empat senario kajian kemudian dimodelkan untuk meneroka implikasi delegasi dan penswastaan kerja dalam tenaga kerja juruterapi pergigian Malaysia. **Hasil kajian:** Majoriti(>90%) juruterapi pergigian mempunyai motivasi tinggi terhadap pekerjaan mereka dengan skor purata minima 5.9 ± 0.51. Hampir seperempat berasa tidak berpuas hati dengan kadar gaji mereka (24.2%) dan peluang promosi (20.5%). 87.6% responden dijangka akan terus bekerja didalam bidang pergigian, tetapi 8.3% berniat untuk meninggalkan sektor kerajaan untuk bekerja di sektor swasta. Mereka yang menjangkakan bekerja di sektor swasta dalam tempoh lima

tahun akan datang adalah 4.14 kali lebih tinggi berniat untuk meninggalkan perkhidmatan. 71.4% ibu bapa pelajar sekolah mempunyai tahap penerimaan yang tinggi terhadap juruterapi pergigian bagi menyediakan penjagaan gigi kepada anak-anak mereka di klinik pergigian swasta dengan; ibu bapa yang lebih muda (OR = 1.71, 95% CI = 1.26,2.52) , mereka yang tinggal di bandar (3.43 OR = 1.71, 95% CI = 1.23,2.36) dan kaum bumiputra (OR = 1.92, 95% CI=1.08,3.43) merupakan prediktor terhadap penerimaan yang tinggi ini. Seterusnya kajian terhadap pengamal pergigian swasta, sikap mereka untuk mengambil juruterapi pergigian bekerja di premis adalah lebih rendah (15.5%) daripada penerimaan ibu bapa dan ia berkaitan dengan pemilikan klinik pergigian swasta (p = 0.010). Halangan mereka untuk mengambil juruterapi pergigian bekerja adalah; peningkatan beban kewangan (69.5%) dan kurang pengetahuan / kemahiran di kalangan juruterapi pergigian (52.0%). Akhirnya, simulasi model asas SD menunjukkan berlebihan juruterapi pergigian di sektor kerajaan dan pengamal pergigian swasta pada tahun 2025. Manakala pengamal pergigian kerajaan berkurangan bagi sepanjang period simulasi (tahun 2015 hingga 2030). Senario alternatif menunjukkan jurang tenaga kerja merentasi pengamal pergigian Malaysia adalah terdiri daripada kekurangan pengamal pergigian awam dan berlebihan pengamal pergigian swasta menjelang tahun 2030. **Kesimpulan:** Kajian ini menonjolkan persepsi di kalangan berlainan pihak berkepentingan sebagai bukti untuk menjadi sumber rujukan kepada pembuat dasar dalam mengurus sumber manusia, terutamanya bagi tenaga kerja pergigian. Penemuan ini menggambarkan bahawa melalui peningkatan aktiviti pentadbiran dan promosi dikalangan juruterapi pergigian dan membenarkan jangkaan kerjaya mereka untuk penswastaan dan bekerja separuh masa, dimasa yang sama mengoptimumkan kedua-dua sektor, akan berpotensi menyerap lebihan tenaga kerja dalam menggunakan keseluruhan tenaga kerja pergigian klinikal di Malaysia.

Kata kunci: Juruterapi pergigian, amalan persendirian, perancangan sumber manusia, perubahan dasar, simulasi computer

DENTAL THERAPISTS' PROFESSIONAL ROLE AND POSSIBLE FUTURES WITHIN THE MALAYSIAN DENTAL WORKFORCE

ABSTRACT

Introduction: The Malaysian Dental Act 2018 has recently superseded the Dental Act 1971. Under this Act, dental therapists are required to register under the Therapist Division, are allowed to work at the private practice, and treat a person up to the age of 18 years old under direct supervision of dentist. It is important to assess the perceptions among essential stakeholders with regards these changes and how it affects the future dental therapists' workforce. **Objectives:** To explore the dental therapist future workforce dynamics across sectors (public-private) in Malaysia. **Materials and methods:** In Phase 1, three parallel quantitative surveys were conducted using validated self-administered questionnaires. Descriptive, univariate and multivariate analyses were undertaken using SPSS Version 20. The findings in Phase 1 were integrated with relevant data to model the supply, need and demand in a System Dynamic (SD) tool using Vensim Version 7.3.5 from a baseline scenario in 2015 to the projected year of 2030. Four exploratory scenarios were then modelled to explore the implications of working delegation and privatisation within the Malaysian dental workforce. **Results:** Majority (>90%) of dental therapists had high job motivation with total mean score of 5.9 ± 0.51. Almost one-quarter felt dissatisfied with their pay rate (24.2%) and promotion opportunity (20.5%). 87.6% expected to stay longer in the dental professional and 8.3% of them had the intention to leave the government sector for private sector. Those who foresaw working in the private sector within the next five years were 4.14 times more likely to have the intention to leave than those who preferred to stay in the public. About 71% of parents had a high level of acceptance of dental therapist providing care to their children in the private settings. Younger parents (OR=1.71, 95% CI=1.26,2.52), those who lived in the urban (3.43; OR=1.71, 95%

CI=1.23,2.36) and of Bumiputera origin (OR=1.92, 95% CI=1.08,3.43) were the predictors of the high acceptance level. Private dentists' attitude towards the employment of dental therapists at the private settings was low (15.5%) and it is significantly related to their ownership type (p=0.01). The main perceived barriers were cost (69.5%) and perceived lack of knowledge/skills among dental therapists (52%). Finally, SD modelling simulation for baseline scenario shows a potential for oversupply of public dental therapists and private dentists by year 2025 while a potential of undersupply for public dentists throughout the simulation period. The multiple scenarios could range from a shortfall of total public practitioners and surplus of private practitioners by the year 2030.

Conclusion: This study highlights the perceptions on the Therapist Division stipulated in the Dental Act 2018 among different stakeholders that can be used as a reference source to the oral health policymakers in managing human resources. Findings portrayed that by increasing dental therapists' administrative and promotion roles within the private settings has the potential to absorb the potential oversupply at the private sectors in the future and this scenario shows the optimum utilization of the entire dental workforce in Malaysia.

Keyword: Dental therapist, private practice, human resource planning, policy changes, computer simulation

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LIST OF SYMBOLS AND ABBREVIATIONS

CLD	:	Causal loop diagram
DT	:	Dental therapist
HRM	:	Human resource management
ICDAS	:	International Caries Detection and Assessment System
JM	:	Job motivation
JS	:	Job satisfaction
NOHSA	:	National Oral Health Survey for Adults
OHP	:	Oral health promotion
PrD	:	Private dentist
PrDt	:	Private dental therapist
PuD	:	Public dentist
PUDt	:	Public dental therapist
SFD	:	Stock and flow diagram
WCW	:	Warr – Cook – Wall scale
WHO	:	World Health Organisation
WTE	:	Working time equivalent

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CHAPTER 1: INTRODUCTION

The Malaysian Dental Act 2018 has recently been passed and superseded the Dental Act 1971. This new act provides for the establishment of registration for the dental therapists and expansion in roles and job scopes. Based on the Dental Act 2018, the dental therapists are now bounded under the Therapist Division and they are required to be registered professionally. They are allowed to work at the private practice and treat person up to the age of 18 years old but only under a direct supervision of dental surgeons. Dental therapists have been referred as the backbones to the school dental service in this country and they have also been said to be a great complement to the dentist in ensuring improvements in the national oral health status (Ministry of Health Malaysia, 2005). Indeed, the Malaysian dental therapists have contributed significantly both to the dental fraternity and the population as can be seen through the improvement of caries experience among schoolchildren that have decreased tremendously since almost four decades ago (Oral Health Program, 2017). Currently, there are 2816 actively practising dental therapist in Malaysian public sector. They underwent a three-year course at the Malaysian Ministry of Health (Dental) Training Institute (MOHDTI) alongside with other dental auxiliaries namely the dental technologists and dental surgery assistants. The scope of practice of Malaysian dental therapists includes preventive, periodontal, restorative treatment (excluding surgical interventions) and other oral care for patients below 18 years old. This will be explained further in the next chapter.

Several studies have been conducted to assess the quality of work done by the dental therapists, the differences in productivity as well as the cost effectiveness in hiring them in the dental practice. Galloway et al. (2002) conducted a systematic review and concluded the positive evidence on the competency of dental therapists where they were comparable to the dentists or the dental students. In 2008, Nash et.al outlined the

practices of dental therapists in six countries; and in 2012 they assessed dental therapists in another 13 countries (Nash et al., 2008; Nash et al., 2014). The findings from both studies are consistent to those found in Galloway's study where dental therapists were found to be effective in providing dental care within their scope of practice.

The current economic situation has triggered numerous labour changes, not only in Malaysia but also in Asian countries, which often result in feelings of dissatisfaction. Satisfaction in the work of dental therapists is felt as a priority for promoting a healthy environment in clinical practice and maintaining the standard of care provided. Considering that dental therapists are the largest class of health professionals as part of the mid-level provider, it is important to examine their degree of satisfaction at work in the light of significant economic and financial changes in the country.

The reform that took place in the health sector with the expansion of places to practice demonstrated the value of evaluating the satisfaction of dental therapists in their current position, as it requires and continues to involve constant adaptation of professionals to new job requirements. Hence, the key goals of all human resources personnel including the dental therapists, irrespective of what their individual job aims, are their job motivations and satisfaction.

A satisfied employee is not just a retained employee but an ambassador for the brand, internally and externally, who can help prosper their organizations in many ways. The satisfied employees take pride in their jobs, more loyal, clear on the organization's objectives, and are willing to go the extra mile to achieve the goals (Bhuian & Mengue, 2002; Dalati, Raudeliūnienė & Davidavičienė, 2017). Data on the level of job satisfaction and working practices of the dental therapist is vital for the policymakers in planning for the future dental therapist workforce.

Prior to the introduction of the new Dental Act, Abu Bakar, Mohd Nor, Ab-Murat and Jaafar (2015) assessed the perceptions of the Malaysian dental therapists on their

own level of job satisfactions and future roles and concluded that most dental therapist did not favor wider expansions of their current roles except in terms of providing care to the adult population. That study however did not probe on dental therapists' job motivations, their perceptions of expanding their job scope in private facilities, and was based on the job roles stipulated in the Dental Act 1971. Employees with low level of job satisfaction may have an intention to leave their organization and seek for another job prospect. Hence, with the implementation of the Dental Act 2018 that opens up job places other than at government practices, the dental therapist intention to leave requires exploration.

In dentistry, the acceptance of working as a team has not been well established. This is the opposite to what is happening in the medical fraternity where qualified clinical nurses and other auxiliaries work hand in hand with the doctors, and medical tasks are delegated to them eloquently. This may be because dentists are more protective towards their profession as they may be concerned that task delegation to the auxiliaries might hamper their profession, and that these dental therapists might overstep the boundaries that have been set by legislation (General Dental Council, 1989).

There has been some negativity shown by the dentists towards the employment of dental therapists in general dental practice (Ross, Ibbetson, & Turner, 2007; Turner, Ross, & Ibbetson, 2011) and issues on malpractice among the dental auxiliaries who falsely play a role as a dentist has been raised (Knevel, Gussy, Farmer & Karimi, 2017). These conflicts may be shaped by occupational groups efforts to attain and maintain professional status and authority (Adams, 2004). Different interest, values and cultures between the two professions could affect the harmony to work as a team. However, a study conducted among Australian dentists found that half of them who considered expanding their practice were more open to the idea of employing dental therapists (Kempster, Luzzi & Thomson, 2015). In accordance to the new Malaysian Dental Act,

however, it was unclear how dentists, and particularly the private dentists (GDPs), view the reform once it had been implemented and the impact to the oral healthcare services in the future.

Contrarily, there are evidences of high degree of patient acceptance on the expanded roles of dental therapists (Calache & Hopcraft, 2012; Macey, Glenny & Brocklehurst, 2016; Sun, Burnside & Harris, 2010). It is believed that when dentists put trust and confidence on the dental therapists to perform certain clinical tasks, it will automatically gain the trust of the patients (Blue et al. 2013). Most studies with these positive findings were conducted on patients who had received dental care by the dental therapists. A public survey conducted in the USA and UK showed that the majority of participants supported the provision of treatment done by dental therapists (Dyer, Humphris, & Robinson, 2010; Dyer & Robinson, 2009; Macey et al., 2016). However, almost half of participants in the UK survey expected that the cost of treatment should be lowered when receiving treatment by the dental therapists (Dyer & Robinson, 2009).

As discussed above, presence of various factors attributing to the dental therapist with regards to their employment (for examples their competencies, motivations at work and job satisfactions), general private dentists' perceptions on the employability of dental therapists in their practice, as well as the general public acceptance towards the dental therapists may affect the dental therapists workforce dynamic with their complex interactions. Each factor itself also has its own system of sub-factor interactions. It is important to assess the interactions of these aforementioned factors and their sub-factor interactions, and use them in exploring the future dynamics of workforce among dental therapists.

One of the health workforce model, namely the System Dynamics Model, may be the appropriate tool to explain this dynamic approach. The System Dynamic model is able to evaluate the pattern of relationship within the whole system, and provide pictures of

manpower dynamics according to any given situation of related issues. It is an approach to understand the behaviour of complex systems over time where it deals with internal feedback loops and time delays that affect the behaviour of an entire system. The uniqueness of the system dynamics modelling compared to the other approaches for studying the behaviour of complex systems is the use of feedback loops and stocks and flows (Sterman, 2000).

Two local studies have employed SD modelling in forecasting the Malaysian dental workforce. The first is a policy study conducted by the Ministry of Health (MOH) in collaboration with academician at a local university (Samah et al., 2014) . System dynamic modelling was employed with Vensim as the tool aided in forecasting the number of dentists needed in the public-private sector from 2015 to 2030. The simulating model for the dentist supply was grouped based on age and gender groups. The model predicted that there is a potential of dentist undersupply by the year 2030. However, this study did not include dental therapist in their dental workforce projection for the country.

A study by Che Musa (2017) also used SD modelling to evaluate the future requirements of dental specialist and dental therapist. The findings of that study which forecasted dental workforce requirements from year 2010 till 2040 suggested a potential for oversupply of dentist and dental therapist (generalists) in both the private and public sectors as early as 2035; and a potential of undersupply for all dental specialists throughout the simulation period. The results was being driven by trends of dentist practice, training, and privatization; but the study did not incorporate other factors that could influence the contribution of dental therapist.

1.1   Research gaps

In Malaysia, apart from the abovementioned studies, to our knowledge, no other study has been conducted to assess both public and private stakeholders' perceptions on the dental therapists' expansion of roles as stipulated in the Dental Act 2018 and their legal infiltration into the private practice. This may give rise to the possibility of an increased turnover, either attrition or migration of this dental workforce and it is interesting to see if there is a need to produce or employ more dental therapists in Malaysia to satisfy the oral health needs of the population or vice versa. These concerns when combined with their job motivations, job satisfaction and their intention to leave, may have an unknown impact on the dental therapist workforce dynamic in the future.

Job motivation and job satisfaction are linked to the intention to leave among the employees in many organisations. No local study has been conducted among Malaysian dental therapist in Malaysia in this context, except by Abu Bakar et al. (2015). However, that study did not explore further on the factors that could affect job satisfaction and was conducted before Dental Act 2018 was introduced.

Apart from that, the employability of the dental therapists into the private practice in Malaysia, together with the assumed attrition of the dental therapists to the private sector, and from the profession overall, are significant and require investigation. It is timely to evaluate the potential roles of the dental therapist under the provision of the new Dental Act 2018. Studies on general dental practitioners' acceptability towards dental therapists shows none that no study has been conducted locally and that the potential barriers must be addressed well before commencing the employment of this midlevel provider into the team.

As the new legislation permits dental therapists to work at private practices, it is also important to assess the public's (patients) acceptance on receiving dental care from a dental therapist as well as the willingness of private dental practitioners to employ them.

A study that focuses on public acceptance towards dental therapist is of no existence in our local context even though they have been servicing our population for more than sixty years. With the implementation of Dental Act 2018 it is timely to gauge public view towards this matter.

Neither of the two models described (Samah et al., 2014; Che Musa, 2017) considered people's health behaviours i.e intention to leave among dental therapist, the acceptance of public towards the use of dental therapists in both sectors or the employability of dental therapists in private sector following the passing of the latest Dental Act (2018), in forecasting the number of workforce needed in the county. All the parameters stated may assist the oral health policy makers and can be their source of reference in allocating a better human resource management in this country. These will be discussed further in the next chapter.

1.2   Implication of the study

The findings from this study will assist in enhancing the delivery of oral health care services in Malaysia, in particular of services rendered by dental therapists. Resources in health are scarce, especially in term of financial and human resources. The use of System Dynamic Model can provide very useful insights in forecasting the actual number of dental therapists needed to achieve the goal of the Ministry of Health.

The findings from this study will also give a clearer view on the perceptions and acceptance of dental therapists' expansion of job places as stipulated by the Dental Act 2018. Such information will be useful to further improve the sustainability of the profession as well as maintaining the effective primary oral healthcare delivery in Malaysia. This in turn will enable an increase in availability and accessibility of dental care with their deployment in the private sector playing a complementary role to their already presence in the public sector.

As part of this study, implementing an operational approach is deemed timely in order to inform the framework and overall design for the translation of policy and practice into the Malaysian context. Therefore, by utilising the system dynamic (SD) model to forecast and plan the future of dental therapists in Malaysia this may influence the future development and establishment of dental workforces. Inclusive the recruitment, retention, training and future model of care it is hoped this may provide a recommendation for the future dental workforce.

1.3   Aim and objectives

To explore the dental therapist future workforce dynamics across sectors (public-private) in Malaysia.

Specific objectives:

Phase 1

1. To describe the dental therapists' and private dental practitioners' awareness on the establishment of Therapist Division under the new Malaysian Dental Act 2018

2. To describe dental therapists' job motivation, job satisfaction, intention to leave, and their perceptions of employment in private practices.

3. To determine the factors associated with the intention to leave among the dental therapist.

4. To assess parental acceptance of dental therapist employment in the private practices

5. To determine factors that influence parental acceptance towards the use of dental therapist in the private sector.

6. To describe private dentists' attitudes and perceptions as well as their perceived barriers on the employment of dental therapist in the private practices

Phase 2

7. To model the future dental workforce of dental therapists in Malaysia in relation to population need and demand

CHAPTER 2: LITERATURE REVIEW

2.1   Dental therapists – Overview

Dental auxiliary is a generic term used to describe dental personnel who assist the dentist in treating patient and can be defined as a person who may or may not perform dental supportive procedures. The dental auxiliaries, known as Dental Care Professionals in the United Kingdom (UK), are divided into two main groups: the operating auxiliary and non-operating auxiliary. The former is permitted to carry out certain treatment procedures in the mouth as authorised by the provisions of certain regulations under the specified supervision of a licensed dentist (Marya, 2011 as cited by Bhalla, Yadav, Siddiqui & Bhalla, 2014), and they include the dental therapist, oral health therapist and dental hygienist. The non-operating auxiliaries are those who assist the dentists in the clinic but do not do any independent procedures in the oral cavity. They include the dental technicians, dental nurse, dental surgery assistants and health attendants.

There are many terminologies used globally to describe distinct roles and function of operating auxiliaries. A number of new personnel have also been introduced for example the orthodontist therapist and clinical dental technicians. Singapore and Australia group dental therapist under oral health therapist categories together with another two dental professions; the dental hygienists, and dual-qualified dental hygienists/dental therapists with different education requirements (Australia dental board, 2017; Singapore Dental Council, 2019b). Dental therapist's who primarily perform dental procedures for children and adults are considered as part of the dental team. Their roles and responsibilities depends on their training under various act and regulations across countries. New Zealand is the first country to introduce dental therapists as early as 1919, in view of the high burden of disease and shortage of

dentists (Nash et al., 2014). They are defined as a highly skilled professional member of the oral health team who provides quality dental care to various sections of the community (New Zealand Dental Council, 2018a). Initially, they were regarded as dental nurses, and were provided with two years training programme with the aim to provide dental care for primary school children in the public schools (Friedman, 1972). It is estimated that over 14,000 dental therapists have serves more than 50 countries worldwide, both in the developed and developing country (Nash et.al, 2008).

Globally, there are variation in terms of dental therapists' job title, job descriptions, the type of population served and the degree of supervision they receive by the dentist. For instances, New Zealand, Canada and Australia allow their dental therapists to provide care for the adults, and they can develop their own treatment plan, although some may need to work under dentist supervision. This supervision could be direct or indirect where dentists' physically presence are required, or 'prescriptive' guidance from dentist remotely from the site (Baltutis & Morgan, 1998; Edelstein, 2011; Nash et al., 2012; Waghray, Mamatha, & Lavanya, 2018). The various duties and job scopes of a dental therapist depends on the country legislation, training of dental therapist, and dentist willingness to delegate task to them. The expansion of roles and responsibilities of dental therapist is also observed globally and this consequently indicate the importance of having appropriate mechanism in addressing issues relating to dental therapist workforce (Calache & Hopcraft, 2012; Waghray et al., 2018).

2.2   Review of dental therapist in Malaysia and globally

As with many other Commonwealth countries, Malaysia followed the dental nurses' system which was introduced to the civil service in 1948. Their profession has greatly evolved over the years and their job scopes were previously bounded under the Dental Act 1971. Historically, dental therapist was introduced to provide simple dental care

under the supervision of dentists, to children age 12 years and below, at public settings only. However, the age restriction has been lifted to 17 years old since 1977 (Oral Health Division, 2003).

2.2.1 Training

The establishment of the training program for dental therapists in Malaysia commenced in the late 1940s. Therefore, dental therapists are not a new dental professional group as its history in Malaysia has span in the last 70 years. They are considered as the "gatekeepers" of the healthcare system in Malaysia and many other countries, as they are often the first point of contact for patients seeking care especially among schoolchildren or referrals to secondary tier physicians (Tjerbo & Kjekshus, 2005; Healy, Sharman, & Lokuge,2006; Schäfer et al., 2010). Originally the training of dental nurses was undertaken by the Malayan School of Dental Nurses which was subsequently renamed as the Malaysian Ministry of Health (Dental) Training Institute (MOHDTI). The training started with a one-year programme where they are only allowed to use slow speed hand-pieces when treating their patients. In 1996, a new three-year programme was introduced, and the qualification was also upgraded from certificate to diploma 1977 (Oral Health Division, 2003). This new curriculum allowed dental therapist to use high speed hand piece and ultrasonic scalers.

Whereby, in the US, dentists and dental professional bodies opposed to the introduction of dental therapists and described them as a hazard in the occupation (Nash, 2012). These interprofessional conflicts is possibly shaped by occupational groups' efforts to attain and maintain professional status and authority (Adams, 2004). The American Dental Association (ADA) opposed the introduction of new workforce models because dental therapists are permitted to conduct irreversible dental treatments, and they firmly believes only a dentist has the ability to extract teeth or to undertake

permanent and invasive dental treatment. Alternatively, ADA proposes that more dental schools shall be opened that will educate more dentists, who can ideally practise in urban and rural areas. The association has emphasised that Medicaid's sufficient coverage and support for conventional dental education services would serve remote communities well (ADA, 2017). This is also supported by recent studies among Maryland dentist which strongly opposed the use of dental therapists in their practises and claimed the poor oral hygiene was due to low oral health literacy (Davis et al., 2020). Instead, dentists in the United States tend to make better use of dental hygienists whose work duties primarily concentrate on the prevention and treatment of periodontal disease. The majority of the dentist have a positive attitude towards dental hygienist due to believes that people in high-status occupations, like dentists, advance by delegating lower-status skills and roles to subordinate groups, such as dental hygienist and dentist still have the control over other oral health care occupations (Reinders et al., 2016).

However, continuous effort made to establish and acknowledge the contribution of dental therapist workforce in the USA where under their guidelines, dental therapists are required to be in training for three years but are not made compulsory on education and supervision period before can be accredited as a dental therapist (Licari & Evans, 2014). Furthermore, they are required to obtained bachelor's degree to be registered as a dental therapist in their locality. Nevertheless, the movement is growing and expanding as individuals, activists, and policy makers understand the role that dental therapists can play in improving access to care, particularly for children (Brickle & Self, 2017).

For Malaysian scenario, the dental therapist had contributed to the significant improvement of Malaysian children oral health status based on the New Zealand model. With the current policy of collapsing down the post and restricting the introduction of new scheme (Public Services Commission of Malaysia, 2016) while make use the large number of available dental therapist, further introduction of Dental Therapist Division

in Dental Act 2018 is deemed to recognise the Malaysian dental therapist existence and contribution to the Malaysian dental fraternity.

Globally, training for the dental therapist varies with the tradition of two years and obtained a diploma in Dental therapy (General Dental Council, 2019; New Zealand Dental Council, 2018b). There are also training of dental therapist combined with dental hygieniest in a three academic years and endorsed with a degree in oral health sciences (Australia dental board, 2017 ; General Dental Council, 2019a; New Zealand Dental Therapist Association, 2011).

2.2.2   Supervision requirements

Supervision level varies among countries and even within the same country. It could be direct where dentists' are physically required to be presence as in Singapore (Donovan & Ansari, 2019), or indirect as a general supervision or 'prescriptive' guidance from dentist remotely from the site as in the UK, Australia, New Zealand and USA (Dyer & Robinson, 2009; Koppelman, Vitzthum & Simon, 2016; Teusner, Satur, Gardner, Amarasena & Brennan, 2018). Malaysian dental therapists are required to work closely under the direct supervision of a dental surgeon at all time at any healthcare facilities including in the private practice (Dental Act of 2018).

Williard and Fauteux (2011) reported that the dental health allied therapists (DHAT) in Alaska perform dental procedures under direct, indirect, and general supervision. The type of supervision received would depend on the dentist's observation of the DHAT's skills and clinical competence. In Vermont or Kansas state dental therapists work under general supervision of a dentist (Mathu-Muju, Friedman & Nash, 2016).

2.2.3   Rules and regulation – The Malaysian Dental Act

With the passing of the new Dental Act 2018 which supersede the previous Dental Act 1971, dentistry in Malaysia has taken a step ahead by making it compulsory for all dental therapist to be registered under the Therapist Board, Malaysian Dental Council. This is similar with what has been practised in various countries globally (General Dental Council, 2019; New Zealand Dental Council, 2018c; Singapore Dental Council, 2019a; Australia Dental Board, 2017), where dental therapists must be registered under their respective dental board.

For a long time, dental therapists were primarily utilized in the school dental service as well as at the public dental settings where they are supervised by a dental surgeon (Dental Act of 1971). The expansion of place to practice gives a broader chance to dental therapist in diversifying their job scope as well as enhancing their career pathway. However, in terms of permitted clinical duties, there are not so much different when comparing between the old Dental Act 1971 and the current Dental Act of 2018. Unlike their counterparts in Australia who are permitted to run their own private dental practice (Kempster, Luzzi, & Thomson, 2015), dental therapists in Malaysia, although legally allowed to work in the private settings, are only authorized to provide care to person below age of 18 years old (Dental Act of 2018).

2.2.4   The roles and responsibilities of dental therapists

The scope of Malaysian dental therapist includes performing simple dental procedures, preventive services, restorative treatment, primary tooth removal, additional oral care i.e., topical fluoride application and oral health promotion for children and adolescents. They have primary oral health care skills including oral health examination, minimal intervention and health promotion as well as specific skills in non-surgical treatment of periodontal disease and dental caries (direct restorations and extraction of deciduous

teeth) in a person below 18 years old. Figure 2.1 shows the clinical procedures that a Malaysian dental therapist may carried out to treat their respective patients as stipulated in the Dental Act (2018).

FIFTH SCHEDULE

[Subsections 43(3) and (4), subsection 50(2) and paragraphs 51(2)(g), (h), (i) and (j)]

PROCEDURES THAT MAY BE CARRIED OUT BY A DENTAL THERAPIST

1. A dental therapist may carry out the following procedures:

    (a) clinical procedures on persons below the age of 18 years;

    (b) dental health promotion, education and instruction; and

    (c) intra-oral photography on instruction of the dental surgeon.

2. The clinical procedures that may be carried out by a dental therapist referred to in subparagraph (1)(a) shall be limited to the following:

    (a) oral examination;

    (b) Class I, II, III and V restorations, using direct restorative materials;

    (c) administration of local infiltration anaesthesia;

    (d) extraction of primary teeth;

    (e) placement of fissure sealant;

    (f) application of topical fluoride gel and paste; and

    (g) supra-gingival scaling and polishing.

Figure 2.1 The clinical procedures that Malaysian dental therapists are allowed to undertake (Source: Dental Act 2018)

Meanwhile, throughout their career journey, Malaysian dental therapists can develop skills in the field of dental expertise such as; periodontology, orthodontics, oral surgery and paediatric dentistry if they are qualified and have acquired basic skills for some time in the course of their careers. They required another 6 months post basic training and obtain professional skills to provide dental treatment for a person over 18 years old as stipulated under the Dental Act of 2018 illustrated in Figure 2.2.

Figure 2.2 The clinical procedures that Malaysian post basic dental therapists are allowed to undertake (Source: Dental Act 2018)

Globally, there are variations in terms of dental therapists' roles and responsibilities. The degree to which various duties and job scopes are delegated to the dental therapists depends on the country legislation, training of dental therapist and dentist willingness to delegate tasks to them. The expansion of roles and responsibilities of dental therapists is seen globally and this may mark as an essential mechanism in addressing issues relating to dental workforce, shortage and serving the underserved communities (Calache & Hopcraft, 2012; Waghray et al., 2018).

Dental therapist in New Zealand, United Kingdom, Canada and Australia are allowed to provide care for the adults under the prescription of a dentist, and they can develop their treatment plan, although some may need to work under dentist supervision. Most dentists were supportive with dental therapists providing the care for children, but they were resistance in delegating adult care to them (Nash et al., 2014). For example, in Malaysia, dentists were positive with the role played by the dental therapists in providing care for the child population. However, when asked whether the role of dental therapists should be expanded, 53% dentists disagreed (Dolah, Bar & Jaafar, 2006). Two studies conducted among general dental practitioners (GDP) in the UK also reported that dentists perceived dental therapists' job scope should only include children and person with special needs (Gallagher & Wright, 2003; Hay & Batchelor, 1993).

Apart from permitted to carry out clinical procedures for a person below 18 years old, under the new Act, the Malaysian dental therapists are also allowed to take intra-oral photography on instruction of the dental surgeon. In the UK, the practice of taking intraoral photograph has long been conducted by post-basic dental therapist especially those under orthodontic specialist prescription, and also among the UK dental therapist (BDJ Team, 2018). Nuzzolese, Lepore, Cukovic-Bagic, Montagna and Di Vella (2008) recommended that dental hygienist/dental therapist working in forensic odontology

should be allowed to assist in the dental charting to speed up the investigation process during a forensic odontology operation. They also recommended that this group are provided with proper training in forensic science, particularly in the knowledge and skills in identifying injuries and reviewing photography.

A study conducted among Singaporean oral health therapist (OHT) graduates by Donovan and Ansari (2019) revealed that only one-third of them used their additional skills once daily. The majority of OHT in that study stated that they were not able to fully apply their skills according to the permitted job scopes when working in the private practices and mostly had to focus on dental hygienist's roles. Their attitude was similar to counterparts in Australia (Amarasena, Teusner, Brennan & Satur, 2018) and the UK (Jones, Evans & Hunter, 2008). A critical thing to note, this study only accounts for a small response rate (35.1%) of all OHT in Singapore; thus, it might not reflect the perceptions of the overall therapist workforce.

2.3   Acceptance of dental therapists among the publics and dental practitioners and the employability of dental therapist in the private dental practice

2.3.1   Definition of acceptability

Accept means "to consider something or someone as satisfactory" while acceptability is defined as "the quality of being satisfactory and able to be agreed to or approved of". As for acceptance, this is defined as "general agreement that something is satisfactory or right, or that someone should be included in a group" (Cambridge dictionary, n.d). Looking into the definition, the term can be interchangeable with the word 'satisfaction' and in healthcare research, many have used this term to evaluate service experiences. Hence, acceptability has been understood as "the judgments about the treatment

procedures by non-professionals, laypersons, clients, and other potential consumers of treatment, for example whether treatment is appropriate for the problem, treatment is fair, reasonable, intrusive, and whether treatment meets with conventional notions about what treatment should be (Kazdin, French & Sherick, 1981 as cited in Spirrison, 1992). Acceptability has always been interchangeable with 'attitude' and 'satisfaction' and is mostly measured as patient satisfaction towards service provided by the dental workforce (Othman & Razak, 2010; Sun et al., 2010) using appropriate Likert scales (Spirrison, 1992).

2.3.2 Dentists' knowledge, attitude, acceptance level and perceived barriers towards the employment of dental therapists

2.3.2.1 Awareness and acceptance

Both positive (Nash et al., 2014; Gallagher & Wright, 2003; Dyer & Robinson, 2006) and negative (Gallagher & Wright, 2003; Ross et al., 2007) receptions by the dentists on dental therapist employment in the general practice have been recorded. A recent online survey conducted among dentists who worked at three major government hospitals in Jeddah, Saudi Arabia, discovered that more than three-quarter of the respondents positively accepted dental therapist as their team members. The same study also indicated that dentist acceptance towards dental therapists can be explained by two significant predictors; dentists' knowledge and attitude towards dental therapists (Alalyani et al., 2018).

A qualitative study conducted on dentists in Atlanta, Jackson and Tampa, US reported that dentists feared of losing their incomes upon employment of dental therapists and they also doubted dental therapists' skills and training, even though the latter only provide service to the marginalised and underserved population. However, the authors acknowledged that the perceptions portrayed through the focus group discussion sessions were the participants' own views and should not be generalised to the context of all providers (Treadwell, Catalanotto, Warren, Behar-Horenstein & Blanks, 2016). Dentist's knowledge of the roles of dental therapist is important to successfully explore the use of skill-mix in the dental team (Gallagher & Wright, 2003; Ross et al., 2007). In addition, dental schools must expand the dental curriculum to sensitise future dentists with regards to the lack of dental care presence in the marginalised (Aksu, Phillips & Shaefer, 2013). This may change their perceptions towards the need to utilize dental auxiliaries in the clinic to cater for the unfortunate

community. Kempster, Luzzi and Thomson (2015) reported that Australian dentists who practised in metropolitan area, had public sector background, had multiple surgeries in their practice, and possessed the intention on practice expansions were more likely to employ dental therapist in their clinic set up. This shows that business aspiration is an important predictor towards dentist acceptance, over their personal characteristics i.e. their gender and age. Furthermore, another opposition view were from the American Dental Association where the association has adopted the stance that expanded Medicaid payment to dentists could resolve the problem of dental care provided to underserve people rather than introducing dental therapist as separate group of services in dentistry (American Dental Association, 2017).

2.3.2.2 Knowledge, attitude and barriers towards dental therapist employment in the dental practice.

Gallagher and Wright (2003) assessed the knowledge of 200 dental practitioners practising in West Sussex on dental therapist roles and responsibilities, prior the commencement of the revised General Dental Council legislation. They reported that nearly a quarter of their respondents did not know the level of supervision that dental therapists required, and more than half thought direct supervision was necessary. In addition, only a quarter knew that dental therapists were allowed to treat children. Despite the low level of knowledge on the roles of dental therapists, half of the dentists were in favour of incorporating dental therapist in their practice. This finding concurs with a study conducted by Jones, Devalia and Hunter (2007) among the principals of general dental practices both in the public (National Health Services) and private settings in Wales. Dental undergraduates who were trained with dental auxiliaries in the dental schools had positive knowledge on auxiliary's role (Ross et al., 2007), which shows the importance of training future dentists and auxiliaries together.

Dentists' lack of knowledge on dental therapist roles may be related to their negative attitude towards the latter's employment. This is proved by a study conducted in Wales among 332 private dentists who examined the attitude towards the employment of dental therapist in their practice. The responses were negative as less than half of the respondents would consider employing dental therapists as there was lack of surgery facilities for dental therapist to work (Jones et al., 2007). Interestingly, Gallagher and Wright (2003) showed a reverse finding. Most dentists in their study believed that dental therapists could make a meaningful contribution to the dental team and that dental therapists would not go off the boundaries set legally for them. Hence, the authors concluded that the private dentists' attitude were favourable despite their limited knowledge on dental therapist roles and responsibilities. Another study conducted in the United States of America and Scandinavian countries reported that dentists had more positive views on dental therapists and believed they have the potential to increase access of care (Blue et al., 2013). This is similar to findings of Lopez, Blue, and Self (2012) among 151 faculty members from the preclinical and clinical departments and dental hygiene division of the University of Minnesota School of Dentistry. They reported that more than half of their health professionals had good knowledge of the roles and responsibilities of a dental therapist, but only few would employ this group into their practice.

Financial issue also plays one of the dentist's major concerns in employing dental therapist in their practice as well as their negative perceptions towards patient's acceptance (Gallagher & Wright, 2003). Space availability was another concern arose by private dentists (Jones et al., 2007; Sprod & Boyles, 2003).

2.3.3 Acceptability of dental therapist among the public

With the implementation of the new act that may affect the regulations of the local dental care services, not only socio-economic status of that area being the factor in influencing the types of patients seen by the dental therapists, but most importantly are the patient acceptance accompanied by the ethical concern. Some studies in the UK have reported positive public acceptability for dental therapist to perform restorative treatment on paediatric patients (Dyer et al., 2010; Dyer & Robinson, 2008, 2009; Dyer & Robinson, 2016). Multiple logistic regression conducted in the studies reported that being younger and having a need for treatment were the predictors of positive social acceptability.

Studies have also been conducted in the United States which looked at public acceptance towards the employment of dental therapist. Wetterhall, Bader, Burrus, Lee and Shugars (2010) reported that Dental Health Aide Therapist (DHAT) was well accepted in the Alaskan native. The community stated that the DHAT were competent in giving dental care in a safe manner and that the care received from the DHAT were comparable with the dentist. Phillips, Shaefer, Aksu &Lapidos (2016) assessed 600 adult patients in an urban university-based dental clinic in Detroit, USA and found that almost half of the respondents felt comfortable being treated by a dental therapist. In addition, majority had positive acceptance towards dental therapist providing fillings, extraction, injection and oral health advice to their children.

Macey et al., (2016) assessed the efficacy and social acceptability of using hygienist-therapists (HTs) as front-line clinicians and the findings were positive, in accordance to similar previous studies (Dyer & Robinson, 2008, 2009; Dyer &Robinson, 2016; Phillips et al., 2016; Ross et al., 2007). This is the only study conducted using an experimental study design as compared to earlier literature that was mostly conducted using observational design. This shows how research has evolved and how important

the elements of patient acceptance in influencing dental therapists' employability. In the Malaysian context, an observational study can be a significant step forward to gauge public view towards this group of dental auxiliaries.

2.4   Job motivation and job satisfaction

2.4.1   Job motivation

Lambrou, Kontodimopoulos, and Niakas (2010) defined motivation as "an individual's driving force to satisfy a need, a term to describe their passion, direction and persistence of an effort toward reaching a goal". In relation to an organisation, motivation is described as "a person's degree of willingness to strive and maintain an effort towards their organisational objectives" (Franco, Bennett & Kanfer, 2002).

Job motivation refers to a person's motivation to perform well in his or her current position (Warr, Cook & Wall, 1979). An earlier definition made by Lawler III (1969), defined intrinsic job motivation as 'the degree to which a job holder is motivated to perform well because of some subjective rewards or feelings that he expects to receive or experience because of performing well'.

Based on these definitions, it is understood that motivation revolves around an individual's exertions in striving self-expectation and deliver an excellent task/job. Employee motivation at work has been an important marker in the evolving nature of work among employees' in an organisation. It has been found to influence work performance and the outcomes of work in health care in several studies conducted in different healthcare organisations (Ayyash & Aljeesh, 2011; Bhatnagar, Gupta, Alonge & George, 2017). For instance, Ayyash and Aljeesh (2011) in their quantitative study aimed to examine the relationship between motivation and work performances among nurses working at European Gaza Hospital found that highly motivated nurses achieved better work performance outcome than low motivated nurses. While a study conducted

in 2011 among Malaysian primary healthcare physicians reported the association between job motivation with the success in delivering meaningful quality healthcare to the public (Chew, Ramli, Omar & Ismail, 2013).

In dental fraternity, a qualitative study based on Vroom's Expectancy Theory among prison dentists in Scotland, UK reported that dentists' motivation to work in Scottish prisons is characterised by their beliefs that their work will give benefit and improve the oral health of the prisoners and act as a rewarding experiences in their career after facing few environmental obstacles (Smith, Themessl-Huber, Akbar, Richards & Freeman, 2011). A recent cross sectional study by Nomura et al. (2018) aimed to investigate factors associated with Japanese dental hygienist willingness to work found that interpersonal relationships with collegues, managers, and patients, were among the motivating factors. While for dental hygienists who reported disliking their work, salary was the only determining factor that could predict their willingness to work.

Career motivation is characterised as the arrangement of individual attributes and related career choices and practices that mirror the individual's profession identity, insight into factors influencing their career path, and strength, despite negative work conditions (London, 1983). Durkan, Belsi, Johnson and Gallagher (2012) explored the career choice and pathways of dental nurses in the UK and revealed that it is related to their opportunity to progress in the dental sector, and job availability. Personal satisfaction was the most important factor expressed while increased chances of employability were the least important factor. Furthermore, studies in the UK and Malaysia among dental fraternities (Abu Bakar et al., 2015; Che Musa, Bernabé & Gallagher, 2016; Gallagher, Patel, Donaldson and Wilson, 2007; Onabolu, McDonald & Gallagher, 2018) revealed a high response for a desire to work in healthcare, working with people and a wish to provide a public service. However, these researchers did not focus on current job motivation that was linked to job satisfaction and intention to leave

dental service. To the best of our knowledge, no study has been conducted to explore the link between dental therapist's job motivation with their satisfaction and intention to leave Such studies have been conducted in other job fields including the medical sector (Ayyash & Aljeesh, 2011; Chew et al., 2013; Toode, Routasalo, Helminen & Suominen, 2015) and among dentists, particularly those in Scotland and Australia (Gardner, 2015; Smith et al., 2011) .

2.4.2 Job satisfaction

Job satisfaction can be defined as individual's impressions either positively or negatively with intrinsic (e.g., affective bond) or extrinsic (e.g., rate of pay) features (Bhuian & Mengue, 2002; Hunt, Head & Sorensen, 1982; Warr et al., 1979). It is directly related to organisational commitment (Blegen, 1993; Knoop, 1995) and employees' intention to leave an organisation (Bonenberger, Aikins, Akweongo & Wyss, 2014) or their profession (Alzayed & Murshid, 2017). Hence, it can influence various behaviours in the dental workforce. Few elements need to be explored and measured to obtain an employee's perceptions towards their job (Liou & Cheng, 2010). Various studies conducted in this research areas had indicated an employee response to various elements in their daily job satisfaction, which include pay rate, rewards, responsibilities, working hours as well as policies (Taber & Alliger, 1995; Johnson & Johnson, 2000).

Job satisfaction is known to be influenced by work environment, productivity, quality of work and quality of life. A study conducted among dental assistants in Brazil found that almost one-fifth was dissatisfied with their salary, dentist's personality, workplace, and workload (Loretto, Caldas Jr & Coelho Junior, 2013). Studies also relate this to the lack of control and being undervalued by the dentist or the perception of

being taken for granted (Humphris & Peacock, 1993; Craven, Blinkhorn & Roberts, 1995).

Dental auxiliaries working in the private sectors in Saudi Arabia were found to be more satisfied with their personal lives and professional work as compared to their public sector counterparts (Al Jazairy et al., 2014). This is mainly due to the flexibility of working hours and the level of income provided in the private settings. They also stated that their respondent 's income plays a major role in satisfaction, but they did not link it to turnover rate.

A local study by Abu Bakar et al. (2015) conducted on Malaysian dental therapist shows that the majority were satisfied with their job, but they were unprepared of performing a more advanced role in their daily task. The authors also proposed the need to reevaluate the Malaysian dental therapists' job satisfaction post-enactment of the new Dental Act. Another local study conducted among 200 Malaysian primary healthcare professional also provided evidence of a positive correlation between age and extrinsic job satisfaction as well as the working condition satisfaction. They also proved that job motivation was correlated with working condition satisfaction (Chew et al., 2013).

Overall, assessment of job motivation and job satisfaction are important because employees often need to make choices between work and family (Ilies, Liu, Liu & Zheng, 2017). Both are work-related attitudes that have generated significant consideration from many scholars around the globe (Eskildsen, Light, Carlisle & Westover, 2016) and are essential components of corporate health (Vorina, Simonic & Vlasova, 2017). As recognised in many studies, job motivation and satisfaction are related to any given profession. Many empirical studies have displayed differences in motivation and satisfaction of employees among various work settings (Mihail & Kloutsiniotis, 2016; O'Connor & Yballe, 2007).

2.4.3 Measurements of job motivation and job satisfaction

One of the commonly used measures of job satisfaction in the field of dentistry (Turner et al., 2011b) is the Warr Cook Wall scales (Warr et al., 1979). The scales have been used in several other investigations in various industries (Navarro et al., 2019) including the medical fraternity (Chew et al. 2013; Leutgeb, Frankenhauser-Mannuß, Scheuer, Szecsenyi & Goetz, 2018) as well as on blue-collar workers (Dalati, et al., 2017; Kazi, Haslam, Duncan, Clemes & Twumasi, 2019; Pick & Teo, 2017). It has been cited by many studies and have been proven to be extremely appropriate for self-completion technique as 'item simplicity' was one of the objectives during its construction. This is when compared to other scales, for example the Job Satisfaction Scale (JSS) which may be complex with many items included (Kvist et al., 2012; Muya, Katsuyama, Ozaki & Aoyama, 2014). In Warr-Cook-Wall (WCW) scale, 'job' refers to the tasks undertaken in a particular setting.

Job motivation refers to an individual's motivation in his/her present job in which they wish to perform well to achieve personal satisfaction. Hence, WCW focuses on the intrinsic element of job motivation that emphasises on the success on personal effort to a particular job. An earlier study conducted by Lawler and Hall (1970) on scientists in 22 research and development labarotories also stressed on the evaluation of personal satisfaction. There are 6 items under job motivation domain in WCW namely; "I feel a sense of personal satisfaction when I do this job well", " My opinion of myself goes down when I do this job badly", "I take pride in doing my job as well as I can", " I feel unhappy when my work is not up to my usual standard", "I like to look back on the day's work with a sense of a job well done" and "I try to think of ways of doing my job effectively".

Meanwhile, the scale for job satisfaction in WCW comprises of 16 items where the last item assesses the participant's overall satisfaction towards their job. This scale is

also characterised as a two or three-factor models; where the former model splits the scale into intrinsic (7 items) and extrinsic (8 items) components. The extrinsic component is based on three major facets namely; job characteristics (4 items), working condition (5 items) and employee relations satisfaction (6 items). The scales' internal homogeneity is good, as represented by its alpha coefficients reported by its developer (Warr et al., 1979)

Both the job satisfaction and job motivation items are rated on a seven-point Likert scales ranging from '1'= "I am extremely dissatisfied" to '7'= "I am extremely satisfied". The use of Likert scales as response options has been shown to be appropriate when extracting participant's information about their experiences (Capuano et al., 2016). The WCW scale has been used on Malaysian primary healthcare professionals including doctors and family medicine specialist, and the scale has been shown to be reliable and valid for use in the local population (Chew et al., 2013)

2.4.4   Factors influencing job motivation and job satisfaction

Factors that increase job satisfaction among dental workers were working hours, work-life balance, remuneration (Donovan & Ansari, 2019), the amount of responsibility assigned, the variety of daily job performance (Donovan & Ansari, 2019; Naidu, Newton & Ayers, 2006; Turner et al., 2011b), the opportunities to use their skills, the abilities and freedom of choosing working method, as well as colleagues and fellow teammates (Goetz et al., 2012; Goetz et al., 2016). Whereas, limited scope of practice (Donovan & Ansari, 2019), longer working hours, income and remuneration, younger age, and the length of working experiences (Goetz et al., 2012) are the factors that would decrease job satisfaction among dental workers. Saudi dental healthcare workers reported that income and job security were the two factors affecting their job satisfaction (Hamasha et al., 2019). The study also highlighted that the dental auxiliares

were more dissatisfied with income and job security as compared to dentist. However, based on the sampling and statistical methods that they used, the findings reported should be interpreted with caution.

A cross sectional study in Portugal investigated the factors influencing job satisfaction among their nurses. They found that ssatisfaction with promotion opportunity was influenced by educational attainment level; and satisfaction with benefits/rewards was influenced by work schedule. They also concluded that work benefits, incentives and promotion opportunity are vital factors that influence long-term job satisfaction among the nurses. Hence, it was suggested that worker's socio-demographic background and professional aspects must be considered when trying to foster healthy work environments (Palha, Macedo & Simães, 2018)

Although the abovementioned studies examined the factors of job satisfaction across healthcare workers, including among dental fraternity, and provided recommendations to overcome the dissatisfaction reported,. the effect of job (dis) satisfaction such as intention to leave were not explored. It is worth to note that job motivation and job satisfaction has been found to be associated with intention to leave either the organisation (Forbes, Freeman, McCombes & Humphris, 2014) or the profession itself (Kruger, Smith & Tennant, 2007; Turner, Ross & Ibbetson 2012). Hence, it is important to include the assessment of intention to leave to ensure future workforce dynamic.

2.5 Intention to leave

Intention to leave has been an interesting construct for researchers in various field to study and understand the possible elements of why employees leave their organisations or professions (Almalki, FitzGerald & Clark, 2012; Fochsen, Josephson, Hagberg, Toomingas & Lagerström, 2006; Lou, Yu, Hsu & Dai, 2007; Simon, Müller & Hasselhorn, 2010). Almost three decades ago, Gaertner and Nollen (1992) defined intention to leave as a social goal that came from various factors, for example, new policies within the organisation, the demand of the labour market, and employee perception. While, Weisberg (1994), Purani and Sahadev (2007) and SamGnanakkan (2010) described intention to leave as employee's plan of intention to quit the current job and try to find another job in the future. Liou and Cheng (2010) asserted that intention to leave is caused by the employees' negative perceptions and attitudes towards their job as well their workplace.

One of the professions that is critical today all over the world is the nursing profession because of its high rate of turnover. Many studies revealed that nursing shortage and vacancies are reported in most countries of the world (Zurn, Dal Poz, Stilwell & Adams, 2004), with turnover being identified as a main contributor to the shortage of nurses (Cohen & Golan, 2007; Ramoo, Abdullah & Piaw, 2013). It is even worse when many nurses, especially from developing countries, migrate or leave their home countries to serve developed countries (Yearwood, 2007; Zurn et al., 2005; Ramoo et al., 2013). The reasons behind this phenomenon are aging nursing workforce, an increase in medical facilities and overseas employment opportunities.

Few studies on dental auxiliaries intention to leave their current organisation have been conducted in the western countries following some policy changes that may affect them (Forbes et al., 2014; Turner, Ross & Ibbetson., 2012). Dental auxiliaries' intention to leave was found to be predicted by poor job motivation and job satisfaction,

especially among those in the low and middle income countries (Blaauw et al., 2013; Bonenberger et al., 2014; Forbes et al., 2014; Rouleau, Fournier, Philibert, Mbengue & Dumont, 2012; Turner et al., 2012; Tzeng, 2002; Willis-Shattuck et al., 2008).

2.5.1   Factors affecting intention to leave

Several factors have been associated with intention to leave among employees in an organisation (Alzayed & Murshid, 2017; Forbes et al., 2014; McKnight, Phillips & Hardgrave, 2009; A. Pepe, Addimando & Veronese, 2017; Turner et al., 2012)

McKnight et al. (2009) surveyed 127 workers in an IT department of a food products organisation in the United States and demonstrated that job satisfaction negatively affected the intention to leave the organisation which was similar to the findings of a cross-sectional study conducted by Pepe et al. (2017) among small samples of clerk and manager in a supermarket chain.   These studies also showed that organisational commitment was the significant factor in retaining employees. Meanwhile, a study on 200 convenience samples of employees from different departments in the Kuwait Ministry of Information concluded that employees will leave the organisation if they perceived lack of commitment, lack of work engagement, had complex perception towards their organisation and were dissatisfied with their job (Alzayed & Murshid, 2017).

Another study conducted among several categories of healthcare workers in three districts of Eastern Ghana identified that job motivation and job satisfaction dimensions were significantly correlated with turnover intention. Other factors affecting intention to leave were promotion opportunities, workload, management, organizational engagement, and burnout (Bonenberger et al., 2014). However, the use of interview technique as the study tool has been subject to a bias in social desirability in such a way that respondents were unwilling to indicate themselves as having negative qualities,

such as inefficient or being late to work. The outcome could therefore report in favour of the interviewer.

Kruger et al. (2007) reported that almost one-third of registered dental therapist in Australiahas left the profession, with family commitments and new career being the major reasons. The other reasons were poor payment scheme and instruction to relocate to rural areas. Other studies conducted among dental auxiliaries also confirmed that job satisfaction is one of the significant factors in having the intention to leave (Forbes et al., 2014; Turner et al., 2012).

Hopcraft et al. (2010) surveyed 180 Australian dentists working at the public sectors and reported that one-third of them had the intention to leave the sector. Age was the most significant factor along with other factors namely poor pay, disappointment with policies and the inability to exercise extensive clinical work. The aspects that would influence them to stay in the organisations were working experience, length of service in public sector, easy access to the specialist, freedom in clinical work, better payment, and financial incentives. In the UK, it is compulsory for dental auxilliaries to register with the GDC starting 2008 Turner et al. (2012) conducted a survey to assess the impact of this new regulations on the dental nurses and reported that the compulsory registration negatively affected their role as a dental nurse in terms of having to pay for the cost of registration and the CPD. Almost 60% were not satisfied with their job, and 22% intended to leave the profession, which was predicted by younger age, greater dissatisfaction with physical working conditions, and opportunities to progress. Young dental nurses having the intention to leave the profession would give serious implications to the workforce as a considerable amount of investment have been spent in training them (Forbes et al., 2014).

Dissatisfied employees are more likely to leave the organisation, and consequently, the remaining employees may participate in detrimental practices such as low-quality

operation and causing damaged equipment (Samad, 2006). Thus, a study involving Malaysian dental therapist is timely following the extension of place to work under this new Dental Act of 2018

2.5.2   Measurement of intention to leave

There are few scales to measure the intention to leave among healthcare professionals (Alam & Muhammad, 2010; Turner et al., 2012; Forbes et al., 2014). The scales used by Jenkins (1993) and Krausz, Kowlowsky, Shalom and Elyakim (1995) has three items in the construct namely; "thought for a new job in the last few months", "actively searching for other job" and "intend to leave the organisation in the near future". The question used by the NHS to assess the intention to leave among dental nurses was 'I plan to leave dental nursing for a different career'. While the scale used by Sager, Griffeth and Hom (1998) included the following questions; "I often think about quitting my job", "I intend to change jobs during next year", and "I intend to leave dental nursing". As most of the scales used to assess intention to leave consist of very few questions, the reliability and validity of the measurement have not been explored.

2.6 Overview of workforce planning and research

Workforce planning is fundamental in improving productivity and can be understood as the process of associating the organisational needs of various conditions which include the volume, type, knowledge, skills and experience of its workforce, in order to achieve organisations' final objectives (Gallagher & Wilson,2008). In a more straightforward meaning, it is about deploying people in the right numbers, with the right skills and in the right place to succeesfully achieve the goals (Cole, 2001). Australian government (2020) defined workforce planning as a 'process of shaping and structuring the workforce to ensure there is sufficient and sustainable capability and capacity to deliver organisational objectives, now and in the future'. It is about the demand and supply of employees and about knowing the gap (between the supply and demand), what is causing it, and methods to accomplish it. WHO (2010) reported that in order to have sufficient volumes in the workforce with the right skills, it is vital to provide evidence-based planning for workforce development as the employees represent the most important and flexible resource available to an organisation. It is also crucial to include the past and planned workforce production, as well as future prediction, to deliver essential dental services that subsequently cater to the population needs.

Factors that influence health workforce planning and forecasting are socio-demographic of the population, economic and financial status, and the development of the country (Deliege, 1987). The composition and distribution of the healthcare workforce, their training and education, the migration either within or across countries, geographical and cultural factors are other important aspects to be considered in workforce planning (Kabene, Orchard, Howard, Soriano & Leduc, 2006). Technological advancements and customer preferences or expectations can change the workforce demands drastically in health systems. Workers tend to seek other opportunities and job

security in dynamic health labour markets that are part of the global political economy. These factors influence how the recruitment, deployment, training, and retention of staff is made (Knevel, Gussy & Farmer, 2017).

Workforce planning is important as the efficient use and distribution of staff is critical in ensuring the expense, quality, and quantity of an efficient service delivery (Ozcan, Taranto & Hornby, 1995; Masnick, 2010; Broclehurst, 2015). Failure in planning may lead to either under supply or surplus in the workforce, where the former is associated with low quality of care as the availability of the resources is limited to provide appropriate services (WHO, 2006). Whereas, oversupply could contribute to a poor distribution of resources and economic imbalance due to unemployment (Roberfroid, Leonard & Stordeur, 2009). A review by Lopes, Almeida, & Almada-Lobo (2015) concluded that a proper planning involves a unified and versatile approach that integrates the supply and demand, as well as includes the less tangible factors, such as productivity and skill mix.

2.6.1   Methods of workforce planning in health

Healthcare system is known for having a complex with many interconnected dynamic parts that are continually changing and evolving besides various policy issue together with higher demands in assessing various workforce requirements to provide better accessibility (Deliege, 1987) under limited financial resource (WHO, 2010). Effective workforce planning helps health care organisations to identify the level of competencies required to achieve their vision, goals, and mission. Workforce planning must become a priority of the health service in any country. Hence, it is necessary to use the right methods to respond to the population's needs and demands and maximising the effect of proper workforce planning (Kuhlmann, Batenburg & Dussault, 2015).

Poor planning methods selection and improper data sources (WHO, 2010) as well as failure to capture related factors (Van Greuningen, Batenburg & Van der Velden, 2012) were among the reasons for the failure in the past and present healthcare workforce planning. These lead to shortages, overproduction and poor distribution of the workforce (WHO, 2016). In some countries, health workforce emigration (Lancet, 2000; 2005), low capacity of production, poor skill-mix (WHO, 2010), as well as demographic issues (McGrail, Humphreys & Joyce, 2011; Skillman, Doescher, Mouradian & Brunson, 2010) were the main reasons for the shortages of the healthcare workforce.

Workforce planning process include the steps on developing current workforce profile, determining future workforce needs, and closing any gaps present (Annual Health Report, 2006). In this context, the WHO (2010) proposed several health workforce planning methods as follows:

1. The Workload Indicators of Staffing Needs (WISN) methodology;

2. Trend analysis

3. Regression analysis;

4. Meta-analysis;

5. Econometric analysis

The above methodologies have been used by numerous authors in different health care settings. For example, the WISN (workload indicators of staffing needs) method, which integrates a mixture of work activity evaluation and expert knowledge, has been used in some Asian and African countries aiming to enhance the planning for health workforce (Azimi Nayebi, Mohebbifar, Azimian & Rafiei, 2019; Kolehmainen-Aitken, 1990; Namaganda, 2004).

Trend analysis uses observed trends to assess the substantial shift in productivity in healthcare expenditure (Mahumud, Sultana & Sarker, 2015) whereas regression analysis

method has been used in assessing retention profile (Khare, Kaloya, Choudary & Gupta, 2015).

Meta-analysis technique has been used to determine clinical effectiveness of health care interventions, but Buchan and Calman (2005) criticised the findings of previous studies who have attempted to use this method in workforce skill mix surveys as they were mostly methodologically weak.

Econometric analysis evaluates the relationship between supply and demand but highlights the cost of health care (for the patient) and the revenue (for the providers) as the primary factors (WHO, 2010).

2.6.2 Types of model/ workforce planning techniques and their strengths and limitations

The literature differentiates between various approaches to forecasting and planning health personnel requirements. Health workforce models that have been used in health human resources planning are described below.

2.6.2.1 Manpower-to-population ratio method

This is a simple method for forecasting the future human resources requirements whereby the number of employees required to serve the population is based on the predetermined ratio to the population (WHO, 2010). Factors such as the present number of practitioners, expected retirement and death, estimates of student numbers in training institutions and the population projection of a particular region were included (Bolton & Segal, 2009). The ratio is calculated from present to target year for each year.

Scheffler, Liu, Kinfu and Dal Poz (2008) suggested three assumptions using this method:

1. The current number, competency mix and distribution of workforce is adequate.

2. Productivity, gender, age and the future workforce pattern will remain unchanged

3. The amount and specific workforce demographics changes based on existing trends observed over time

Apart from being simple, the main advantages of using this method is that it uses existing data that are easily available and the manpower to population ratio obtained can be compared across countries (O'Brien-Pallas et al., 2001; Scott, Sivey, Joyce, Schofield & Davies, 2011). The weaknesses of this methods are in its inability to demonstrate distributional or geographical imbalances and in that it gives little consideration on the population age distribution, epidemiological characteristics, and socio-economic conditions (Lurie, Goodman, & Wennberg, 2002; Dussault, Buchan, Sermeus, & Padaiga, 2010). In addition, the model does not consider changes in workforce productivity. The proposed workforce supply is also based on an arbitrary ratio, which may not reflect actual human resources requirement.

2.6.2.2 The health needs method

This method relies on incidence and prevalence data in the general population which are then converted into treatment needs based on expert opinion. The total hours of workforce required in a given target year to meet the health needs of a projected population are then calculated based on following formula:

$$Mpt = \frac{P*I*N*T}{S}$$

Mpt: Workforce required in a given year

P   The current or projected population to receive a specific service in a
      year

I   The average number of conditions per person per year

N   The average number of a given kind of services to be provided per
      condition per year per population unit.

S   The total amount of time a health personnel work a year for a
      specific health service

T   The average time required per services

There are four main assumptions (O'Brien-Pallas et al., 2001);

   i.   All healthcare needs are possible and should be fulfilled

   ii.   The distribution of resources to address all public health needs is a cost-
effective strategy, regardless of other needs in various sectors in a country.

   iii.   Methods of addressing needs are explained and identifiable without any
difficulty.

   iv.   Healthcare resources are always used in terms of actual needs

This approach needs well-managed databases and surveillance capacities, as well as planning expertise (De Silva, 2012). It was deemed ideal for use in a country with a strong planning capability, an active public health policy, a stable public sector, and relatively high public awareness of health problems (Hall & Mejia, 1978). The method is more realistic for planning services that require unique population characteristics with established standards (Roos et al., 1999; Katz et al., 2009). It is also useful when analysing disease burden among various populations of an area (Katz et al., 2009). An

example, a study conducted in China by Sun et al. (2017) was based on the analysis of national survey data on risk assessment in 12-year-old sample.

A local study by Ab-Murat (2012) modified the health needs model into a socio-dental approach where she integrated sociodental indicators and propensity behavioural into the system. The sociodental approach prioritise intervention on population who has oral impact due to their oral condition and who has good oral behavioural, considering the limited resources available to provide treatment to all. This approach allows differentiation in skill mix to determine the requirements for the workforce. The findings show a significant lower estimate for dentists and dental therapists as compared to the conventional approach. Meanwhile, Abdul Aziz (2014) in her cross-sectional retrospective study assessed the trends of periodontal disease in Malaysia. Three different workforce models were employed namely; The Health Needs, The Health Demands and The Workforce to Population Ratio models and it was found there were differences in dental workforce requirements for periodontal care where a greater number of dentists required is when the Health Needs model, is used, followed by the Ratio and the Health Demands model. In conclusion, there were marked differences in dental workforce requirements for periodontal care when different health workforce or skill mix models were used. However, that study did not consider the requirement estimation for local dental auxiliaries.

The health needs method seems rational to be used but defining health needs is very challenging as it acquires the expert opinion from a group of professionals. The measurement of needs is also a significant difficulty. The problem may be even more critical when there are no established norms yet (Roos et al., 1999; Katz et al., 2009; Roberfroid et al., 2009; Dussault et al., 2010). Furthermore, the method does not depict the population's willingness to pay for the total amount of money for health services acquired (Deloitte Center for Health Solutions, 2013). The method also lacks the

resource-allocation balance between health care and other activities. It is of great importance to find a correlation between needs-based approach principles and economic values such as resource opportunity costs (O'Brien-Pallas et al., 2001). Moreover, health needs change (Dussault et al., 2010) and technology evolved drastically over time, and these improvements should be observed and should not be neglected (Birch, 2002).

2.6.2.3 Health demand (utilisation) method

The method of health demand model builds on the identified service utilisation rate. Then, the estimated rates are tailored to potential population characteristics to determine service demands and converted to the required health workforce (Keet, Henley, Power & Heese, 1990). The tool is appropriate for such health system where a sufficient combination of resources is made available to the public. The method, however, needs substantial data sets and forecast patterns to be focused on the status quo situation (McQuide, Stevens & Settle, 2008). Demand and utilisation are two terms which are used interchangeably. Demand is defined by patients' seeking behaviour for healthcare, resulting directly from the perceived or subjective need for treatment (Spencer 1980; Davis, 1982), whereas utilisation refers to the amount of dental care consumed or purchased as a result of compromised patient-provider decisions (Grytten, Carlsen & Skau, 2001).

The health demand approach has been used to forecast future doctor requirements in Mexico (Nigenda & Munos, 2015), Australia, Belgium and Canada (Ono, Lafortune & Schoenstein, 2013) and dentist requirements in Australia (Mason, 2014). The method was used at a sub-national level, in Beijing, China to measure requirements for physicians, nurses, public health staff and allied health workers who worked at community health centres (Yin et al., 2016). Recently Pagaiya, Phanthunane, Bamrung,

Noree, & Kongweerakul (2019) used this method for the projection of multi-profession in Thailand health service system by the year 2026. However, the data used was primarily based on curative and rehabilitation services only, and no attention was given to health services related to health promotion, disease prevention and home health care. Failure of health care planners to address the disparities in demands would result in further inequality and perpetuate the status quo (McQuide et al., 2008; Milsom, Jones, Kearney-Mitchell & Tickle, 2009).

This model was based on a few assumptions; (i) the existing demand for healthcare services is sufficient and can be fulfilled by the present number, (ii) the workforce age and sex trend will remain unchanged in the future; and (iii) the volume and demographic specification of workforce shifts after some period due to recent trends observed (Roberfroid et al., 2009).

The strength of this approach is that data required are mostly available, with the assumption that the providers currently deliver services per social standards (Goodman, 2005). Besides, it may capture potential trends of increasing numbers of demands (O' Brien-Pallas, 2001; Dussault et al., 2010; Katz et al., 2009; Roberfroid et al., 2009; Scott et al., 2011; Dussault & Franceschini, 2006).

The main issue with this method is that it ignores the implications of the errors arising from the false assumptions, i.e. the supply, need and demand, economic, political, technological and socio-cultural factors (O' Brien-Pallas et al., 2000). Interestingly, the utilisation of services relies on the stock, and any inaccurate calculation of the service requirements would contribute to changes in the amount of health personnel per capita population (Scott et al., 2011; O' Brien-Pallas et al., 2001). Secondly, the service demand is not well reflected in healthcare services need; it is sort of an indicator of perceived need (Barer & Stoddart, 1991; Birch, 2002; Chan, 2002). Thirdly, the demand-based methodology uses current utilisation rates as a framework

for potential demand estimation (Lee, Jackson & Relles, 1998). Consequently, such an approach may allow injustice and imbalance to the future (Dreesch et al., 2005; Dussault et al., 2010; WHO, 2010). Another drawback is on the assumption that there is no overuse in utilisation trend and that the people only use the volume of healthcare services that are important for preserving or improving their wellbeing (Gavel, 2004). Finally, this approach implies that there is no space for improvement for the population and that the health status is ideal and will be sustained the same way in the future (Goodman, 2005).

2.6.2.4 Service target method

This method calculates the workforce requirements based on the volume and skills for a particular setting (Dreesch et al., 2005). The model extends its coverage to include several unconsidered factors such as costs, public demand for services, accessibility, input from political views, the efficiency of service and the affected population groups (Jaichuen, 2018; Dreesch et al., 2005; Hall & Mej'ia, 1978; Hornby, Ray, Shipp & Hall, 1980). However, this approach assumes that the populations' needs are the same and the providers' efficiency and style of practice are in no heterogeneity (Keet et al., 1990; Dussault et al., 2010).

Apart from being politically appealing and most appropriate to be used at the local setting (Murphy & O' Brien-Pallas, 2002) as well as requiring a flexible and moderate data quality (Scott et al., 2011), the advantages using this method are its simplicity in cost estimation and the segregation of health services into a few components which provides an active strategy to improve the health service (Dussault et al., 2010).

One of the shortcomings of using this method is that it focuses on desires rather than on realities, as judgment errors would consequently occur. In reality, goals, in some cases, are not explicitly stated and may only be a representation of the views of experts;

thus, may suffer from subjective manners (Dussault et al., 2010). Another weak point is that it neglects the heterogeneity of populations and the providers (public-private) (Keet et al., 1990; Dussault et al., 2010).

2.6.2.5 Operational research (OR) and simulation modelling

Operational research (OR) modelling is another type of technique in healthcare workforce planning which is used to authorise decision-making process by individual consumers in various area. OR modelling differs from other workforce modelling as it can test and simulate future scenarios (Garretth, 1999) and capable of representing the real scenario (Pidd, 2003). It is a discipline that aims to provide a rational basis and aid policy makers for decision making by seeking to understand and structure complex situations in improving system performance (Lagergren, 1998; Fone et al., 2003). Priyan (2017) cited that operational research is a term that can be used with mathematical and statistical methods and computer systems, with the goals to quantify various issues of the scenarios in the modelling and handling of the model approach in developing the decisions, plans as well as policies. Based on the literature, the OR approach is categorised into four: mathematical programming (deterministic and stochastic), heuristics, queuing theory, and simulation.

Healthcare OR is not new and has been used since the 1950s, where it offers a systematic approach to aid in problem-solving and also to assist in making a complex decision over complex healthcare issues. Mielczarek and Uziałko-Mydlikowska (2012) in their study concluded the uniqueness of OR modelling in healthcare as compared to other models as it can assist in forecasting broader scopes i.e. from medical decision making, epidemiology, health promotion, prevention program evaluation to extreme events planning. The model also facilitates healthcare system operations and designs.

2.6.2.5.1 Type of OR modelling

OR models can be made of the same or different materials from the system they represent. Models can be iconic (made to look like the real system), abstract, or somewhere in between (Reeb & Leavengood, 1998). Exact models can be full-scale, scaled-down, or scaled-up in size while the other end of the model spectrum can be abstract mathematical models (Figure 2.2).
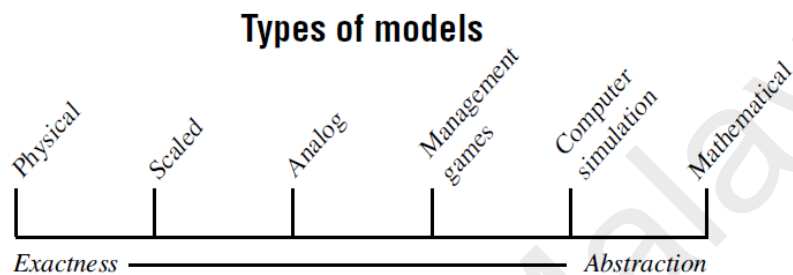
Figure 2.3 Models range from physical to abstract (Reeb & Leavengood, 1998) cited from (Shannon, 1977).

2.6.2.5.2 OR models in healthcare workforce planning

A wide range of OR techniques, such as statistical analysis, queuing theory, linear programming, integer programming and modelling have been used in the broader field of healthcare. Of these, statistical analysis is the most commonly used, followed by simulation modelling (Brailsford, 2008).

Simulation modelling is a tool in science management that uses a computer to make a model in understanding and experimenting with a system that can mimic the changes occur through time in the real system (Pidd, 2003). It can be classified as static or dynamic, deterministic or stochastic, and discrete or continuous (Banks, Carson II, Nelson & Micol, 2001). A static simulation model represents a system at a particular point in time and usually called Monte-Carlo simulation. Whereby, dynamic simulation models represent systems that change as time advances, for example, the inventory

system for a particular time. Besides, simulation models are classified as deterministic, when the inputs are known and exclude randomness as in the SD model, where it mostly uses aggregate values as input variables. While, a stochastic simulation model has one or more random variables as inputs that lead to random outputs i.e. the queuing system in an outpatient clinic, where patients arrive at a random time resulting in a vary waiting times for that individual patient. Another prominent classification is between the discrete and continuous systems that are based on how time is handled in the system. For a discrete system, state variables change in distinct time-steps as in the number of patients attending the emergency department of a hospital, while in a continuous system state variables change continuously as in the amount of water flowing through a pipe. For most systems, one type of change predominates, and it is therefore, possible to classify systems as either discrete or continuous (Banks et al., 2001; Law & Kelton, 2000; Pidd, 2003). Brailsford (2005) highlighted the barriers of utilising OR simulation models in practice in healthcare settings. Moreover, they have also suggested numerous approaches as to how to increase the participation and acceptance of OR simulation among healthcare professionals. A decade later, Salleh, Thokala, Brennan, Hughes and Booth (2017) provided an umbrella review towards multiple systematic reviews that has been published from year 1990 till May 2017. They concluded the number of articles released in that period indicates a growing interest in healthcare simulation modelling. Besides, a wide variety of software tools were used for simulation modelling but within these reviews there were no clear recommendations made. Furthermore, their review justify that the most popular and established simulation approached used in OR are Discrete-event simulation and System Dynamics (Pidd, 2004; Tako, 2008). However, the existing tool specific to quality evaluation of methodology reviews was not addressed hence, blanket recommendation with regards to choosing the most

appropriate method to be used cannot be made as it is heavily reliant on the identified issue.

Most of the time, Discrete-event simulation and System Dynamics methods share a common aim of imitating the real system by examining the variables of interest utilising computer programs for model development and advancement of system purposes (Tako, 2008).

Nevertheless, the variations between SD and DES are several. It is necessary to identify these characteristics as it will direct the modeler in choosing the correct technique to use based on the identified problem. Their individual characteristics are presented below followed by their comparison in differentiating both SD and DES **(Table 2.1).**

2.6.2.5.2.1 Discrete-event simulation (DES)

Discrete-event simulation (DES) model is characterized by the ability to simulate dynamic behaviors of complex systems and interactions between individuals, populations and their environments (Pidd 2004). It examines individual entities and follows them taking part in different processes through a system. In healthcare, patients are the usual entities involved in simultaneous activities in an interdependent queue. For example, when a patient is queuing and waiting their turn to see a doctor, their progress of either being delayed or not in the system is followed. The uncertainty of admission of different entities and the duration of delay along the process will affect the progress. Different output measures are needed to calculate and evaluate the system behaviour (Law & Kelton, 2000). In the DES model, the sources were random; therefore, the central aspect of it includes variability and gains its stochastic nature (Tako, 2008). The use of DES in healthcare is appropriate as it includes the randomness and uncertainty

present in the health system together with input and engagement from the stakeholder via a graphical interface.

The evolution of DES is related to the availability and developments in computing (Pidd, 2003,2004; Robinson, 2005). The first simulation models were developed in the form of computer code in 1960s (Robinson, 2005). Distributed simulation has then emerged over the last 15 years, linked particularly to the idea of running simulation models on the Wide World Web (WWW). It enables the split of a large model across many computers or the link of separate models on different computers, which can be run concurrently (Cassel & Pidd, 2001).

DES has historically been used in manufacturing sector but has been progressively being used recently in the service sector since the 1990s (Robinson, 2005; Tako 2008). Airports, call centers, fast food chains, banks, health care and corporate processes are some of the main DES applications. While computing advances have influenced innovations in DES modeling to a large degree, Robinson brought attention of the problems that may arise, including the emergence of broad and complicated issues, with a turn-on impact on model quality as well as to a lack of a broader DES modeling methodology (Robinson, 2005). There are various types of DES packages on the market, such as: Simul8, Arena, Promodel, Simio, Anylogic, and Flexsim used for simulation modelling (Robinson, 2005).

2.6.2.5.2.2 System Dynamics (SD): The choice of selection

System dynamics is an analytical modelling approach and a methodology for studying complex feedback systems, the foundations of which were laid in the late 1950s at Massachusetts Institute of Technology by Forrester (1968) in his pioneering work on industrial dynamics. Essentially, it is an aid to understanding the behaviour of complex systems over time (Lane, 2000). The key features of SD, as stated by Williams and

Harris (2015) are that it; i) models the problem issue or evaluation questions, ii) assumes endogenous causes of the problem, iii) assumes events are part of patterns which are generated by structures, iv) places importance on problem boundary selection, v) places more importance on extent in time and space than on detail and vi) involves hypothesis testing. SD describes how the behaviour and relationships of separate components of a system contribute to the behaviour of the system as a whole. In other words, the fundamental principle of SD is that *structure determines behaviour*. Such emergent behaviour can often be counter intuitive. Therefore, it is only by the studying and analysing of the component parts that the reasons for this "unexpected" behaviour can be understood (Brailsford, 2008).

The SD approach is useful in allowing relatively rapid modelling to be carried out in a generally intuitive manner to clarify the complexities of a system. It answers questions that may have been overlooked by those using other modelling approaches and enables various pieces of incomplete information to be put together to allow systematic extrapolations to be made based on current knowledge and belief (Sterman, 2000). Besides, as stated by Forrester (1968), SD models are learning laboratories, and it provides a natural learning environment, reflecting the dynamic nature of any system.

In addition, the SD model allows scenario testing where it uses different values in the parameter of the model which causes changes in forecasting, particularly of the supply model (Imison et al., 2009). To illustrate the model modes of behaviour, "what if" scenario can be use to test different policies (Sterman, 2000). Comprehensive observations from different data serve as a primary tool to induce "designated improvements" to the model (Rich, 2015) provided a 'principal prediction' or 'anticipated future' through scenarios. The model was also suggested by the FDI and Center for Workforce Intelligence to be used in different works that meet the goals of any venture (FDI Dental Practice Committee, 2005).

SD has two aspects, one qualitative and one quantitative. The qualitative aspect is a diagramming approach which involves mapping the causal relationships between pairs of elements within a system and then identifying feedback loops which drive certain types of behaviour. These loops can explain unintended consequences and can be either balancing (maintaining the status quo) or reinforcing ("vicious circles") which can cause a system to spiral out of control. The feedback loop also acts as one of control system where the output is fed back to the system (Sterman, 2000). The quantitative aspect involves the development of stock-flow models, which are essentially compartmental differential equation models which are solved numerically by discretisation.

In projecting Australia's health workforce by 2025, Crettenden et al. (2014) found the stock-and-flow methodology best suited their purpose. They analyzed their model's sensitivity to variables such as innovation, reform, and immigration, and assessed how future changes would differ in outputs such as future workforce shortages. A limitation of stock-and-flow models is that they depend heavily on computerized analytical solutions. However, this approach is the basis for system dynamic modelling to be considered as one of the most powerful simulation tool.

The distinguishing characteristic of many models including Discrete Simulation Of Events (DES) is in its ability to explain and provide feedback on causal relationships and also simulates wider and complex issues, including evaluation of different and various scenario in policy testing (Meadows, 1980; Wolstenholme, 1999; Coyle, 1997; Tako, 2008). Furthermore, in scenarios where key variables cannot often be quantified and where there is no single optimal solution, system dynamics is a valuable tool (Royston, 2016; Freebairn, Atkinson, Kelly, McDonnell & Rychetnik, 2018; Marshall et al., 2015). Table 2.1 illustrates the conceptual differences between SD and discrete-event simulation, as suggested by Lane (2000) cited in Koelling and Schwandt (2005).

Table 2.1: Conceptual differences between DES and SD

Concept	DES	SD
Perspectives	Analytic; detail complexity as it is appropriate for an operational level with a narrower perspective and more specifics	Holistic; dynamic complexity where it demonstrates the connection of the overall system
Resolution of models	Takes in comprehensive and individual values	SD method utilises aggregate value clustered into similar characteristics; homogenised entities
Data resources	Essentially quantitative with certain elements of judgment	Widespread and possess qualitative data which can be quantitatively transformed by applying numerical value
Problem studied	Developed to overcome event problems or symptoms and try to find solutions in the short term at operational level	Looking at modeling a problem pattern to find the root causes and is attempt to fix it in the long run. This technique is therefore used to model long term issues at strategic level.
Model items	Physical, tangible and some informational	Physical, tangible, judgmental and information links
Human agents represented in model as	Decision makers	Rational policy implementers
Clients find the model	Opaque/dark grey box, nevertheless convincing	Transparent/fuzzy glass box, nevertheless compelling
Model outputs	Points forecasts and detailed performance metrics across a variety of criteria, principles of decision, and scenarios while modelling the "process".	Understanding systemic behavioral source, identifying main performance indicators and successful policy levers while modelling the "system".

Specialised computer software is required to perform SD, and a number of commercial packages are available. The software tools are generally based on mathematical equations such as the Euler algorithm or Runge-Kutta algorithm (Houcque, 2005). Vensim and Stella are the popular packages used for SD modeling (Vensim, 1985, Stella Systems, 1987), grounded in the fields of cybernetics,

engineering and organizational theory (Meadows, 1980). Technically, the grouped differential equations can be solved by Vensim and other system dynamics. SD software is known to support continuous simulation depending on how it is ideally adapted to circumstances where the plurality of variables continuously change (Vensim, 1985).

SD model development involve five stages as depicted in Figure 2.3. It is characterized as a repetitive process where it undergoes a constant process of modelling, testing and refinement (Sterman, 2000). The framework has been widely used by many researchers as shown in Table 2.2.
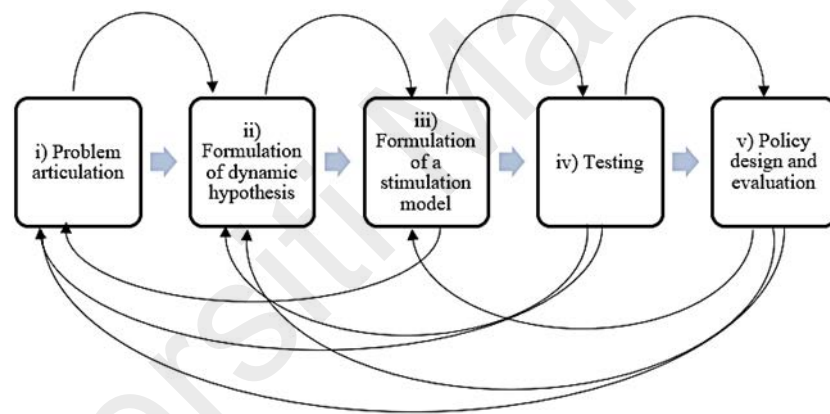
Figure 2.4: Steps in SD modelling process

Table 2.2: Examples of the utilisation of system dynamic modelling

Fields	Authors	Application
Business management	Kiani, Shirouyehzad, Bafti and Fouladgar (2009)	Analysing the impact of quality costs in a manufacturing company in Iran.
	Adiweno, Zagloel and Ardi, (2018)	Highlight the economic and environmental prospects of the halal supply chain in third party logistic company industry in Indonesia.
Ecotourism	Lola et al. (2017)	This study provides a framework for ecotourism growth and analysis and examines the dimensions of ecotourism's socio-economic and environmental implications in communities surrounding Tasik Kenyir in Terengganu, Malaysia.
Insurance	Mohamad, Tumin, Noor, Saman, and Amin (2018)	Identifying the potential internal and external implications in the hypotheses used to assess the contributors' participation levels.
Engineering	Mamter, Aziz and Zulkepli, (2017)	Create a systematic model identifying the emergence of root causes contributing to poor acceptance in Building Information Modelling (BIM).
	Pluchinotta, Pagano, Giordano, and Tsoukiàs (2018)	Investigate how various actions can affect the decision-making processes of various stakeholders in the concepts of Interaction Space (IS).
Healthcare	Rwashana, Williams and Neema (2009)	Capturing the complex and dynamic nature of the immunisation process and testing its efficacy using a case study of Ugandan health care.
	Samah et al. (2014)	Projecting and analysing the provision of dentists at public-private health care providers in Malaysia between 2015 and 2030.
	Che Musa (2017)	Projecting and analysing the provision of dentists at public-private health care providers in Malaysia between 2015 and 2040. This study incorporating the view of key stakeholders and final year students in Malaysia
	Abas et al. (2018)	Projecting the nurse supply in Malaysia through the development of a nurse simulation model using System Dynamics as part of the needs-based approach

Education	Altamirano and Van Daalen (2004)	Assist Nicaragua 's National Ministry of Education in the education system, where the model showed that the number of illiterate people will be doubled in the future without if no changes done in the education policies
	Al Hallak, Ayoubi, Moscardini and Loutfi (2019)	Construct appropriate simulation models to assess the diverse and complex interactions between student flow pattern, staff ratios and private higher learning facilities in Syria.

The use of a system dynamics model in the healthcare setting is continually increasing in the literature but the practical impact of the OR simulation in healthcare settings has not been as high as expected. Jahangirian, Taylor, Eatock, Stergioulas and Taylor (2015) in their study reported that the main factors of the low uptake in healthcare simulation projects were poor communication between simulation and stakeholders' group. These were led by 'bad managerial support,' 'heavy workload of clinicians' and 'failure to achieve measurable and rapid outcomes.'

A few examples of simulation models in various fields are shown in Table 2.1 to show SD's versatility and ability in addressing dynamic and highly interdependent systems. Hence, considering our research aim, SD is a more suitable technique to be used and was selected for multiple reasons cited above, as compared to DES.

CHAPTER 3: METHODOLOGY

This study includes Phase 1 and Phase 2. In Phase 1, observational quantitative cross-sectional study design was used towards three different populations namely, (1) the Malaysian dental therapist, (2) parents of the schoolchildren, and (3) the private dentists. Findings from these three studies were then used in Phase 2 which involved the use of system dynamic modelling and scenario planning of the future dental therapist workforce.

Details of each study are presented as follows.

PHASE 1: MATERIALS AND METHODS

3.1   Study 1: The Malaysian dental therapists' awareness on Therapist Division in the Dental Act 2018, and their job motivation, job satisfaction, intention to leave and perceptions towards being employed in the private practices.

3.1.1   Study design

This was a cross-sectional study using a self-administered questionnaire distributed to practising dental therapists in the Ministry of Health Malaysia (MOH).

3.1.2   Study period and study population

Data collection was conducted from July until August 2019. The number of active dental therapists in 2019 was 2816. This study included all dental therapists working at the Ministry of Health with the exclusion of those who has retired, worked on a contract basis, worked in the Universities as well those who were on extended leave, maternity leave or were attending courses during the data collection period.

3.1.3 Sample size calculation

Using a single proportion sample size formula; $n = N*X/ (X + N - 1)$ (Daniel, 1999), for accuracy level of 0.95 with a margin error of $\pm 5.0\%$, for an approximately 2816 Malaysian dental therapist nationwide, the sample size needed was 407. A 20% dropout rate was estimated during the study period and a design effect of 2 and therefore, the minimum sample size required was 814 dental therapists.

3.1.4 Sampling method and technique

Probability sampling using stratified random sampling technique (Table 3.1) was employed. Firstly, states in Malaysia were divided into five geographical regions (four from Peninsular and one from West Malaysia). This was to ensure geographic representation of the participants (Wong, George &, Tan, 2011). From here, one state was randomly selected from each region. There were 1148 out of 2816 dental therapist in these five selected states (Oral Health Program, 2018). Then, the proportionate to size technique was adopted for sampling from each state. The sampling sites in the districts include all hospital, dental clinic and district dental office.

Table 3.1 Stratified random sampling technique

No.	Region	States	State selected through random process	Facilities involved	Primary Sample unit
1	North	Perlis, Kedah, Pulau Pinang	Pulau Pinang	Hospital / Dental clinic/ state @ district dental office	Dental Therapist
2	Centre	Selangor, FT Kuala Lumpur and Putrajaya, Perak	Selangor		
3	South	Johor, Melaka, Negeri Sembilan	Melaka		
4	East	Terengganu, Kelantan, Pahang	Kelantan		
5	East Malaysia	Sarawak, FT Labuan, Sabah	Sarawak		

Proportionate to size technique (Table 3.2) was adopted for the sampling of the participants from each state as follows:

$$\frac{\text{Total number of dental therapists of each state}}{\text{Total number of dental therapists in 5 states}} \quad X \ 814$$

Table 3.2: Numbers of dental therapist estimated in this study

State	Total number of Dental therapists	Proportionate number needed
Selangor	240	170
Pulau Pinang	201	143
Melaka	102	72
Kelantan	198	140
Sarawak	407	289
TOTAL	1148	814

3.1.5   Study instruments

3.1.5.1   Self-administered questionnaire

The questionnaire was drafted based on literature reviews and discussions with the experts. The followings are sections and items used in the questionnaires:

A. Demographics and current working practice

This section consisted of four questions pertaining to the respondent's demographical profile (age, ethnicity, place of practice and qualifications) and five questions related to their employment (years in service, grade, post-basic qualifications, daily working experience and their current posting) (Table 3.3)

Table 3.3: Items definition and its measurement

Conceptual definition	Operational definition	Scale of measurement	Unit
I) Sociodemographic profile			
Age	Age as last birthday	Continuous	Years
Ethnicity		Nominal	1 – Malay 2 – Chinese 3 – Indian 4 – Others
Place of practice	Place of working	Nominal	1 – Dental clinic 2 – Hospital 3 – Others
Highest level of education	Level of education	Nominal	1 – Diploma 2 – Degree 3 – Masters/PhD
II) Employment profile			
Years in service	Years working in the government sector	Continuous	Years
Grade	Grade system in MOH based on years in service	Ordinal	1 – U29 2 – U32 3 – U36 4 – U38 5 – U40
Undergone post-basic training	A continuous two-year training after gaining some experience in the MOH service	Ordinal	1 – No 2 – Yes
Current workplace	Placement of their posting/current workplace	Ordinal	1 – Applied for this current placement 2 – Posted
Percentages of working hours	Hours spent daily in the workplace	Ordinal	1 – Paperwork / administrative 2 – Clinical practice 3 – OHE

B. Awareness of the establishments of Therapist Division under the Dental Act 2018.

Questions were developed based on the provisions described in the Dental Act 2018. Items asked are shown in Table 3.4. Both positive and negative statements were used to increase respondents' alertness and to avoid them giving the same response (Roszkowski & Soven, 2010). A "Yes", "No" or "Do not know" response options was employed. The "Do not know" option was offered to cater the possibility of non-response from the respondents and to avoid them from being forced to answer the items asked (Groothuis & Whitehead, 2002). Few researchers have suggested that a "Do not know" is more likely to be a No than a Yes (Haener & Adamowicz,1998; Carson et al., 1998).

Table 3.4: Questions assessing the dental therapists' awareness towards the Dental Act 2018

No.	Question*	Response key	Type of statement	Correct answer (Awareness)
1	There is a provision of the Therapist Division.		Positive	0 – No /Do not know 1 – Yes
2	To be able to practice, a dental therapist must register themselves with the Malaysian Dental Council.	1 – Yes 2 – No 3 – Do not know	Positive	0 – No /Do not know 1 – Yes
3	Dental therapists can only treat patients aged below 17 years old.		Negative	0 – Yes / Do not know 1 – No
4	Dental therapists are allowed to work at a private dental clinic		Positive	0 – No /Do not know 1 – Yes
5	Dental therapists must work under the direct supervision of a dentist.		Positive	0 – No /Do not know 1 – Yes

6	A dental therapist can make a treatment plan on her own.		Negative	0 – Yes /Do not know 1 – No
7	Dental therapists can place fissure sealant on adults' patients.		Negative	0 – Yes /Do not know 1 – No
8	All dental therapists can perform subgingival scaling on their patients.		Negative	0 – Yes /Do not know 1 – No
9	A dental therapist can take dental X-Ray as per instructed by the dental surgeon		Negative	0 – Yes /Do not know 1 – No
10	Dental therapists can be fined if intentionally practising dentistry with individuals who do not have a valid dental practising certificate.		Positive	0 – No /Do not know 1 – Yes

Source: Dental Act, 2018

C. Job Satisfaction, Job Motivation and Intention to Leave

i. Questions Regarding Job Motivation and Job Satisfaction

The Warr-Cook-Wall (WCW) Scale (Warr, Cook & Wall, 1979) was used to assess job motivation (JM) (6 items) and job satisfaction (JS) (16 items). The scale was developed to provide a short, reliable, valid, and easy-to-use measure of work-related attitudes and has been used extensively among various disciplines of healthcare workers (Warr et al., 1979). All the items have seven-point Likert type rating scales. However, the Likert scales have been reduced to 4 and the neutral point has been omitted for this study in order to give more informative results and enable participants to express their opinion on the issues asked (Chyung, Roberts, Swanson & Hankinson, 2017; Garland, 1991). The degree of responses ranges from "completely dissatisfied" (score 1) to "completely satisfied" (score 4), with 4 being the most positive response in each case.

Table 3.5 shows the items used in this WCW scale. Modification and rephrasing were made to some of the items, based on experts' advice, to illustrate a more fundamental understanding of the meaning in the local context. The change can be seen in the job satisfaction scale item 9 "Industrial relations between management and

workers in your firm" that was rephrased to "Working relations between management and workers in your health centre". These changes were also incorporated by a study among healthcare professionals in Malaysia (Chew et al., 2013).

Table 3.5: Items in WCW scale

No.	Item*	Response
Job Motivation		1 – Completely disagree
1	I feel a sense of personal satisfaction when I do this job well	
2	I'm disappointed with myself if I do this job badly.	2 – Disagree
3	I take pride in doing my job to the best I can	3 – Agree
4	I feel unhappy when my work is not up to my usual standard	4 – Completely agree
5	I want to feel satisfied when I look back at the work I did on that day.	
6	I try to think of ways of doing my job effectively	
Job satisfaction: How satisfied are you with…		1 – Completely dissatisfied
1	Your physical work conditions	
2	Your fellow workers	2 – Dissatisfied
3	Your immediate boss	3 – Satisfied
4	Your rate of pay	4 – Completely satisfied
5	Your working relations between management and workers in your health centre	
6	The way your workplace is managed	
7	Your job security	
8	Your freedom to choose your own method of working	
9	The recognition you get for good work	
10	The amount of responsibility you are given	
11	The opportunities to use your abilities	
12	Your chance of promotion	
13	The attention paid to suggestions you make	
14	The amount of variety in your job	
15	Your hours of work	
16	Now, taking everything into consideration, how do you feel about your job as a whole?	

Source: Warr – Cook – Wall (1979)

ii. Questions Regarding the Intention to Leave

Table 3.6 shows the items used which was adapted from the literature (Turner et al., 2012; Forbes et al., 2014). Participants' intention to leave was assessed on a 4-item scale based on a cognitive process which includes "thinking of quitting", "intention to search", "intention to quit" and "plan to quit profession". In this study, the Likert scale has been reduced to only four scales from a 9-point Likert scale ranging from 1 ('completely disagree') to 4 ('completely agree') and the neutral point was omitted.

Table 3.6: Items used in intention to leave scale

No.	Item	Response	Regroup
1	I often think about leaving this post.	1 – Completely disagree	1 – Disagree
2	I will probably look for a job at a new organisation in the next 12 months.	2 – Disagree	2 – Agree
3	As soon as I can find another job, I will leave this post.	3 – Agree	
4	I plan to leave the profession of dental nurse for a different career.	4 – Completely agree	

D. Perceived Employment in Private Dental Practice

Table 3.7 describes the questions used in this section which aimed to assess participants' perceived employment in private dental practice. It was developed based on discussion with the experts and through literature review (Gallagher, Clarke & Wilson, 2008; Gallagher, Patel & Wilson, 2009). Questions were in the form of close-ended type and used a 4-point Likert scale from 'Strongly Agree' (Score - 1) to 'Strongly Disagree' (Score - 4).

Table 3.7: Question assessing dental therapists' perceived employment in the private sectors

Sub domain	No	Item	Response key
Future role in dentistry	1	Expected role in 5 years' time	1 – Dental therapist 2 – Post basic dental therapist 3 – Others
	2	If 'Others', what is the possible reason(s)?	1 – Want a career break 2 – Pursue a different career 3 – Need more experience before deciding on career path 4 – I don't want to work 5 – Family commitment 6 – Pensions / retirements 7 – Don t know 8 – Others
Sector they forsee working in the next 5 years	3	Sector they foresee working with in the next 5 years	1 – Public (Government) 2 – University (Government) 3 – Private (clinic/ university) 4 – Others
	4	If they choose to work at private sector, which type of dental treatment they prefer to provide to the patients	1 – Giving oral health instruction 2 – Carry out Class I, II, III and V restorations 3 – Extraction of primary teeth 4 – Placement of fissure sealant 5 – Application of topical fluoride and gel 6 – Scaling and polishing

Long term plan for work	5	Perception and plan to work full-time or part-time in dentistry in the long term	1 – Full-time 2 – Part-time 3 – Undecided 4 – Others
	6	Number of **sessions per week** they envisage working in dentistry in the long term	1 – 10
Factors influencing working hours	7	a) Childcare commitments	1 – Very important 2 – Important 3 – Not very important 4 – Not Important
		b) Other family commitments	
		c) Financial stability	
		d) Balance of work and life	
		e) Range of work (variety)	
		f) Want to pursue other interests	
		g) Professional development	
		h) Other	

3.1.5.2   The validity of the instrument

a) Face and content validity

The questionnaire used in this study which aimed to assess different study objectives was validated by two Dental Public Health Specialists (DPHS) through face and content validity processes. Both the DPHS were asked to assess if the questionnaire adequately covered the study objectives and to see the validity used on the target population. The comments and feedback received from these experts involved only grammatical modification (Appendix A). A minor adjustment was made and the questionnaire underwent a linguistic translation process.

3.1.5.3   Linguistic translation process

The questionnaire then underwent a forward and backward translation processes based on the guidelines provided by Acquadro, Conway, Giroudet and Mear (2004) and Wang, Mayer, Ottawa and Wippert (2015).

Step 1: Forward translation

The English version of the questionnaires developed was translated into the Malay language by two independent translators who were native speakers and were fluent in the English language. The first translator was a Chinese schoolteacher who taught English subject to primary school children while the second translator was a Malay Linguistics graduate from the University of Technology Mara (UiTM) who had experiences in translating documents on social sciences and behavioural aspects. It is important to have at least one translator who is familiar with the concepts involved in the research to be able to produce a meaningful interpretation of the instruments (Van Widenfelt, Treffers, De Beurs & Koudijs, 2005). According to Hambleton, Merenda and Spielberger (2004), translators from different background and ethnicity will ensure that the translated version is understood by various ethnic groups.

The researcher briefed both the translators about the objectives of this process and guidelines on the process was provided. Initially, they worked independently and once the translation was completed, a session was held whereby both translators and the researcher met and decided on the agreed translated version of the instrument.

Step 2: Backward translation

The agreed version of the forward translation document then underwent a backward translation process by another two independent translators. The first translator was a retiree senior dental therapist of three years who had vast experience in dentistry, and the second translator was a Chinese postgraduate student of Sultan Idris Education University (UPSI) who had the experience in translating survey questionnaires in both

targeted languages. The process applied the same as in the forward translation step mentioned previously.

Step 3: Committee review

The agreed version of the backward translation was presented to a committee consisting of two dental public health specialists. The difficulties encountered during the processes were put forward and discussed. Only minor changes were required, and no further adjustments were needed in the documents of both languages. The original English version, the forward Malay version and the agreed backwards translation version are presented in Appendix B.

3.1.5.4   Pretest of the questionnaire

The instrument was then pretested among 12 dental therapists using guidelines specified by Dillman (2000) and Bradburn, Sudman and Wansink (2004). The participants were asked on their understanding of the questionnaire, the clarity of each item, whether any sensitive question was present, and the relevance of each item as well as to provide their feedback should they have any. All responses were positive and only one participant gave further comment, but it was irrelevant to this research topic (Appendix C).

3.1.5.5   Pilot study for reliability and validity testing

A pilot study was conducted among 125 dental therapists who were working in the Federal Territory of Kuala Lumpur and Putrajaya (FTKL&P) in the Ministry of Health to assess the reliability and validity of the instrument. The permission to conduct this exercise was obtained and granted by the Dental Deputy State Director of Health (TPKNG). The ethical permission to conduct this pilot study was obtained from MOH Research and Ethics Committee (MREC).

The items for job motivation, job satisfaction and intention to leave scale used in this survey underwent reliability and validity testing. Reliability testing was conducted to assess the internal consistency of the items in the construct. It was measured using Cronbach's alpha and Corrected Item-Total correlation (CITC). For this exercise, the Cronbach alpha coefficient measured in the instrument was 0.86 for job motivation, 0.83 for job satisfaction and 0.91 for intention to leave. While CITC ranged between 0.49 – 0.77 for job motivation, 0.23 – 0.61 for job satisfaction and 0.79 – 0.85 for intention to leave. Cronbach's alpha value of more than 0.7 and CITC more than 0.3 was considered as having good internal consistency (Nunnally, 1978).

As for validity testing, exploratory factor analysis (EFA) was conducted using SPSS version 22.0 and based on Hair (1998) a total of 100 or more participants were adequate to run the analysis. The highest correlation for each item with at least one other item was between 0.53 to 0.84 for job motivation construct, 0.27 to 0.71 for job satisfaction construct and 0.83 to 0.90 for intention to leave construct. By using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, the score for job motivation was 0.79, job satisfaction 0.78 and intention to leave 0.84. All the instruments exceeded the recommended value of 0.6 as the minimum value for good factor analysis (Tabachnick & Fidell, 1996).

3.1.5.5.1 Test-retest reliability analysis

Two weeks following the pilot exercise, a test-retest exercise was conducted on the same dental therapists (n=40) to check for the reliability of the instruments. Kappa statistics was employed for the categorical outcome that was relevant to binary ratings and intraclass correlation was employed for continuous scale (Fleiss & Cohen, 1973). Cohen's kappa, k was used to measure the agreement between two-time points on the response for an item. If in the complete agreement, the kappa is equal to 1 (Cohen, 1960). Table 3.8 shows the Kappa values obtained were generally moderate (mostly greater than 0.40) for job motivation, job satisfaction and the intention to leave.

Table 3.8: Kappa score for the reliability of the instruments (n=40)

Items	Kappa	95% CI	Intraclass correlation	95% CI
Job motivation				
(1) I feel a sense of personal satisfaction when I do this job well	0.36	0.08-0.65	0.57	0.20-0.78
(2) I'm disappointed with myself if I do this job badly.	0.59	0.36-0.83	0.80	0.62-0.89
(3) I take pride in doing my job to the best I can	0.43	0.16-0.70	0.68	0.39-0.83
(4) I feel unhappy when my work is not up to my usual standard	0.69	0.43-0.94	0.75	0.53-0.87
(5) I want to feel satisfied when I look back at the work I did on that day.	0.37	0.07-0.67	0.57	0.19-0.77
(6) I try to think of ways of doing my job effectively	0.43	0.14-0.72	0.62	0.27-0.80

Job satisfaction				
(1) Physical work	0.48	0.16-0.80	0.54	0.13-0.76
(2) Teammates	0.30	0-0.65	0.46	0.02-0.72
(3) Immediate boss	0.38	0.02-0.74	0.64	0.32-0.81
(4) Pay rate	0.49	0.25-0.73	0.77	0.57-0.88
(5) Relationship in workplace	0.41	0.09-0.73	0.60	0.17-0.77
(6) Well managed workplace	0.59	0.31-0.86	0.81	0.63-0.90
(7) Job safety	0.35	0.03-0.68	0.65	0.34-0.82
(8) Freedom to work	0.48	0.16-0.80	0.58	0.21-0.78
(9) Acknowledgement	0.44	0.14-0.74	0.79	0.61-0.89
(10) Work responsibilities	0.59	0.34-0.84	0.81	0.63-0.90
(11) Chances to use abilities	0.50	0.13-0.87	0.71	0.46-0.85
(12) Promotion opportunity	0.61	0.35-0.87	0.79	0.60-0.89
(13) Appreciation of suggestion	0.38	0.02-0.73	0.65	0.34-0.81
(14) Job variety	0.60	0.30-0.89	0.80	0.62-0.89
(15) Work hours	0.60	0.30-0.89	0.80	0.62-0.89
Intention to leave				
1) I often think about leaving this post.	0.30	0.05-0.56	0.79	0.60-0.89
2) I will probably look for a job at a new organisation in the next 12 months.	0.35	0.10-0.61	0.75	0.53-0.87
3) As soon as I can find another job, I will leave this post.	0.35	0.10-0.60	0.80	0.61-0.89
4) I plan to leave the profession of dental therapist for a different career.	0.39	0.04-0.53	0.81	0.64-0.90

Following these exercises, the questionnaires was sent to the experts for revalidation (face and content validation). The final questionnaire was then ready for distribution to the participants.

3.1.6   Conduct of the study

An official letter was sent to the Director, Oral Health Program, Ministry of Health, to seek permission to conduct the study. Once the permission was obtained, a letter to notify the Dental Deputy State Director of Health with regards to this study was sent.

Since this study was conducted in the MOH facilities and involved the MOH personnel, the registration of this study was required under the National Institutes of Health (NIH) (NMRR-18-3736-45157). Approval by the MOH Research and Ethics Committee was also obtained (NMRR-18-3736-45157(IIR)).

The questionnaire was distributed through an online medium. The information sheet containing simple and understandable instructions were provided together with the consent form as a front cover of the questionnaire. Potential participants were informed that participation in the study was voluntary and that all information would be treated as confidential. This study was conducted in multiple states in Malaysia and due to budget constraint for travelling, written consent was not sought from the participants. However, obtaining informed consent online is not substantially different from obtaining it via paper presentation (Varnhagen et al., 2005). The goal of the informed consent process is to provide sufficient information so that a participant can make an informed decision about whether or not to enroll in a study or to continue their participation. For this survey, a statement indicating the agreement of the participants' participation has been included on the first page (the information page) and the return of the completed questionnaire implied consent for use of the data in this research study. Their withdrawal in the midway of this survey would not affect anything as any data they had entered would be destroyed.

Next, the head matron of each state was contacted to assist in conveying the survey link to their subordinates via their clinic/ workplace official email addresses. Participants were given two weeks to complete the survey. They were reminded in a week interval to submit their response which was connected into an online database. All the collected data were automatically uploaded in the google drive and were then converted into SPSS file. The data collection period took two weeks from the day of questionnaires distributions (Appendix D).

3.1.7   Data management and statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences version 22.0 (SPSS; Chicago, IL, USA). The converted data was checked for completeness and only completed questionnaire were included in the analysis. This approach was taken as most statistical techniques are designed for complete data (Schafer & Graham 2002) where failure to correctly edit the data could make the data unsuitable for a statistical procedure and statistical analysis exposed to assumption failures. Descriptive analysis was done on the socio-demographic characteristics. Normality test performed for continuous data by using Kolmogorov-Smirnov goodness-of-fit test and taking the value of skewness and kurtosis into account. Values of $p<0.05$ were considered significant.

1) The Awareness of the Provision of the Dental Act 2018

There were ten questions related to this objective, which were made of five positive statements and five negative statements. For each question, any correct answers given were scored "1" as "aware" whereas the incorrect and "Do not know" responses were scored "0" as "unaware".

The total score was the sum of all the scores obtained from each question in this section. The total possible score is 0-10, with higher scores indicating a higher level of awareness towards the Dental Therapist Provision stipulated in the Dental Act 2018. The mean for the total awareness score for the dental therapist was then calculated.

2) Job motivation and job satisfaction.

The total job motivation and job satisfaction score for each statement was 4. The total score for the scales were summated and obtained, and it ranged between 4-24 for job motivation. As for job satisfaction, items number 1 to 15 were summated, and the score obtained should range between 6-60. Item number 16 assessed the overall job satisfaction, and a high score demonstrate a high motivation and satisfaction.

3) Intention to Leave

Some of the categories in the 4-point scale had low counts and did not meet the requirements of a chi-square test, hence the 4-point Likert-type data were converted to a 2-point scale (0 = completely disagree and disagree, 1 = agree and very agree). The intention to leave score for each statement was 1 point. The total score for the scales were summated and obtained, and it ranged between 0-4. A score of 1 was determined as the cut-off point for having low intention to leave based on the median of the total intention score. The total intention to leave score was grouped into 2 categories: low intention (scores 0-1) and high intention (scores 2-4).

4) Determination of Predictors

Association between the dependent variable (level of intention to leave) and independent variables (participants' characteristics, awareness score, job motivation score, job satisfaction score, their expected role and the sectors they foresee to work in the next five years) were assessed using both univariate and multivariate analysis.

Initially, the selection of potential predictors for dependent variables was made by analysing all independent variables using simple logistic regression and the crude odds ratio was estimated with 95% confidence interval. All the variables that had a p-value of less than 0.25 were included in multivariate analysis (Greenland, 1989).

Both forward stepwise variable selection methods were used to obtain a preliminary main-effect model. Only the variables that had a p-value less than 0.05 were selected and subsequently analysed further with multiple logistic regression using the enter method to obtain preliminary final model. All significant interaction variables were analysed and assessed using multiple logistic regression. None of the interaction variables was found to be significant at p-value of 0.05, thus were excluded from the model.

The significance of the model was tested by applying the likelihood ratio test with the maximum likelihood estimate. Fitness of the model was tested using three different methods: Hosmer-Lemeshow goodness of fit test, the classification table and the Receiver Operator Characteristic curve. The final model was determined by using the enter method. The adjusted odds ratio was estimated with 95% confidence interval. A p-value of less than 0.05 was taken to be statistically significant.

3.2   Study 2: Parental acceptance of dental therapist employment in the private practices

3.2.1   Study design

This was a cross-sectional study using a quantitative method and was designed to assess the parental acceptance of dental therapist employment in the private dental practices.

3.2.2   Study period, study area and study population

3.2.2.1   Study population

According to the Malaysian Medical Council (2017), individuals under the age of 18 years old are considered not competent to give medical consent. This indirectly indicates that these individuals are not capable of making decisions relating their health care. Parents are considered to be appropriate surrogate decision-makers for their children, and they undoubtedly will act to the best interests of their child (Canadian Paediatric Society, 2004). In this study, parents of children aged 11 years old who were attending public schools were invited to act as a proxy for their children in making dental care decisions with regards to the utilisation of dental therapists in private dental clinics. This age group was chosen because students aged 11 years old have had adequate exposure to the dental therapist under the school dental service. Furthermore, they were in the middle years when they would soon be going to secondary schools. As a 11-year-old schoolchild, they are not involved in any national examinations and this was also a critical criterion highlighted by the Ministry of Education when involving school children to be part of any survey to be conducted in their facilities (Ministry of Education, 2018).

3.2.2.2   Study period and study area

Data collection was conducted from February until May 2019 in the state of Selangor which is located in the centre of Peninsular Malaysia and bounded by Perak, Pahang, Negeri Sembilan and the Straits of Malacca. There are nine distinctive districts in Selangor which comprises of five urban districts and four rural districts (Department of Statistic Malaysia, 2010b). Petaling is the most central and urban, easily reachable from Gombak, Klang and Sepang. Sabak Bernam, Kuala Selangor and Hulu Selangor are up north, while Kuala Langat and Hulu Langat lie further south. Due to cost and time constraint only, public schools were selected. There were 278 secondary schools in Selangor, which are under the jurisdiction of the Ministry of Education.

Selangor houses the Malaysian capital city, Kuala Lumpur and 20% of Malaysian population resided in Selangor (Department of Statistic Malaysia, 2011). This state was selected as the reference sample in this study because of its highest population density and largest number of dentists per state, with a dentist-to-population ratio of 1:4118.8. The number of government schools accounts for around 98.5 %of all Malaysian schools (Educational Planning and Research Division, 2019). Given the challenge of collecting a full list of students for sampling purposes of private schools and the fact that the percentage of private schools was just around 1.5%, the study team agreed to exclude private schools from the sample. Since the percentage of private schools was very small, this omission was considered to have little substantial impact on the results. Furthermore, various national survey also omitted private school considering small sample (Yusof et al., 2014).

Source: selangor.gov.my

Figure 3.1: Map of State of Selangor

3.2.3 Inclusion and exclusion criteria

Inclusion criteria:

- All school children aged 11 years old who attended the selected schools during data collection

Exclusion criteria:

- Non-citizen
- School children who went to boarding schools
- Schoolchildren who have been on an extended medical leave

3.2.4 Sample size calculation

The minimum sample size required was 960 and the calculation was based on the expected prevalence of acceptance towards the use of dental therapists in the UK (Dyer et al., 2010), a margin of error of 5%, 95% confidence interval, 20% probability of non-response, and a design effect of 2 (Table 3.9).

Table 3.9: Variables and estimated sample size

Parents' acceptance of treatment provided by dental therapists for children		
Type of treatment*	**Proportion indicating positive acceptability**	**Estimated sample size**
'Carry out fillings'	47	383
'Give you injections to make your teeth and gums go numb.'	48	384
'Extract children's milk teeth.'	44	379
'Put preventive coatings on children's teeth	69	329
'Give health education and prevention advice.'	82	227

*Source: Dyer et al. (2010)

3.2.5 Sampling method and technique

This part of the study employed a multistage sampling method as illustrated in Figure 3.2. First, the state of interest was divided into urban and rural clusters, where there

were five districts in the urban cluster and four districts in the rural cluster (Department of Statistic Malaysia, 2010b). Only one district was randomly selected from each cluster based on a high population density. The total number of schools in the chosen urban district (Hulu Langat) was 60 with a total student enrolment of 9947.

For the rural district (Kuala Selangor), the total school number was 35 with a total student enrolment of 3592 (Table 3.10). Only schools with a total enrolment of 1500 schoolchildren or more were included for a better logistic management, and this resulted in only 17 schools in the urban cluster and five schools in the rural cluster fitting the inclusion criteria. In the next stage of sampling, five schools and two schools were randomly selected to ensure representativeness. The weightage was based on the distribution of the population in urban and rural areas in Malaysia (Department of Statistic Malaysia, 2010a).

From each selected school, six classrooms were randomly selected where 30 children were randomly selected from each class. All parents of selected schoolchildren who fulfilled the inclusion criteria were invited to participate in the study.

Table 3.10: Number of public primary school (Sekolah Kebangsaan), the total enrolment in all two districts in Selangor and the school selection.

District/ Student's enrolment	Urban Hulu Langat (N)	Rural Kuala Selangor (N)	Total
Total number of schools	60	35	95
Total enrolment of standard five students (Malaysian citizen)	9947	3592	13539

Schools with enrolment > 1500	17	5	22
Total number of standard five students	5331	1703	7034
Total number of class	149	45	194
Ratio	75.8 %	24.2 %	100%
Number of schools selected randomly	5	2	7
Number of class selected randomly	6 class for each school (180 participants)		1260

**Source: Jabatan Pendidikan Negeri Selangor (2019)*
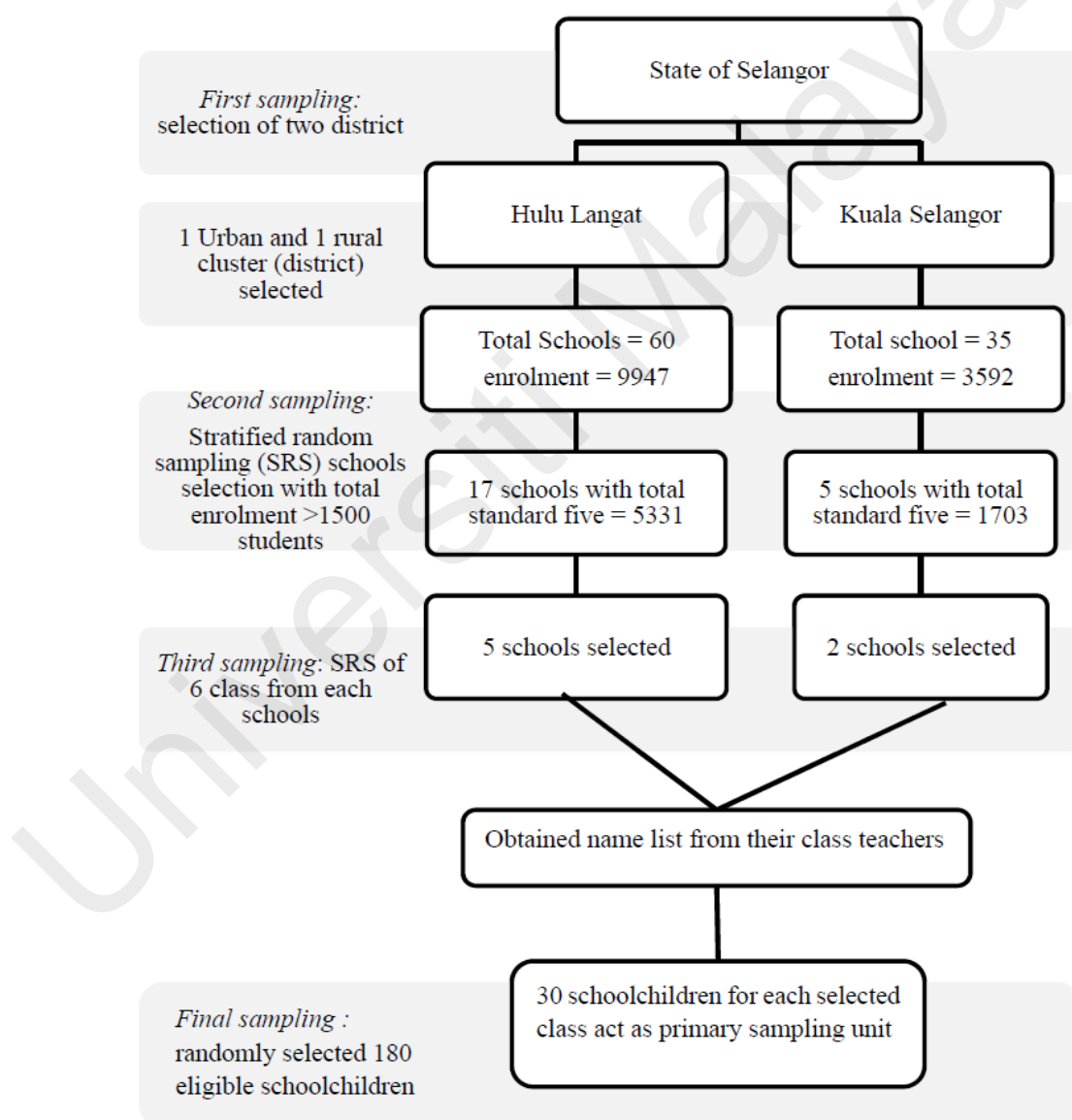
Figure 3.2: Flowchart of multistage stratified random sampling method and conduct of the study among parents of eleven-year-old schoolchildren in Selangor.

3.2.6 Study instrument

3.2.6.1 Questionnaire for parents of the schoolchildren

The questionnaire was drafted based on literature reviews and discussion with the experts. Table 3.11 shows the domain and items used in the questionnaires:

Demographics, the utilisation to the dental service and perceived oral health status

Table 3.11: The definitions and measurement used in this section

Conceptual definition	Operational definition	Scale of measurement	Unit
I) Sociodemographic profile			
Age	Age as of 1st January 2019	Continuous	Years
Gender		Nominal	1 – Male 2 – Female
Ethnicity		Nominal	1 – Malay 2 – Chinese 3 – Indian 4 – Others
Parent's education level	The highest education level achieved by parents	Ordinal	1 – No formal education 2 – Primary school 3 – Secondary school 4 – College / University
Household monthly income*		Nominal	1 – No monthly income 2 – ≤ RM 1,200 3 – RM 1,201 – RM 3,200 4 – RM 3,201 –RM 6,200 5 – RM 6,201 –RM 9,200 6 – RM9,201 – RM 12,499 7 – ≥RM 12,500

Source: Department of Statistic Malaysia (2016)

II) The utilisation to the dental service and perceived oral health status

Dental service utilisation	Presence of dental clinic nearby	Ordinal	1 – Yes 2 – No 3 – Do not know
	Preferred dental clinic for son/daughter	Ordinal	1 – Government 2 – Private 3 – Do not know
	Ever visit a dentist for the past 12 months	Ordinal	1 – No 2 – Yes
Perception of oral health	Teeth condition	Ordinal	1 – Poor 2 – Fair 3 – Good 4 – Very good 5 – Do not know
	Gums condition	Ordinal	1. Poor 2. Moderate 3. Good

B. Acceptance towards Dental Therapist to Treat Their Child in the Private Dental Clinic

The content of this section was developed based on discussion with the experts and review of the literature (Dyer et al., 2010). Six closed questions with subdomain were used. The participants answered the questions based a 4-point Likert scale where 1 =Completely disagree to 4=Completely agree). Details are as shown in Table 3.12.

Table 3.12: Questions assessing parental acceptance towards dental therapists providing dental care to their children in the private dental settings

Sub domain	No.	Item	Response key
		1. Would you agree if a dental therapist treats your child in a private dental clinic for the following treatment procedures?	
	a	To seek advice on oral hygiene care	1 – Completely disagree
	b	To have a simple cavity filled	
	c	To get an injection to make their teeth and gums go numb	2 – Disagree
			3 – Agree
Acceptance	d	To 'pull out' milk teeth	4 – Completely agree
	e	To have a protective coat (fissure sealant) done	
	f	To apply topical fluoride gel and paste	
	g	To have scaling and polishing done	
	h	Overall, I am comfortable and will allow if my child were to be treated by a dental therapist.	
	2.	2. If the option was "Disagree" what is the reason	1 – Worried about the quality of service
			2 – Do not know enough about them
			3 – More confident with a dentist
			4 – Others
	3.	Would you allow your children to be treated by dental therapists at the private dental clinic?	1 – Yes
			2 – No
			3 – Do not know
	4.	Following age group do you think is appropriate for a child (including your children) to be treated by a dental therapist at a private dental clinic	
	a	Toddler	1 – Yes
	b	Preschool	2 – No
	c	Primary school	3 – Do not know
	d	Secondary school	

Table 3.12 continued.

	5.	Willing to pay for services provided by the dental therapists	1 – Yes
Willingness to pay			2 – No
			3 – Do not know
	If "Yes", please indicate the estimated cost that you are willing to pay to the dental therapist for the following treatment conducted on your child/children		
	a	Receive advice on oral hygiene care	RM
	b	Scaling and polishing	
	c	Taken out of milk tooth	
	d	Simple cavity filled	
	e	Had a protective coat (fissure sealant)	
Conclusion	6.	Do you think it would be a good idea to let dental therapists to work in the private dental clinic in Malaysia?	1 – Yes 2 – No

3.2.6.2 Linguistic translation process, validity assessment and pre-test

The instrument was formulated in the English language after a thorough review and underwent the forward and backward translation process. The translation procedure was conducted the same as for the dental therapist population in section 3.1.5.3 (Appendix E).

The questionnaire underwent face and content validation before it was pretested among ten volunteers in face-to-face interviews at the Faculty of Dentistry clinic, University Malaya. No amendment was made as the questionnaires were reported to be clear and concise.

3.2.6.3 Reliability of items

Reliability testing was conducted to items of the acceptance for each of the listed dental treatment conducted by the dental therapist. It was to assess the internal consistency of the items in the construct. It was measured using Cronbach's alpha and Corrected Item-Total correlation (CITC). For this exercise, the Cronbach alpha coefficient measured in the instrument was performed for the seven items and the Cronbach's alpha was 0.89.

While CITC ranged between 0.37 and 0.72. Hence, the items correlate adequately in the

construct (Kline, 1986).

Table 3.13: Internal consistency of the type of treatment acceptance instrument among the parents (N=922)

Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
(1) To get advice on oral hygiene care	0.57	0.89
(2) To have a simple cavity filled	0.71	0.87
(3) To get an injection to make their teeth and gums go numb	0.67	0.88
(4) To have a milk tooth taken out	0.65	0.88
(5) To have protective coat (fissure sealant) done	0.75	0.86
(6) To have topical fluoride applied	0.75	0.87
(7) To have scaling and polishing done	0.73	0.87
Cronbach's Alpha Based on Standardized Items =	**0.89**	

Table 3.14: Inter-Item Correlation for types of treatment provided by dental therapist in private dental clinic (7 items) (N=922)

Items	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) To get advice on oral hygiene care	1.00						
(2) To have a simple cavity filled	0.51	1.00					
(3) To get an injection to make their teeth and gums go numb	0.39	0.53	1.00				
(4) To have a milk tooth taken out	0.37	0.50	0.57	1.00			
(5) To have protective coat (fissure sealant) done	0.47	0.60	0.53	0.58	1.00		
(6) To have topical fluoride applied	0.60	0.63	0.48	0.49	0.72	1.00	
(7) To have scaling and polishing done	0.45	0.57	0.64	0.53	0.60	0.61	1.00
Mean	0.88	0.80	0.64	0.62	0.74	0.83	0.70
SD	0.33	0.40	0.48	0.49	0.44	0.37	0.46

3.2.7   Conduct of the study

This study was registered with the NIH (NMRR-19-1323-48026) and ethical approval was obtained from the Medical Ethics Committee, Faculty of Dentistry, University of Malaya (DF CO1905/0005 (P))

An official letter was sent to the Ministry of Education and the Selangor State Education Department (JPNS) to seek permission to conduct the study (Appendix F). Permission was granted and eligible schools were identified based on the interactive website built by the JPNS (2019). Then, the selected school authorities were contacted and the researcher arranged briefing sessions with the schools authorities (the headmaster, senior assistant in student affairs and class teacher).

The questionnaires together with the patient information sheet (PIS) and the consent form were sealed in an envelope and given to the schoolchildren. This was then conveyed to their parents at home. A reminder note was placed on the questionnaire to encourage parents to return the questionnaire the next day to their children's class teacher. A token was given to the parents as an incentive to increase the participation rate as well as to the participating schools. A reminder call was made thrice during the period and feedback was obtained from the class teacher. Once completed, the class teacher helped to collect the questionnaires and the researcher collected it personally at the school on an agreed date (Appendix G).

3.2.8   Data management and statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences version 22.0 (SPSS; Chicago, IL, USA). Only completed returned questionnaires were included in the analysis. Descriptive analysis was conducted on the socio-demographic characteristics and the acceptance level. For analysis purposes, 'Malay' and 'Other' ethnicities were grouped as 'Bumiputera' while 'Chinese' and

'Indian' ethnicities were grouped as 'Non-Bumiputera' (Federal Constitution, Article 153, (reprint 2010)).

The participants' level of acceptance for each of the listed dental treatment conducted by the dental therapist was dichotomised into two groups; those who answered 'agree' and 'completely agree' (Likert scales 3 and 4) were grouped into the 'agree to accept' group, while those who chose 'disagree' and 'completely disagree' (Likert scales 1 and 2) were grouped as 'disagree to accept'.

The association between the dependent variable (parental level of acceptance) and independent variables (demographics, patterns of dental service utilisation and perceived oral health status factors) were assessed using both univariate and multivariate analyses. Initially, the selection of potential factors for parental acceptance was made by analysing all the independent variables using the Chi-square test. All variables that had a p-value of less than 0.25 were included in the multivariate analysis. Both forward and backward stepwise variable selection methods were used to obtain a preliminary main-effect model. Only variables that had a p-value of less than 0.05 were selected and subsequently analysed further with multiple logistic regression using the enter method to obtain the preliminary final model. All meaningful interaction variables were analysed and assessed using multiple logistic regression. None of the interaction variables was found to be significant at a p-value of 0.05, thus were excluded from the model. The significance of the model was then tested by applying a likelihood ratio test with the maximum likelihood estimate. Fitness of the model was tested using three different methods: the Hosmer-Lemeshow goodness of fit test, the classification table, and the Receiver Operator Characteristic curve. The final model was determined by using the enter method. The adjusted odds ratio was estimated with a 95% confidence interval. A p-value of less than 0.05 was considered statistically significant.

**3.3	Study 3: The private dentists' attitudes and perceptions and as well as their perceived barriers on the employment of dental therapist in the private practices.**

**3.3.1	Study design, study period and study population**

This was a cross-sectional study conducted from March until June 2019 using a systematic random sampling method among Malaysian registered private dentists who were actively practicing in Selangor, Malaysia. Non-citizen dentists were excluded. Based on the Malaysian Dental Council (2018), there were 1050 registered private dentists in Selangor and this was the highest number of dentists as compared to the other state in Malaysia.

In light of the changes of legislation that permitted the dental therapist to work in private sector it is important to gauge the private dentist acceptance as they are the employer and the one who manage the private clinics. This is as compared to the public dentists who may not have direct control to the cost and revenue of a clinic. Apart from cost and time constraints, public dentist was not included in this study as it seems that the perception of private dentists is more crucial in relation to the aim of this study.

**3.3.2	Sample size calculation**

The sample size was calculated based on the population proportion with the margin error of 5% and 95% CI. Hence, using a single proportion sample size formula (Daniel, 1999), the sample size required with the accuracy level of 0.95 and a margin error ±5.0% was 282. A 20% dropout rate (Rayapudi & Usha, 2018) was estimated during the study period providing a minimum sample size requirement of 338.

3.3.3　Sampling methods and technique

A probability sampling using systematic sampling techniques was used where the eligible private dentists working in the private dental clinics were surveyed. Private dental clinic owners acted as a proxy out of convenience as it is easier for the researcher to locate the potential participants. This also helped in getting a higher response rate with a minimal cost incurred.

Selangor has the highest number of private dentists in Malaysia, with 34% accounted in Selangor (MDC, 2017). For the convenience of data collection, samples were only taken from this area. There was a total number of 767 registered private dental clinics in Selangor (Bahagian Amalan Perubatan KKM, 2018). From the list obtained, clinics listed with even numbers were selected to participate in the study (Table 3.15). In the event that the chosen clinic could not be contacted, the next private dental clinic from the list was selected. Once the clinics have been randomly selected, all the private dentists in the selected clinic who fulfilled the inclusion criteria were considered as the primary sampling unit and became the sample of participants in this study.

Table 3.15: Distributions of private dental clinic in Selangor

Cluster	District	Number
Urban	Klang	69
	Petaling	391
	Hulu Langat	202
	Gombak	38
	Sepang	13
Rural	Hulu Selangor	4
	Kuala Selangor	12
	Kuala Langat	15
	Sabak Bernam	2
	Total	**767**

Source: Bahagian Amalan Perubatan KKM (2018).

3.3.4 Study instrument

3.3.4.1 Questionnaire for the private dentists

The questionnaires were drafted based on literature reviews and discussion with the experts. The followings are the sections and items that were used in the questionnaires:

A. **Demographics and current working practice**

As shown in Table 3.16 below, this section consisted of four questions on the participant's demographical profile, three questions related to their dental training, four questions regarding their ownership and two questions on their working experiences.

Table 3.16: The definitions of items used in this section

Conceptual definition	Operational definition	Scale of measurement	Unit
I) Sociodemographic profile			
Age	Age as of 1st January 2019	Continuous	Years
Gender		Nominal	1 – Male 2 – Female
Ethnicity		Nominal	1 – Malay 2 – Chinese 3 – Indian 4 – Others
Place of practice	Place of working	Nominal	1 – Dental clinic 2 – Hospital 3 – Others
II) Dental training			
Place of graduation	Place where they graduate and obtained their dental degree	Nominal	1 – Malaysia 2 – Overseas
Year of graduation	The year they obtained dental degree	Continuous	Years
Undergone any specialty training	Any training after graduation while working or attended full-time course	Ordinal	1 – No 2 – Yes

III) Ownership

Ownership,	Clinic ownership	Nominal	1 – Yes
			2 – No
Income	Clinic monthly income	Nominal	1 – <RM20K
			2 – RM 20K-RM40K
			3 – RM41K-RM60K
			4 – >RM61K
Employment			5 – Others
	Number of dentists employed	Discrete	1 – Part-time
			2 – Full time
	Numbers of dental auxiliaries' present	Discrete	Numbers

IV) Working experience

Working experience in private practice	Years working in the private sector	Discrete	Years
	Ever worked with dental therapists	Nominal	1 – Yes
			2 – No

B. Awareness of the establishments of the Therapist Provision under the new Dental Act 2018.

Questions were developed based on the Dental Act 2018. The items used were the same as for the dental therapist as explained in section 3.1.5.1(B).

C. Attitudes towards dental therapist employment in the private clinic

The content of this section was developed based on a review of the literature (Gallagher & Wright, 2003). It consists of seven close-ended questions which included four negative statements and three positive statements as shown in Table 3.17. The private dentists were required to score each item on a four-point Likert scale from 'Completely disagree' (Score - 1) to 'Completely agree' (Score - 4).

Table 3.17: Items used in assessing dentists' attitude towards dental therapists

Item*	Type of statements	Response key
If dental therapists are used for some treatments, I will not be able to personalize dental care to all my patients' needs.	Negative	1 – Completely disagree
If more treatment is delegated to dental therapists, there will not be anything left for dentists to do.	Negative	2 – Disagree 3 – Agree
I think the dental therapist would disrupt the dentist's relationship with patients.	Negative	4 – Completely agree
I believe that using a dental therapist will increase a dentist's enjoyment of the dental practice.	Positive	
I think patients would have less respect for dentists once being treated by a dental therapist.	Negative	
I feel that dentists can work more effectively/ efficiently using dental therapists in a team approach.	Positive	
I feel that in general, patients want to be treated by dental therapists.	Positive	

Source: Gallagher and Wright (2003).

D. Private dentists' perceived employment of dental therapist in the private dental clinic

The content of this section was developed based on discussions with the experts and review of the literature (Gallagher and Wright, 2003). Table 3.18 shows the item used in this section, where it consisted of five close-ended questions under three subdomains.

Table 3.18: Item used in perceived employment section

Sub domain	Item	Response key
Dental therapist employment in the private sector	Would you consider employing a dental therapist in your practice	1 – Yes 2 – No 3 – Undecided
	If 'Yes' or 'Undecided', how many percentages of work delegation for each dental treatment listed would you like to hand over to the dental therapist?	1 – Giving oral health instruction 2 – Carry out Class I, II, III and V restorations 3 – Extraction of primary teeth 4 – Placement of fissure sealant 5 – Application of topical fluoride and gel 6 – Scaling and polishing

Perceived barriers	What may be your perceived barriers to employ dental therapist in your practice	1 – Increase the financial burden (overhead costs)
		2 – Dental therapist's lack of knowledge and skills
		3 – Additional administrative burden
		4 – Poor patients' acceptance
		5 – The quality of care that the dental therapists provide
		6 – Legislation issue
		7 – Require additional supervisory responsibilities
		8 – Availability of space in my practice
		9 – Split treatment between operators
		10 – Dentist reluctance to delegate procedures
		11 – Others
Overall perceptions	Do you think dental therapist would have a useful contribution to make in the private practice	1 – Yes
		2 – Undecided / Maybe
		3 – No
	Please suggest an appropriate **per hour salary** for dental therapist **who work in private clinic?**	Ringgit Malaysia (RM)

3.3.4.2 Validity assessment and pre-test

The questionnaire underwent face and content validation and it was then pretested among ten private dentists who were working in Kuala Terengganu, Malaysia. There were no amendments made as the questionnaires were reported to be clear, concise and understood by the private dentists.

3.3.5   Conduct of the study

This study was registered with NIH [NMRR ID: NMRR-19-1328-46990]. Ethical approval to conduct this study has been obtained from the Medical Ethics Committee, Faculty of Dentistry, University of Malaya (DF CO1905/0005 (P)]).

The research team contacted the person in charge of the respective selective private dental clinics to explain the objectives of this study and the importance and implications of the findings. Eligible participants were included in the study if they agreed to participate when approached by the research team at their respective dental clinic on an agreed date and a self-administered questionnaire was employed.

On the day of the agreed collection date, the research assistant (RA) greeted the participants and gave him/her a research information sheet which described the study outlines and objectives. If they agreed to participate, they were asked to sign the consent form before answering the questionnaires. Then, the RA remained at the dental clinic to encourage the participant to participate. However, if the participants were fully occupied in the event, the RA left the questionnaires and came back to collect the completed survey upon contact. Where the participants cannot commit to answering the same day, they contacted the RA to retrieve the completed survey question in an agreed time and date. As for those who declined, they were asked the reasons for their refusal and this was recorded. Then a subsequent participant was chosen from the list to substitute the refused participant. The questionnaire was distributed to 380 private dental clinics owner during the data collection period (Appendix H).

The research team used few measures in ensuring high participation during data collection whereby the participants were contacted and the study objectives explained prior the data collection. Previous study conducted among Malaysian private dentist have shown low response rates (between 36.0% and 50.3%) (Chin, Chong & Mani,

2016; Yusof, Han, San & Ramli, 2008). Another study by Ly et al. (2019) that used a postal survey only achieved a response rate of 38%.

3.3.6   Data management and analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences version 22.0 (SPSS; Chicago, IL, USA). Only completed returned questionnaire were included in the analysis.

Descriptive analysis was done on all data in each section.

1) The awareness of the provision of the Dental Act 2018

There were ten questions which were made of five positive statements and five negative statements. Any correct answers given were scored "1" as "aware" whereas the incorrect and "Do not know" responses were scored "0" as "unaware". The total score was the sum of all the scores obtained from each question in this section. The mean for total awareness score for the private dentist was calculated.

2) The attitude towards the dental therapist and perceived employment towards dental therapist

There were seven questions. The percentages of the Likert responses were calculated for each statement.

3) The barriers to the employment

There were five questions in this section and the percentages were calculated for each response. For the barriers' question, the participants were given opportunity to give comments and their responses were group into a similar theme.

PHASE 2 METHODOLOGY

This phase is designed to present the approaches, process and resources needed when exercising workforce modeling, thus addressing the final objective of this study. The science and rationale behind workforce planning and modelling have been detailed in Chapter 2.

3.4   Study 4: SD Modelling for Malaysian dental therapists' professional role and its impact on future dental workforce dynamics

3.4.1   Overview and study design

This study was built based on the validated System Dynamic (SD) model developed by Che Musa (2017). The existing data used in his model and additional data derived from Phase 1 of this study (the acceptance of public dentist and public as well as perceptions of dental therapist) were used to develop the model. The details are explained in section 3.4.2.3.1 (a – b).

It was modified in Vensim® PLE software for Windows Version 6.3 (x32) to study and manage a complex feedback system (Forrester, 1968; Williams & Harris, 2015) among Malaysian dental workforce post-implementation of the Dental Act 2018. It primarily focuses on the dental therapists as well as for total dentists across two sectors (public-private) in meeting the needs and demands of population (by six age-bands) over a period of 15 years (2015-2030).

This SD model consists of two sub-models of supply and needs/demand model. The potential of oversupply or undersupply was explored based on the clinical hours' requirement, which were then converted to the volume of workforce needed for different type of dental workforce. The SD model was designed to provide the baseline and scenarios models on the current and future supply, and the demand to the dental

workforce based on the findings from Phase 1 studies. The modelling was also supported by other available and relevant data (for example previous trends in demographic and dental disease, level of demand for care, treatment time, etc.).

The use of the SD model was peer-reviewed and agreed by the academicians at the University of Malaya following a series of discussions and meetings. The main data inputs were the numerical figures of:

a) **Supply data** informed by the OHP/MDC data and relevant documents namely; i) workforce volume in 2015; ii) trends and patterns of stocks and flow (attrition, death, and training); iii) working pattern (full-time/part-time) and iv) supply hours per year (% of working time equivalent (WTE)) and findings from Phase 1 (perceptions of dental therapists);

b) **Demand data** such as i) volume and proportion of population (age-bands); ii) dental utilisation (demand level) varied by type of treatment, specific workforce and sectors informed by current trends; iii) and treatment time, and findings from Phase 1 (perceptions of private dentists and the public)

Whilst, the baseline scenario outputs were the workforce's total volume, clinical hours supply and demands, unmet demand of stocks by volume of workforce needed across sectors and ratio.

Finally, five main different alternative policy scenarios [Scenario 1 to 5] were developed and tested over the simulation period based on alternative (WTE), the potential supply based on current trends and perceptions of dental therapists and private dentists; and the potential demand based on parental acceptability towards dental therapist providing dental care. Scenario testing in this study is vital to provide a clear image of potential healthcare and dental workforce services in a dependable direction (Garreth, 1999). This aims to assist the oral health provider in planning for the future workforce needed to meet the current and future population demand for the potential

oversupply of clinical hours (Samah et al., 2014). The alternative scenario modeled were based on parameters as below:

- Scenario 1: Baseline scenario
- Scenario 2: Optimising dental therapist's oral health promotion role in the public service
- Scenario 3: Optimising dental therapist's clinical role at public setting
- Scenario 4: Enhancing private dental therapist's clinical role at private setting
- Scenario 5: Optimising private dental therapist's oral health promotion role in the private setting

The details philosophy of each scenario is described in Section 3.4.2.5

3.4.2 SD model development

The development of the SD model for this study was conducted in five stages. Stage 1 – 4 serves to develop the baseline model, whereas stage 5 for scenario testing for possible policy implication. This is further explained below.

3.4.2.1 Stage 1: Problem articulation – The conceptualisation

Firstly, the model is defined based on the objectives of this study. Then, the model boundary which was initially informed by supporting document and literature was revised according to the new Dental Act 2018 and survey's findings of Phase 1 to create a causal loop diagram (CLD): a conceptual model. Then, the relationship and behaviours of each parameter in that conceptual model were reviewed and examined using a primary mechanism and feedback loops system as represented in a diagram. Several hypotheses were created to be tested in subsequent stages.

a) Development of Causal Loop Diagram (CLD)

CLD involves interactions between variables, interconnected by arrows, rates and feedback loop, which represent the real world (Sterman, 2000; Vensim, 1985). The model consisted of two sub-models: the need/demand and supply model.

b) Model boundary

The key variables were selected to achieve full conceptualization which assists in examining the model behaviours and feedback. The variables were categorised as endogenous or exogenous based on their functions, as presented in Table 3.19.

a) **Endogenous**: dynamic variables, and it presents as well as involved in the feedback loops within the boundary of the SD model.

b) **Exogenous**: variables that not directly affected and exist outside the system.

Table 3.19: Variables of dental therapist workforce in Malaysia

Endogenous variables	Exogenous variables
Dental therapist graduates (F)	Time to train
New registered dental therapists (S)	Policy- job places
Public dental therapists (S)	Population, treatments required, dental attendance and treatment time
Private dental therapists (S)	Intention to leave (Study 1; Scenario 4a: productivity (full-time/part-time)
Dentist (S)	Private dentist acceptance and employability of dental therapist in the private sector (Study 3; Scenario 4b)
Leave, retired, influx, others (F)	Parental acceptance towards dental therapist in the private sector (Study 2; scenario 4c)
Population/ age-bands (S)	
In training (F)	
Supply/ demand clinical hours	
Used/ unused clinical hours	
Oral health status	

Note: S: Stock; F: Flow

3.4.2.2 Stage 2: Formulation of dynamic hypothesis

This stage involved describing and demonstrating types of behaviour over time. It also represents the real problem for the local context of the Malaysian dental therapists' workforce. The identified variables in stage one (data from phase one studies and supported by works of literature) were used to inform the causal loop diagram (CLD) to understand the relation of variables to each other (Sterman, 2000). Those behaviours could emerge in more than one presentation in one single causal loop, suggesting that SD is best used to capture the complexity and dynamic of the healthcare system.

3.4.2.2.1 Hypothesis

The SD model was developed to explore the relationship between the supply of dental therapists and dentists across sectors (public and private) with the need and demand for dental care, post-implementation of the Dental Act 2018. The model was constructed based on several hypotheses. Hence, the SD model objectives are:

i. To examine and fulfil the supply and demand for dental care among age-bands across sectors: toddler (T), pre-school (PS), primary school (1s), secondary school (2s), adult (A) and elderly (E).

- The dynamic hypothesis is (i)the health sectors at both public and private are capable in strengthening their primary dental care by developing more opportunity or positions and (ii) demand for the dental workforce will lead to an increasing supply of clinical hours for dental services.

ii. To examine the implication of dental therapist expectations on future working patterns (working in the private sector and part-time mode) and profile (clinical vs administration) on the dental workforce volume needed in the country for Malaysian dental workforce.

- The dynamic hypothesis is that the acceptance of health providers across sectors in providing dynamic and flexible working environments could influence and improve the workforce stability, mobility and retention among the Malaysian dental therapists and dentists.

This hypothesis did not consider numerous aspects of dental facilities as it was assumed that the facilities develop at the same rate as currently, in parallel with the dental workforce output.

3.4.2.2.2 Development of Conceptual Model/Causal Loop Diagram (CLD)

At this initial stage of model-building, the conceptual model that is in the form of a causal loop diagram (CLD) was developed by identifying a model boundary (parameters) informed by previous literature. This conceptual model demonstrates the relationship and the complexity of two sub-models: a need/demand model and a supply model (Figure 3.3).

The model illustrates that the parameters identified are influenced by or cause changes to other parameters. The whole interactions of both the sub-models coincide at the parameter of 'used or non-used clinical hours' indicating the existence of a potential of undersupply or oversupply of clinical hours. The inflows for private dental therapists or dentists are only from the public sector as it is compulsory for all to start in the public sector. This conceptual model comprises of several behaviours and feedback following various interactions of sub-CLD models. Nonetheless, only CLDs that assess behaviours and feedback of dental therapists' intention to leave and the used or non-used clinical hours are considered here, whereas the other remaining CLDs are presented in **Appendix J.**
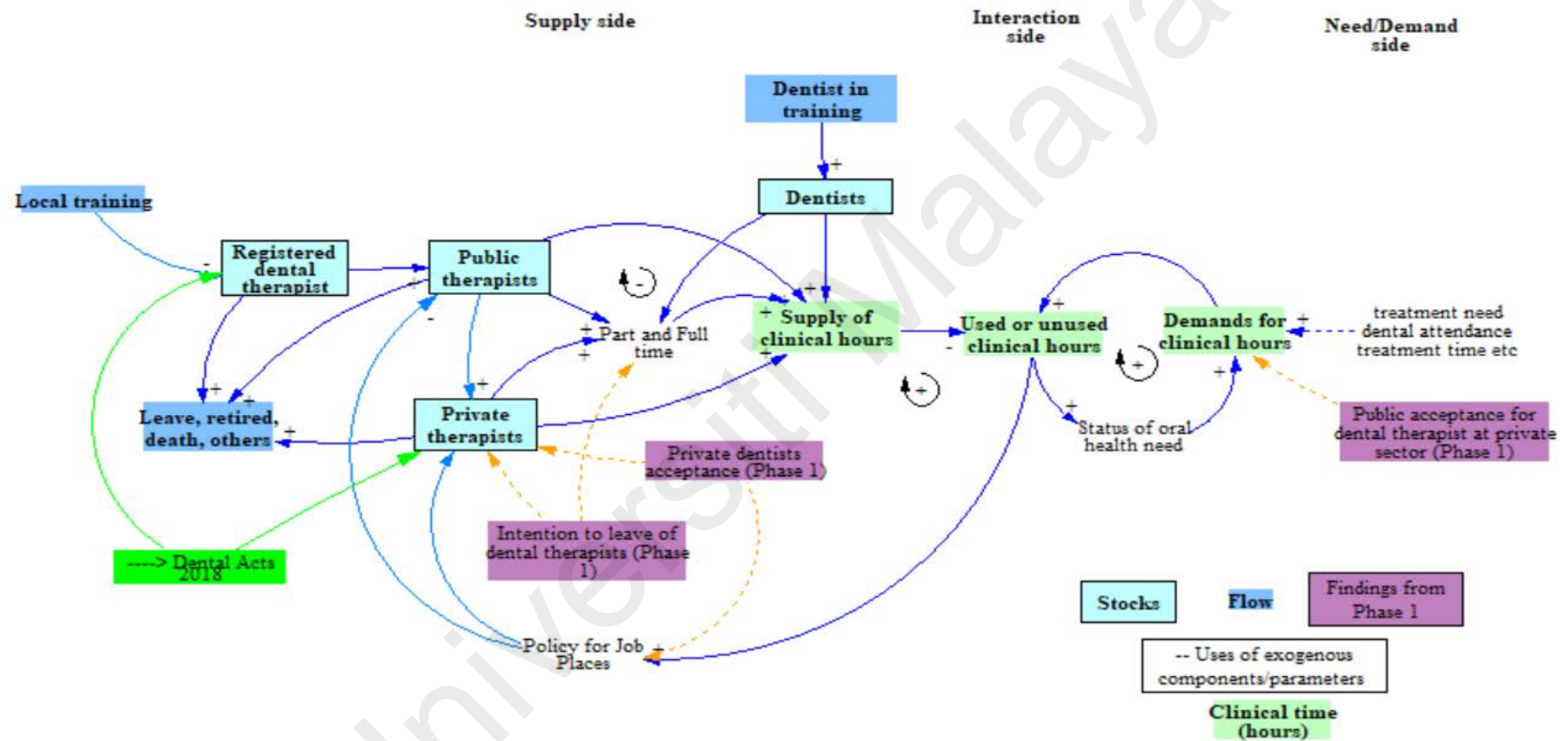
Figure 3.3 Conceptual model of Causal Loop Diagram (CLD) of overall influences on Malaysian clinicians' dental workforce focusing on dental therapist informed by the Dental Act 2018 and findings from Phase 1

Model's behaviours and feedback

a) As explained, the components for intention to leave among dental therapist, private dentist views, and parents of school children acceptance were considered in the model-testing to endorse a better accuracy of modelling results (Crettenden et al., 2014) and to reflect on reality.

b) Only specific model behaviours are described in this section which is the implementation of Dental Act 2018.

Based on the new Act, all dental therapists are required to register with the Malaysian Dental Council under the Therapist Board and are allowed to work in the private sector under dentist's direct supervision (Dental Act of 2018) (Figure 3.4).

    i.   Cross-sector mobility (public-private): therapists view

        By enhancing the policy on job places in the private sector, they have an opportunity to leave and migrate from public sector to private sector (+)

    ii.   Working pattern (full-time and part-time mode)- therapists view

        Consequently, it will increase the supply of clinical hours, either for the full-time or part-time mode that has implications for the non-used clinical hours, respectively.
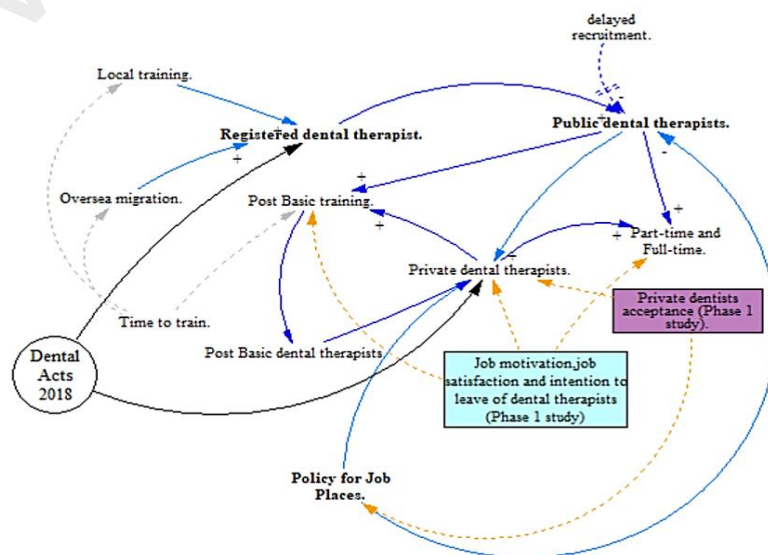
Figure 3.4: CLD of cross-sector mobility and working pattern for Malaysian dental therapist

iii. Clinical hours (used/non-used)

An increase in demand for clinical hours will increase the use of clinical hours (Figure 3.5), and this is illustrated by "+". Based on the assumption that dental attendance improves oral health, the increase in the use of clinical hours by population signifies the potential of unmet demand if the supply of clinical hours is insufficient. In turn, it might worsen the oral health status shown by "+". If this causal loop shows an even number of positive signs, it has been identified as a positive feedback loop or reinforcing loop. In this loop, the oral health status will continue to deteriorate and become out of control, thus increasing the demand for clinical hours to dental care.

Similarly, when there is a low demand for dental care, it will increase the non-used clinical hours, which in turn will also worsen the oral health status at the same time.
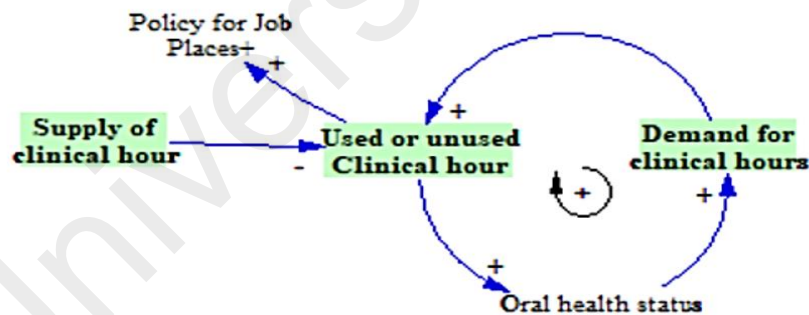
Figure 3.5: CLD of used/ non used clinical hour for Malaysian dental therapist

The other model boundary parameters (ii) to (v) that made the CLD is explained in Appendix J. Next, the conversion of CLD into SFD is described.

3.4.2.3   Stage 3: Formulation of a simulation model – SFD development

At this stage, the developed CLD was then converted to the level and rate of equations. This is to allow an individual parameter to be defined and quantified by a researcher. Relevant data were selected and estimated to quantify the variables. At this stage of model coding and data input, the conversion process formed the stock and flow diagram (SFD) from the CLD which link all related variables. This SFD often goes back to review its conceptual model (CLD) to develop a more holistic and valid model that is suitable for the current local context (Tako, 2008).

3.4.2.3.1 Type of data needed for SFD

Various sources collected such as published sources of the MOH Malaysia, the Department of Statistics Malaysia, the Malaysian Dental Council or the Malaysia Dental Association (MDA) were used. Furthermore, findings from Phase 1 studies were utilised to complement other variables in testing the alternative scenario.

As explained in Chapter 2 (literature review) and earlier, the SD model developed by Che Musa (2017) was modified incorporating Phase 1 data that influenced Phase 2 modelling. Figure 3.6 described the primary outcome informed by studies in Phase 1 which involved three quantitative surveys among three populations; dental therapist, the private dentist and parents of the schoolchildren as well as baseline data, supported by relevant secondary data and literature reviews.
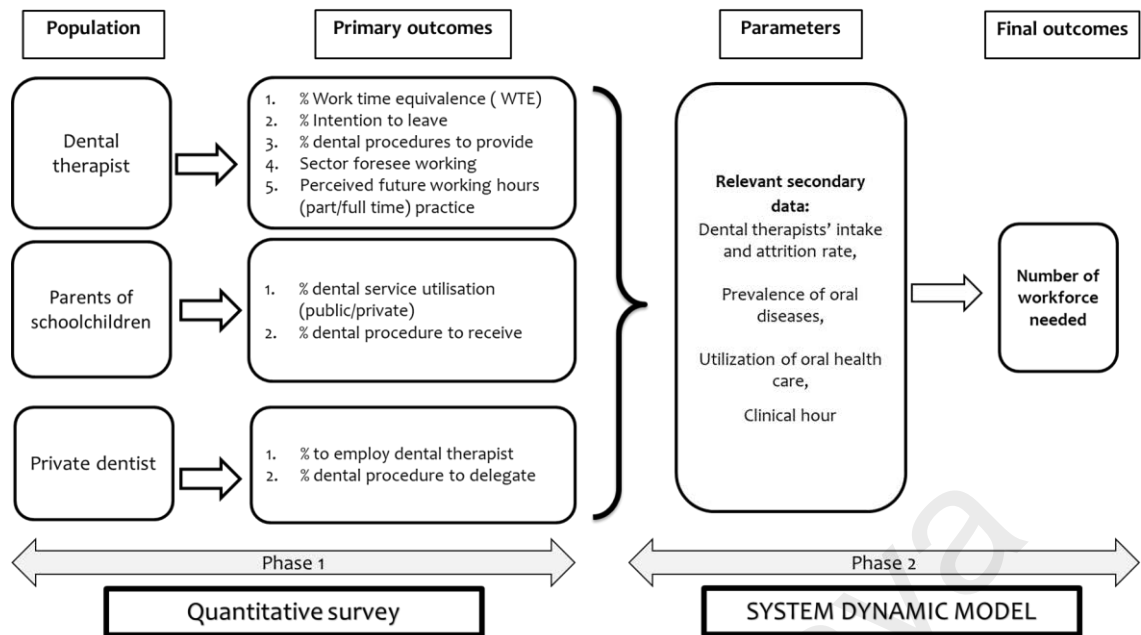
Figure 3.6: Study framework

The data needed to formulate the two sub-models in SD modelling, comprising a) need/demand and b) supply. Description as follows:

a) The overall data input for the need/demand model

Figure 3.6 demonstrates the data needed for the interactions of various sub-CLD under the need/demand model that led to the production of clinical hours demand across age-bands. The figure illustrates the pathways on how the clinical hours' demand is calculated and produced, initiated by the size of the population (vary by age-band) that is needed or demanded according to specific types of treatments (primary or secondary care).
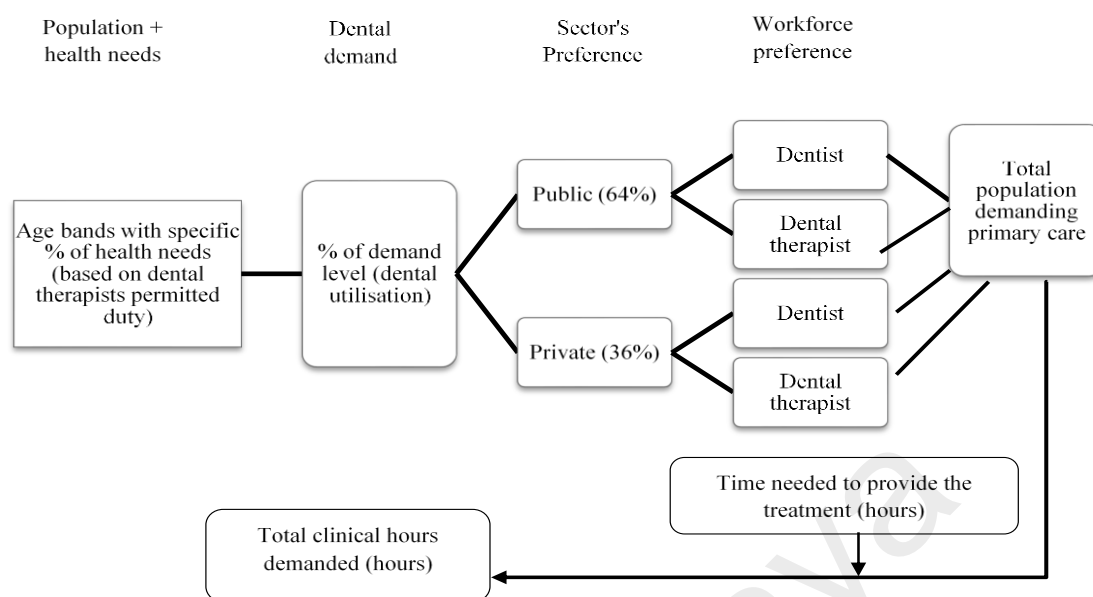
Figure 3.7: Schematic diagram of oral health need/demand model *[Modified from (Che Musa, 2017)]*

Modelling demand level

A survey reported a pattern of public attendance in the government dental clinic was 64% while the remaining 36% attended private dental clinic (Oral Health Division Ministry of Health Malaysia, 2013). Table 3.20 presented the proportion of dental utilisation at MOH primary care across age group. These data were used to calculate the demand level for both the public and private sectors, as no data was available from the private sectors.

Presented below is **the formula used in calculating the demand** for the private sector:

Total utilisation rate by age-band in private sector =	Total utilisation rate in the private sector (36%)	**X** Total utilisation rate by age-band in public sector
	Total utilisation rate in the public sector (64%)	

Table 3.20: Proportion of dental utilisation at primary care (MOH) across age group for the year 2013-2017

Year	Toddler (%)	Preschool (%)	Primary School (%)	Secondary School (%)	Adults (%)	Elderly (%)	Overall (%)
2013	8.9	23.6	98.1	85.5	6.8	7.6	25.6
2014	11.6	25.2	98.4	90.1	8.3	8	24.2
*2015	11.7	25.9	98.8	92.0	8.7	8.2	25.3
2016	13	27.5	96.8	87.1	8.8	8.5	25.1
2017	13.9	27.9	92.3	95.8	9.2	8.7	25.3
Average of increment (%)	1.3	1.1	-1.5	2.6	0.6	0.3	-0.1

current demand level in the public sector

Source: Oral Health Program Ministry of Health, 2017; Oral Health Program Ministry of Health, 2016

Demand for dental services varies based on sector (public vs private) and workforce (dentist vs dental therapist) preference. The demand clinical hours was calculated based on the size of the population (vary by age-band) that is needed or demanded according to specific types of treatments provided by the dental therapists. This was determined using the following formula:

> Clinical hours demand = The total volume of the population requiring specific dental treatment **X** treatment time

The details of data sources, model assumptions, critical arguments, and model outputs for the need/demand model comprising components of population, oral health needs and demand are presented as follows:

i) Total volume of the population requiring specific dental treatment

Various data sources, model assumptions and outputs, as described by Table 3.21, were used to calculate the clinical hours' demand.

Table 3.21: Details of data sources, model assumptions, key arguments, and model outputs for the need/demand model

Parameter	Details	Data source	Model assumption
Population	Population by age-band (Appendix K)	1) Report of Malaysian population's projection for 2010-2040	1) The birth rate and death rate for the population is modified every five-years
	1. Toddler (T) (0-4 years old)		2) The proportion of age-band is modified in every five-years
	2. Preschool (PS) (5-6 years old)		3) The net immigration is maintained at a constant rate
	3. Primary School (1ry) (7-12 years old)		4) Please refer (Appendix L) for SFD representative of the population by age-band
	4. Secondary School (2ry) (13-18 years old)		
The next stage was to sort the population into the type of treatments required for age bands			
Oral health needs	Population needing specific dental treatments (Appendix M)	1) National oral health surveys of adults and schoolchildren	1) People who are leaving a particular age category through ageing are assumed to have a similar oral status to the category they enter or leave.
	1) List of dental treatment needed by age-band in % based on prevalence/ incidence, a case seen, severity, and range of condition.	• National Oral Health Survey of Preschool Children 2015	2) One particular treatment provided is bound over time to increase the probability of another.
	2) Based on the Dental Act, permitted duty by dental therapist sectioned into:	• National Health and Morbidity Survey 2017: National Oral Health Survey of Schoolchildren 2017	* Given this, the oral health needs are assumed to remain constant until 2025 and the percentages are slowly reduced by 5% in 2030 and followed by another 5% in 2035; based on utilised historical data.
	i. Oral hygiene instruction		
	ii. Simple restoration		
	iii. Local anaesthesia	• National Oral Health Survey of Adults 2010 (NOHSA 2010).	3) Every dental extraction needed local anaesthesia. Hence the figure will be the same as dental extraction.
	iv. Dental extraction		
	v. Fissure sealant	2) Annual dental reports (MOH)	
	vi. Topical fluoride vi. Scaling & Polishing		

Table 3.21, continued

Dental utilisation was then used as an indicator for demand level which varied by the age-band

Dental demand	1) T (14.8%-40.1%)	1) National Health and Morbidity Survey: Oral health surveys of adults and schoolchildren	1) The total oral health demand is also assumed to remain constant until 2025, and the percentages are slowly reduced by 5% in 2030 and followed by another 5% in 2030, based on reduces trend in need model
	2) PS (29%-51.7%)	2) Annual dental report (MOH)	2) The level of preference to the sector (public or private) was based on the findings of the national oral health surveys for adults and elderly people which claimed that about two-thirds of adults prefer to seek oral care from public facilities. Since adults are the proxies for schoolchildren, it is assumed that the demand across age-band (Toddler, Preschool, Primary and secondary School children) continues to be the same as adults.
	3) 1ry (98%-100%)		3) The level of demand for the types of the workforce (Dentists, dental therapists) across age-band continues to be as at present
	4) 2ry (95.1%-100%)		
	5) Adults (3.1%-9.6%)		
	6) Elderly (11.2%-19.5%)		

ii) Assessment of treatment time in clinical hours

The treatment time used in this study was gathered from two local studies by (Ab Murat, 2012) and (Che Musa, 2017). Ab Murat (2012) assessed the treatment time required by using observation and activity analysis technique. Both researchers received the unpublished treatment times provided by the MOH to complement the treatment time for children and other uncovered treatments. Various factors were considered in selecting and choosing the proper treatment time, such as the dentition types, treatment severity, sectors of practice, the implication of chosen treatment time as well as researchers experience.

To ensure there were not over or underestimation, series of test were conducted for the clinical hours' demand to avoid improper treatment time usage to retain the accuracy of the model in assessing and evaluating the right volumes of the dental therapist in Malaysia.

b) Data input for supply model

In this section, data required to assess several interactions of various sub-CLD under the supply model that lead to the production of clinical hours supply across clinician dental workforce. The figure illustrates the potential working patterns for full and part-time obtained from Phase 1. The obtained data were used to calculate the clinical hours' supply, as demonstrated in Figure 3.8 below.
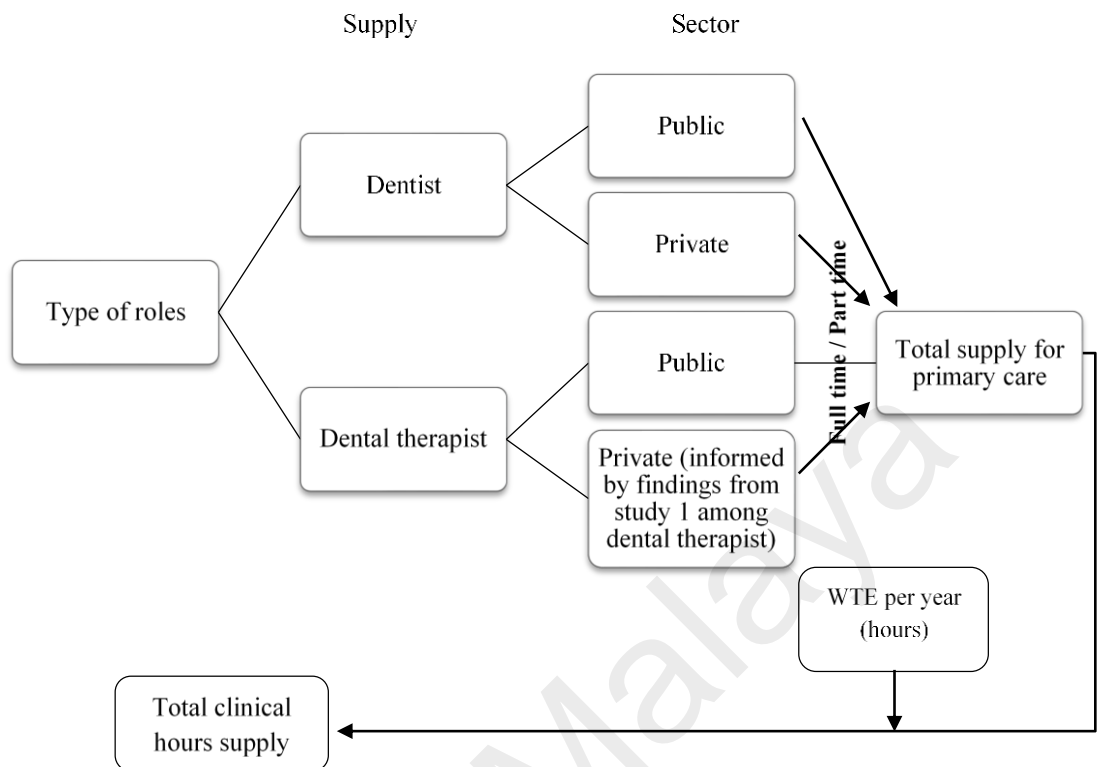
Figure 3.8: Schematic diagram of the supply model *[Modified from (Che Musa, 2017)]*

Conversion of the total volume of the dental workforce into total clinical hours supply is undertaken by multiplying the workforce volume with their total working hours in a year (Working time equivalent [WTE]) as in formula below:

Clinical hours supply = The total volume of dental therapist and dentist across sectors **X** total working hours in a year (Working time equivalent [WTE])

The details of data sources, model assumptions, critical arguments, and model output for the supply mode are shown in **Appendix N.**

c) Interaction side: Conversion of Malaysians' working days to clinical hours supply

The number of working days for an individual workforce member per year is calculated based on the difference between the total volume of working days and the annual leave taken in a year. Clinical hours of supply are based on an eight-working hour per day. Both the total supply and demand for clinical hours from these two main models were then compared to investigate the following features:

i) Level of clinical hours being used and non-used

The difference between supply and demand clinical hours based on 'used' or 'non-used' clinical hours, would suggest the potential of either under or oversupply of clinical hours.

ii) The volume needed for the respective workforce type

The gap in clinical hours between the two sub-models was divided by the total clinical hour supply per individual workforce annually (WTE) in order to provide the workforce volume needed

3.4.2.4   Stage 4: Testing the model assumptions

The model was then tested and simulated to distress under extreme conditions, looking at model behaviour and sensitivity. A series of calibration and validation were performed throughout the process including a sensitivity analysis to get a spread of output values.

3.4.2.4.1 Model validation

3.4.2.4.1.1 Structural validation

The findings from Phase I of this study were used to develop the model and indirectly served the structurally based validity as it ensured the model consistency. The research team consist of a group of dentists who were familiar with the system and evidence provided from various literature; hence the developed model is valid to be used locally in Malaysia. Apart from that, the variables used in the model were carefully designed and then tested under extreme data input to answer the objectives.

3.4.2.4.1.2 Behavioural validation

Behaviour validation was performed separately for the need/demand model, which was later combined. This study mainly focuses on the projection of dental therapists in Malaysia. Therefore, major validation activities were presented here, and others can be found in Appendix M.

a) Demand model

Based on the formula to calculate the demand for the private sector in Section Table 3.22 shows the different levels of demand across-age band and sectors. The demand levels in both sectors determined the total demand for each individual age-band that was used in the model simulation, which increases over time based on historical trends. No adjusted demand levels were considered given the restriction of dental facilities at the public sector and unavailability of dental scheme insurance at the private sector.

Table 3.22: Different levels of dental demand in percentages by age-bands for the year 2010 to 2030

Year	Toddler			Pre-school			Primary school			Secondary school			Adults			Elderly		
Sector	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
2015*	11.7	3.1	14.8	25.9	3.1	29	98.8	3.1	101.9	92	3.1	95.1	8.7	3.1	11.8	8.2	3	11.2
2020	18	6.2	24.2	31.2	6.2	37.4	100	6.2	106.2	100	6.2	106.2	11	6.2	17.2	9.6	5.4	15
2025	24.2	7.9	32.1	36.7	7.9	44.6	100	7.9	107.9	100	7.9	107.9	14	7.9	21.9	11.1	6.2	17.3
2030	30.5	9.6	40.1	42.1	9.6	51.7	100	9.6	109.6	100	9.6	109.6	17	9.6	26.6	12.5	7	19.5

b) Supply model

Variables that are likely to affect the future profile of dental therapist in terms of their volume (number needed) and distribution (sectors) were informed by our survey findings among the dental therapist (Section 4.1) and private dentists (Section 4.3). They are tested, calibrated, and presented here.

i) The total volume of dental therapists and dentists

Total volume for the dentists and dental therapist were modelled based on past year trends (Appendix N). The initial output for 2015 was then compared with the actual data reported by the MDC for the same year. Table 3.23 shows that the initial output from Vensim was lower (2802) than the actual trend (2859). The critical data used to quantify the parameter for the total dental therapists in this modelling testing is considered valid and acceptable as the output reflects the reality. Therefore, it was used in the subsequent modelling activities for forecasting.

Table 3.23: Comparison between the Vensim and the actual trends on the total dental therapist outputs in 2015-2020

The volume of DT and Dentist (Vensim)		2015	2018	2020
A	Volume for PuDt	2726	2802	2852
	Volume for dentist (PuD) & (PrD)	4021	9165	11505
#Actual trend of DT and Dentist				
B	Actual trend PuDt	2726	2859	-
	Actual trend Dentist (PuD) & (PrD)	6644	9717	-
Difference (B-A)				
C	Dentist	2623	552	-
	Dental therapist	0	57	-

Source: Ministry of Health Malaysia (2013;2015;2017)

Attrition rate of DT and dentist 1.0%, *returning rate DT dentist 0.1%

PuD: Public Dentist; PuDt: Public dental therapist; PrD: Private dentist

3.4.2.5 Stage 5: Implementation of various tested policies virtually (scenario testing).

Following the test and validation process, scenario testing was conducted to describe the modes of behaviour (Sterman, 2000). Various policy options informed by the findings from Phase 1 surveys were considered, balanced and tested. Then, the model's responses were examined to inform the practical decision to the policymakers (Senge & Forrester, 1980). Thus, those findings were used, adopted and tested to seek the best scenario that fit in the situation.

3.4.2.5.1 Scenario testing

Figure 3.9 illustrates the four scenarios that serves as the alternative scenario which caused the structural and behavioral changes in the SD model. All other parameters remain constant in the baseline scenario and are presumed to continue as at present.
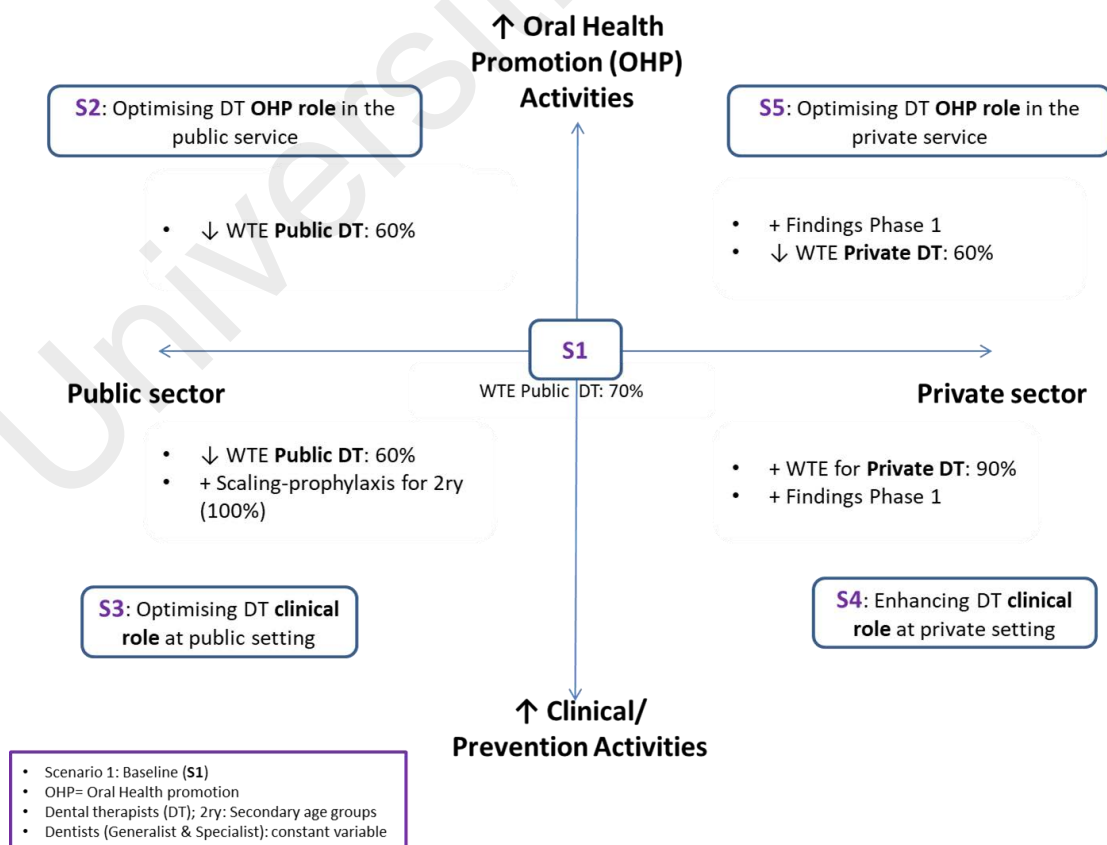
Figure 3.9: The alternative scenarios testing for future Malaysian dental therapists.

This model was first run to test a basic scenario and four other policy scenarios over a period of 15 years up to 2030. Those scenarios have their own focus and philosophy of care, working patterns, privatisation and training rate as well as the level of demand that serve as base for designing a policy. Then, the output was compared with a 'baseline' or current trend projection. There were four suggested changes (scenarios) relating to the model behaviour, in terms of the sector and clinical activities (Figure 3.8) that could cause alteration in the model structure especially the supply side. The outcomes were in the form of workforce volume, ratios, clinical hours and the level of unmet demands for dental therapist and dentist across sector in both sectors. This scenario also projected the volume of dental workforce under the assumption that current flows and patterns will continue unchanged by the needs and demands of the population.

As shown in Table 3.24 few factors have been integrated based on the supply, needs, and demands to create five scenarios, including the baseline scenario as follows.

Scenario 1: Baseline (Definitive scenario)

This baseline scenario forecasts the dental workforce under the assumption that current trend continues as it is (assuming that there are no changes in the Dental Act). Therefore, no changes can be seen under normal delegation of task and WTE of 70% (data from Table 4.2, Percentage of daily task) being used as the reference point against other four scenarios to predict the future workforce behaviour in Malaysia.

Scenario 2

The aim of this scenario was to optimise dental therapist's oral health promotion role in the public sector and by reducing the WTE to 60% based on pilot project conducted among dental therapist in Federal Territory of Kuala Lumpur (Mohd Zamzuri & Othman, 2017)

Scenario 3

The aim for this scenario was to optimise dental therapist clinical role in public sector by assuming 100% of scaling and prevention activities delegated under dental therapist care for secondary schoolchildren while the WTE remain at 60%. This scenario was based on researchers own observation and experience as public dentist in managing a public dental clinic.

Scenario 4

This scenario has its sub-scenarios with the aim to enhance private dental therapist's clinical role. Under this scenario the switch in demand to the private sector and the WTE of 90% was introduced as the policy started to focus on strengthening private primary delivery service. The current flows and patterns of the dental workforce were tested under three different assumptions informed by Phase 1 findings:

Scenario 4 (a): Testing the scenario if public dental therapists were allowed to work at the private sector by assuming that 8.3% of them had the intention to leave the public sector (findings from Phase 1; Table 4.15).

Scenario 4 (b): Testing the scenario if private dentists were willing to employ dental therapists by assuming 15.5% of them would employ dental therapist in their clinic (findings from Phase 1: Table 4.40).

Scenario 4 (c): Testing the scenario if parents allowed dental therapists to provide dental care at the private settings (Table 4.27) by assuming that 76.4% parents would give permission. However, for this scenario, the rate use was capped at 15.5%

Scenario 5

Scenario 5 assumed changes in the model structure and projects the dental workforce under the following assumptions:

1. Optimising private dental therapist OHP role in the private sector

2. Strengthening private dental service

3. More clinical hours supply for OHP among private dental therapist

The following factors have been incorporated into the model to obtain an expected future:

1. WTE reduces from 90% to 60%

2. Privatisation rate remained at 8.3%

3. 33.3% private dental therapist wish to work part-time at private setting

Given this is a modelling work of policy testing, policy analysis scenario testing focuses on analysing future uncertainties and the impact of 'policy options' within the Malaysian dental workforce, specifically the impact of introducing the DT into private setting as it could be argued that there is the potential for unfavourable and less clear outcomes across all futures. The details as in Table 3.24.

Table 3.24: The philosophy for each scenario testing used in Phase 2

No.	Parameters		Scenario 1 **Definitive Scenario (baseline)**	Scenario 2 **Optimising DT promotion/admin role in the public service**	Scenario 3 **Optimising DT clinical role at public setting**	Scenario 4 **Enhancing DT clinical role at private setting**	Scenario 5 **Optimising DT promotion/admin role in the private service**
1	Philosophy of care		Status quo	Policy on strengthening public primary delivery and service		Policy on strengthening private primary delivery and service	Policy on strengthening private dental service
			Assumes that current trends continue	To provide more clinical hours supply for administration and promotion works from **public DT (PuDt)**	To provide more clinical hours supply for hygienist activities from PuDT	To create clinical hours supply from **private DT (PrDt)**	To provide more clinical hours supply for administration and promotion works from private DT
2	Delegation of tasks/ working patterns		Normal delegation of tasks	More provision of primary care from DT in performing oral health promotion and admin work.	More provision of primary care from DT in treating perio cases	More provision of primary care service from DT at private sector Scenario **4 (a)**: Work delegation **preferred by DT** (Phase 1)	More provision of primary care from PrDT in performing admin and promotion works
			DT treating all assigned treatment to patients age groups of toddler, preschool and primary school at public setting.		More delegation of scaling (100%) activities to public DT at secondary age groups	Scenario **4 (b)**: Work delegation **preferred by Private Dentist** (Phase 1)	
					More provision of primary care from DT	Scenario **4 (c)**: Work delegation **preferred by parents** (Phase 1)	
			WTE rate as at present (70%)	WTE rate (public) is reduced from 70% to **60%**	WTE rate (public-private) similar to S2	WTE is introduced at 90%	WTE rate (public) is similar to S2, WTE rate (private) is reduced from 90% to 50%
			100% PuDt working Full-time (FT)			33.3% PrDt wish to work part-time (PT) at private setting (Phase 1)	
3	Privatisation rate		Privatisation rate for DT as at present (0%)			Scenario 4 (a): 8.3% of **public DT preferred** to do work at private sector (Phase 1).	Privatisation rate for dental therapists as at present (8.3%)
						Scenario 4 (b): 15.5% of **private dentists willing to delegate work** to DT (Phase 1)	Privatisation rate for dentists as at present
						Scenario 4 (c): 76.4% of **parents accept DT** to treat their children at private sector ; the rate is capped at 15.5% same as 4 (b)	
4	Training rate		Training rate is continued as at present (50 student in a year)	Training rate is continued as at present	Training rate is continued as at present	Training rate is continued as at present	Training rate is continued as at present
	Recommended scenario		**Scenario5: 4(a) + reduced WTE (60%);** Fulfilling PuDt career expectation (privatisation, doing part-time)+ optimising PrDt promotion role in the private service				
5	Population	Birth and death rate modified intervally	Similar to baseline scenario	Similar to baseline scenario	Similar to baseline scenario	Similar to baseline scenario
		Proportion across age-bands modified					
		Constant of imigration net rate					
6	Oral health needs		Oral health need decreased by 5% in 2025 and 2030	Similar to baseline scenario	Similar to baseline scenario	Similar to baseline scenario	Similar to baseline scenario
7	Level of demands for dental care (increase gradually over time)	Toddler (2.2- 20.2%)	Similar to baseline scenario	Similar to baseline scenario	Similar to baseline scenario	Similar to baseline scenario
		Pre-school (32.3-100%)				
		Primary school (98-100%)				
		Secondary school (80.5-100%)				
		Adults (11.1-39.1%)			Scenario: Percentages of work delegation perceived by private dentists to DT across 7 domains of work at private sector (primary care)- private dentists views	
		Elderly (9.5-56.6%)				

Modified from (Che Musa, 2017)

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CHAPTER 4: RESULTS

Introduction

In this chapter, findings from Phase I are presented based on the population studied and the relevant study objectives. This is followed by findings obtained from Phase II. The chapter ends by summarising the main findings for each objective of the study.

PHASE 1 FINDINGS

4.1 Study 1: The Malaysian dental therapists'

In this sub chapter, findings are presented based on the study objectives. Descriptive results of the participants'characteristics, re-evaluation of psychometric properties of the instruments, followed by job motivation, job satisfaction, intention to leave, and perceptions towards being employed in the private practices are presented. Finally, the results on the factors associated with the intention to leave among the dental therapists are shown.

4.1.1 Response rate

A total of 1119 questionnaires were distributed to randomly selected dental therapists. A total of 1078 was returned; giving a response rate of 96.3 %. Table 4.1 shows the distribution of respondents by states in Malaysia and its respective response rates.

Table 4.1: Distribution of participants by states in Malaysia (N=1078)

No	State	*Number of dental therapists	Number of eligible participants	Number of responses	Response rate (%)
1	Selangor	240	236	228	96.6
2	Pulau pinang	201	192	192	100.0
3	Kelantan	198	197	179	90.7
4	Melaka	102	98	98	100.0
5	Sarawak	407	396	381	96.2
	Overall	**1148**	**1119**	**1078**	**96.3**

Source: (Oral Health Program,2019)

4.1.2   Characteristic of the participants

More than a quarter of the participants (35.3%) worked in Sarawak and most (66.0%) were Malay in origin with a mean age of 38±8.7 years old. The majority of the participants held a diploma (98.3%) but never underwent for a post-basic course (91.4%). An almost equal proportion of participants were at Grade U29 (50.3%) and U32 and above (49.7%), and their mean years of working experience was 14.3±8.6. Slightly more than three-quarter (76.8%) worked at dental clinics. The participants were either posted to their current workplace (49.5%) or they applied to work at the area (50.5%). Almost 40% of their working times were spent on doing administrative work, as compared to doing clinical (33.3%) or oral health education (28.1%).

Table 4.2: Characteristics of participants (N= 1078)

Characteristics	n (%)
State	
Selangor	228 (21.2)
Pulau Pinang	192 (17.8)
Melaka	98 (9.1)
Kelantan	179 (16.6)
Sarawak	381 (35.3)
Ethnicity	
Malay	711 (66.0)
Chinese	63 (5.8)
Indian	21 (1.9)
Others	283 (26.3)
Age	
Mean ± SD = 37.9±8.7	
20-29 years old	219 (20.3)
30-39 years old	417 (38.7)
40-49 years old	329 (30.5)
50-59 years old	113 (10.5)
Education level	
Diploma	1060 (98.3)
Degree / Master / PhD	18 (1.7)
Post basic attainment	
No	985 (91.4)
Yes	93 (8.6)
Grade	
U 29	542 (50.3)
U 32 and above	380 (49.7)
Years of service	
Mean ± SD = 14.3 ± 8.6	
1-10 years	387 (35.9)
11-20 years	449 (41.7)
≥ 21 years	242 (22.4)

Place of work	
Dental clinic	828 (76.8)
Hospital	30 (2.8)
Others	220 (20.4)
Current work placement	
Applied for this place	544 (50.5)
Posted here	534 (49.5)
Percentage of daily task	**Mean percentage ± SD**
Administrative	38.7 ± 21.1
Clinical	33.3 ± 16.0
Oral health education	28.1 ± 12.8

4.1.3 To describe the dental therapists' awareness on the establishment of the Therapist Division under the new Dental Act 2018 (Objective 1).

Table 4.3 lists the parameters used in assessing the dental therapists' awareness regarding the Therapist Division in the Dental Act 2018. Majority of the participants (96.8%) knew that a dental therapist must register with the MDC in order to practice and that dental therapist can be fined if they worked with someone who is not registered with the council (94.8%). More than three-quarter (79.1%) were also aware on the establishment of the Therapist Division in the Dental Act 2018 and that they can work in the private sector (71.2%). Almost 60% correctly acknowledged that they must work under the direct supervision of a dental surgeon.

However, only about 7% correctly answered on the age group that they are allowed to treat and only 12.7% knew that taking dental x-ray as per instructed is not under their job scope. Only slightly more than half (51.5%) knew that they are not warranted to perform subgingival scaling to adult patients. Majority (93.8%) incorrectly thought they

can make the treatment plan but more than three-quarter (88.8%) knew that the placement of fissure sealants on adults is not under their job scope. Overall, the participants mean total score on awareness was 6.4 ± 1.4 out of ten items questioned.

Table 4.3: Awareness of the Dental Act of 2018. (N=1078)

Item	Correct (%)	Incorrect (%)
1. There is a provision of the Therapist Division.	853 (79.1)	225 (20.9)
2. To be able to practice, a dental therapist must register themselves at the Malaysian Dental Council.	1043 (96.8)	35 (3.2)
3. Dental therapists can only treat patients aged 17 years old and below.	75 (7.0)	1003 (93.0)
4. Dental therapists are allowed to work at a private dental clinic	768 (71.2)	310 (28.8)
5. Dental therapists must work under the direct supervision of a dental surgeon.	635 (58.9)	443 (41.1)
6. A dental therapist can make a treatment plan on her own.	67 (6.2)	1011 (93.8)
7. Dental therapists can place fissure sealant on adults' patients	957 (88.8)	121 (11.2)
8. All dental therapists can perform subgingival scaling on their patients.	555 (51.5)	523 (48.5)
9. All dental therapist can take dental x-ray as per instructed by the dental surgeon	941 (87.3)	137 (12.7)
10. Dental therapists can be fined if intentionally practising dentistry with individuals who do not have a valid dental practising certificate.	1022 (94.8)	56 (5.2)
Mean awareness score ± SD	6.42 ± 1.42	

Correct = score 1; Incorrect = score 0

4.1.4 Re-evaluation of psychometric properties of the instruments

Re-evaluation provides needed confirmation that the instruments are a valid and reliable measure of the WCW (job motivation, job satisfaction) and intention to leave scales for the targeted population.

4.1.4.1 Reliability analyses

Tables 4.4, 4.5 and 4.6 show the internal consistency for job motivation, job satisfaction and intention to leave scales. The Cronbach's alpha based on standardised items for job motivation, job satisfaction and intention to leave were 0.89, 0.94 and 0.91, respectively. These scores were above the recommended levels of good internal consistency (Nunnally, 1978).

Table 4.4: Internal consistency of the job motivation scale (N=1078)

Items on job motivation	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
(1) I feel a sense of personal satisfaction when I do this job well	0.67	0.88
(2) I am disappointed with myself if I do this job badly.	0.66	0.88
(3) I take pride in doing my job to the best I can	0.74	0.87
(4) I feel unhappy when my work is not up to my usual standard	0.71	0.87
(5) I want to feel satisfied when I look back at the work I did on that day.	0.75	0.87
(6) I try to think of ways of doing my job effectively	0.75	0.86
Cronbach's Alpha Based on Standardized Items =	0.89	

Table 4.5: Internal consistency findings of the job satisfaction scale (N=1078)

Items on job satisfaction	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
(1) Physical work	0.63	0.94
(2) Teammates	0.54	0.94
(3) Immediate boss	0.69	0.94
(4) Pay rate	0.53	0.94
(5) Relationship in workplace	0.70	0.94
(6) Well managed workplace	0.78	0.94
(7) Job safety	0.67	0.94
(8) Freedom to work	0.76	0.94
(9) Acknowledgement	0.74	0.94
(10) Work responsibilities	0.76	0.94
(11) Chances to use abilities	0.75	0.94
(12) Promotion opportunity	0.65	0.94
(13) Appreciation of suggestion	0.75	0.94
(14) Job variety	0.72	0.94
(15) Work hours	0.64	0.94
Cronbach's Alpha based on Standardized Items	0.94	

Table 4.6: Internal consistency of the intention to leave scale (N=1078)

Items on intention to leave	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1) I often think about leaving this post.	0.72	0.91
2) I will probably look for a job at a new organisation in the next 12 months.	0.80	0.88
3) As soon as I can find another job, I will leave this post.	0.84	0.86
4) I plan to leave the profession of dental therapist for a different career.	0.82	0.87
Cronbach's Alpha Based on Standardized Items	0.91	

Tables 4.7, 4.8 and 4.9 show the scores for the corrected item-total correlation (CITC) which ranged between 0.66 – 0.75 for job motivation, 0.54 - 0.78 for job satisfaction and 0.72 – 0.84 for intention to leave, which were above the recommended levels of 0.20 (Kline, 1986). The inter-item correlation scores which were positive indicates that the item was homogenous for job satisfaction, job motivation and intention to leave. The highest correlation for each item with at least one other item in the construct was between 0.3 and 0.9. Hence, the items correlate adequately in the construct.

Table 4.7: Inter item correlation for job motivation scale (N=1078)

Items on job motivation	(1)	(2)	(3)	(4)	(5)	(6)
(1) I feel a sense of personal satisfaction when I do this job well	1.000					
(2) I am disappointed with myself if I do this job badly.	0.51	1.00				
(3) I take pride in doing my job to the best I can	0.66	0.52	1.00			
(4) I feel unhappy when my work is not up to my usual standard	0.46	0.62	0.56	1.00		
(5) I want to feel satisfied when I look back at the work I did on that day.	0.57	0.53	0.63	0.62	1.00	
(6) I try to think of ways of doing my job effectively	0.58	0.52	0.65	0.61	0.70	1.00
Mean	3.52	3.41	3.64	3.48	3.53	3.58
SD	0.54	0.63	0.49	0.56	0.53	0.51

Table 4.8: Inter item correlation for job satisfaction scale (N=1078)

Item for job satisfaction	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Physical work	1.00														
(2) Teammates	0.51	1.00													
(3) Immediate boss	0.48	0.44	1.00												
(4) Pay rate	0.36	0.27	0.34	1.00											
(5) Relationship in workplace	0.47	0.41	0.57	0.43	1.00										
(6) Well managed workplace	0.51	0.45	0.63	0.41	0.67	1.00									
(7) Job safety	0.44	0.38	0.49	0.45	0.50	0.62	1.00								
(8) Freedom to work	0.50	0.40	0.59	0.41	0.58	0.67	0.63	1.00							
(9) Acknowledgement	0.49	0.41	0.55	0.40	0.56	0.58	0.48	0.61	1.00						
(10) Work responsibilities	0.52	0.40	0.54	0.43	0.52	0.63	0.53	0.63	0.61	1.00					
(11) Chances to use abilities	0.47	0.41	0.51	0.37	0.49	0.60	0.50	0.59	0.63		1.00				
(12) Promotion opportunity	0.41	0.33	0.42	0.47	0.43	0.50	0.45	0.50	0.56	0.51	0.57	1.00			
(13) Appreciation of suggestion	0.43	0.40	0.60	0.38	0.57	0.64	0.49	0.59	0.61	0.61	0.63	0.60	1.00		
(14) Job variety	0.45	0.38	0.48	0.39	0.52	0.57	0.50	0.55	0.53	0.60	0.62	0.52	0.68	1.00	
(15) Work hours	0.42	0.48	0.43	0.40	0.44	0.46	0.43	0.50	0.47	0.52	0.56	0.44	0.50	0.56	1.00
Mean	3.24	3.33	3.06	2.89	2.98	2.95	2.91	3.00	3.07	3.00	3.16	2.96	2.94	2.99	3.22
SD	0.60	0.59	0.69	0.70	0.60	0.64	0.65	0.62	0.65	0.61	0.57	0.69	0.60	0.61	0.57

Table 4.9: Inter-item correlation for intention to leave scale (N=1078)

Item for intention to leave	(1)	(2)	(3)	(4)
(1) I often think about leaving this post.	1.00			
(2) I will probably look for a job at a new organisation in the next 12 months.	0.67	1.00		
(3) As soon as I can find another job, I will leave this post.	0.67	0.78	1.00	
(4) I plan to leave the profession of dental therapist for a different career.	0.67	0.73	0.82	1.00
Mean	1.76	1.39	1.48	1.49
SD	0.90	0.68	0.77	0.78

4.1.4.2 Validity assessment

Exploratory factor analysis (EFA) was carried out for job motivation, job satisfaction and the intention to leave scales in order to identify the underlying structure of relationships among individual items.

The percentage of variance is 51.72% for job satisfaction items. By using a scree test criterion, one single factor was extracted where all the items showed a factor loading ranging from 0.55 to 0.81. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.96 as shown in Table 4.10

Table 4.10: Promax rotation for job satisfaction items (1 factor) with Extraction Method is Principal Axis Factoring (N=1078)

Items on job satisfaction:	Factor 1
(1) Physical work	0.65
(2) Teammates	0.55
(3) Immediate boss	0.71
(4) Pay rate	0.54
(5) Relationship in workplace	0.72
(6) Well managed workplace	0.81
(7) Job safety	0.69
(8) Freedom to work	0.79
(9) Acknowledgement	0.76
(10) Work responsibilities	0.79
(11) Chances to use abilities	0.78
(12) Promotion opportunity	0.67
(13) Appreciation of suggestion	0.78
(14) Job variety	0.74
(15) Work hours	0.66
Percentage of variance (%)	51.72

Kaiser-Meyer-Olkin = 0.96; Sig = 0.00; Barlett's Test of Sphericity = 10508.27

One single factor extracted for job motivation and intention to leave items as shown in Table 4.11 and Table 4.12. All the items showed a factor loading ranging from 0.69 – 0.91. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.88 and 0.83 for the latter. The percentage of variance is 58.41% for job motivation and 72.58 % for intention to leave.

Table 4.11: Promax rotation for job motivation items (1 factor) with Extraction Method is Principal Axis Factoring (N=1078).

Items on job motivation:	Factor 1
(1) I feel a sense of personal satisfaction when I do this job well	0.72
(2) I'm disappointed with myself if I do this job badly.	0.69
(3) I take pride in doing my job to the best I can	0.80
(4) I feel unhappy when my work is not up to my usual standard	0.75
(5) I want to feel satisfied when I look back at the work I did on that day.	0.81
(6) I try to think of ways of doing my job effectively	0.81
Percentage of variance (%)	58.41

Kaiser-Meyer-Olkin = 0.88; Sig = 0.00; Barlett's Test of Sphericity = 3467.56

Table 4.12: Promax rotation for intention to leave items (1 factor) with Extraction Method is Principal Axis Factoring (N=1078).

Items on intention to leave:	Factor 1
1) I often think about leaving this post.	0.76
2) I will probably look for a job at a new organisation in the next 12 months.	0.86
3) As soon as I can find another job, I will leave this post.	0.91
4) I plan to leave the profession of dental therapist for a different career.	0.88
Percentage of variance (%)	72.58

Kaiser-Meyer-Olkin = 0.83; Sig = 0.00; Barlett's Test of Sphericity = 3070.17

All items in the three constructs showed a factor loading of greater than 0.32, thus, acceptable to be used in the target population (Tabachnick & Fidell, 2014) while the KOM exceeded the recommended value of 0.6 as the minimum value for good factor analysis (Tabachnick & Fidell, 1996). Overall, the validity results indicated that this instrument is valid for use among Malaysian dental therapist.

4.1.5 To describe dental therapists' job motivation, job satisfaction, intention to leave and their perceptions of employment in private practice (Objective 2)

4.1.5.1 Dental therapists' job motivation, job satisfaction and intention to leave

Table 4.13 describes the job motivation items used in this study. Majority of participants agreed or completely agreed to the following statements "I take pride in doing my job to the best I can" (99.4%) and "I try to think of ways of doing my job effectively" (99.2%). The other items also show high agreement in job motivation with the total mean score of 21.16 ± 2.63.

Table 4.13: Job motivation among dental therapist (N=1078)

Item	Completely disagree	Disagree	Agree	Completely agree	Mean ± SD
	n (%)	n (%)	n (%)	n (%)	
1.I feel a sense of personal satisfaction when I do this job well	0	24 (2.2)	470 (43.6)	584 (54.2)	3.52 ± 0.54
2. I'm disappointed with myself if I do this job badly.	11 (1.0)	51 (4.7)	498 (46.2)	518 (48.1)	3.41 ± 0.63
3. I take pride in doing my job to the best I can	0	7 (0.6)	371 (34.4)	700 (64.9)	3.64 ± 0.49
4. I feel unhappy when my work is not up to my usual standard	4 (0.4)	24 (2.2)	500 (46.4)	550 (51.0)	3.48 ± 0.56
5.I want to feel satisfied when I look back at the work I did on that day.	0	14 (1.3)	481 (44.6)	583 (54.1)	3.53 ± 0.53
6.I try to think of ways of doing my job effectively	0	9 (0.8)	440 (40.8)	629 (58.3)	3.58 ± 0.51
				Total job motivation score	21.16 ± 2.63

Each Likert scale score = 1; each item score = 4

While for the job satisfaction as shown in Table 4.14, majority of the participants were satisfied with their physical work (92%), teammates (94.2%), chances to use abilities (91.7%), job variety (92%) and work hours (92.7%). Similarly, four-fifth reported being satisfied with their immediate boss (84%), relationship in the workplace (84%), workplace management (80.6%), freedom to work (84.5%), acknowledgement received (85%), work responsibilities (84.5%), and appreciation of suggestions to the organizations made by them (81%). However, almost one-quarter felt dissatisfied with their pay rate (24.4%), job safety (21.2%), and promotion opportunity (20.5%). Overall, the total mean scores for job satisfaction were 45.70 ±6.86.

Table 4.14: Job satisfaction among dental therapist (N=1078)

Item		Very dissatisfied	Dissatisfied	Satisfied	Very satisfied	Mean ± SD
		n (%)	n (%)	n (%)	n (%)	
1	Physical work	0	24 (2.2)	584 (43.6)	584 (54.2)	3.24 ± 0.60
2	Teammates	2 (0.2)	61 (5.7)	598 (55.5)	417 (38.7)	3.33 ± 0.59
3	Immediate boss	28 (2.8)	144 (13.4)	624 (56.6)	264 (24.5)	3.06 ± 0.69
4	Pay rate	35 (3.2)	228 (21.2)	637 (59.1)	178 (16.5)	2.89 ± 0.70
5	Relationship in workplace	16 (1.5)	157 (14.6)	741 (68.7)	164 (15.2)	2.98 ± 0.60
6	Well managed workplace	19 (1.8)	190 (17.6)	695 (64.5)	174 (16.1)	2.95 ± 0.64
7	Job safety	26 (2.4)	203 (18.8)	688 (63.8)	161 (14.9)	2.91 ± 0.65
8	Freedom to work	17 (1.6)	158 (14.7)	713 (66.1)	190 (17.5)	3.00 ± 0.62
9	Acknowledgement	16 (1.5)	146 (13.5)	659 (61.1)	257 (23.8)	3.07 ± 0.65
10	Work responsibilities	15 (1.4)	152 (14.1)	725 (67.3)	186 (17.3)	3.00 ± 0.61
11	Chances to use abilities	7 (0.6)	83 (7.7)	723 (67.1)	265 (24.6)	3.16 ± 0.57

Table 4.14, continued

12	Promotion opportunity	28 (2.6)	193 (17.9)	650 (60.3)	207 (19.2)	2.96 ± 0.69
13	Appreciation of suggestion	11 (1.0)	194 (18.0)	723 (67.1)	150 (13.9)	2.94 ± 0.60
14	Job variety	12 (1.1)	165 (15.3)	719 (66.7)	182 (16.9)	2.99 ± 0.61
15	Work hours	3 (0.3)	76 (7.1)	680 (63.1)	319 (29.6)	3.22 ± 0.55
16	Overall job satisfaction	3 (0.3)	83 (7.7)	735 (68.2)	257 (23.8)	3.16 ± 0.57
		Total job satisfaction score item (1) – (15)				45.70 ±6.86

Each Likert scale score = 1; each item score = 4

Only about one-quarter of the participants ever thought of leaving their post (21.5%), as shown in Table 4.15. Furthermore, among the participants, only a small number intended to seek another job in different organisations (8.3%). Slightly more than one-tenth has the intention to leave their post when they get another job (11.5%) and 11.5% planned to leave their profession for a different career. Of all, 13% had high intention of leaving their job as a dental therapist.

Table 4.15: Intention to leave among dental therapist (N=1078)

Item	Completely disagree & disagree	Agree & completely agree	Mean ± SD
	n (%)	n (%)	
1. I often think about leaving this post.	846 (78.5)	232 (21.5)	0.22 ± 0.41
2. I will probably look for a job at a new organisation in the next 12 months.	989 (91.7)	89 (8.3)	0.08 ± 0.28
3. As soon as I can find another job, I will leave this post.	954 (88.5)	124 (11.5)	0.12 ± 0.32
4. I plan to leave the profession of dental therapist for a different career.	950 (88.1)	128 (11.9)	0.12 ± 0.32
	Total intention to leave score		0.53 ± 1.11
	Level of intention to leave		**n (%)**
	Low intention		938 (87.0)
	High intention		140 (13.0)

Completely disagree and disagree, score=0; Agree & completely agree, score= 1
*Low intention: scored 0; * High intention: scored 1

4.1.5.2 Dental therapists' perceptions of employment in private practice

This section asked on dental therapists' perception of employment opportunity in the private practice. Questions asked included their expected role in dentistry and sector they foresee to work in the next five years, their future planning, and factors that influence it. More than two-thirds (67.2%) of the participants expected to still be a dental therapist in the next five years while one-fifth (20.4%) aimed to be a post-basic dental therapist (Table 4.16).

Table 4.16: The expected role in dentistry in 5 years

Role	n (%)
Dental therapist	724 (67.2)
Post basic dental therapist	220 (20.4)
Others (n=134)	134 (12.4)
Career break	30 (2.8)
Different career	48 (46.4)
Need more experience before deciding	38 (3.5)
Do not want to work	5 (0.5)
Family commitment	18 (1.7)
Pension/retirement	53 (4.9)
Do not know	13 (1.2)
Other reasons	7 (0.5)

For this question, participants were given the options to provide additional comments on their other expected role in dentistry in 5 years. Only 0.5% provided insight on this aspect.

The open-ended response:

1) Further study

Four participants indicated that they would like to further their studies but did not specify the fields of study. As stated by one participant:

"I want to further my study and advance to a higher level than my current position."

(Participant #103)

Health issue

One participant did not foresee to still be working in the dental field in the future, as stated by her:

"Because of my health problem"

(Participant #749)

Better income

Another participant hoped to get a higher income elsewhere

"I want a better income than what I have now"

(Participants #286)

Of those who chose to remain as a dental therapist, only 7% considered to work in the private sector (Table 4.17). A majority wished to provide oral hygiene education (98.5%) extraction of primary teeth (80.3%), placement of fissure sealant (83.3%) and application of topical fluoride and gel (86.4%) at the private sectors.

Table 4.17: The sector they foresee working within the next 5 years and the chosen treatment they prefer provide to the patients if they were to work in the private sector (n=944).

Sectors	n (%)
Public sector	828 (87.7)
University (Ministry of Education Malaysia)	50 (5.3)
Private sector	66 (7.0)
Type of dental treatment they prefer to provide to the patients if they choose to work in the **private sector** (n=66).	
Giving oral health instruction	65 (98.5)
Carry out Class I, II, III and V restorations	48 (72.7)
Extraction of primary teeth	53 (80.3)
Placement of fissure sealant	55 (83.3)
Application of topical fluoride and gel	57 (86.4)
Scaling and polishing	47 (71.2)

More than three-quarter (79.7%) of the participants perceived of working full time in the future with a mean number of 8 ± 2.4 sessions per week (Table 4.18). In this context, part time work was defined as working less than 10 sessions per week.

Table 4.18: Their long-term plan to work and number of sessions they envisage working in dentistry (n=944)

Perceived type of future working hours *	n (%)
Full time	752 (79.7)
Part-time	105 (11.1)
Do not know	87 (9.2)
Perceived future number of sessions*	**n (%)**
Part-time	435 (46.1)
Full-time	509 (53.9)
Mean session ± SD	8.01 ± 2.36

*Part-time = 1-9 session; Full-time = 10 session

Table 4.19 describes the 'important' and 'very important' factors that determine the number of sessions they were willing to work in the future. The most important factors perceived were childcare commitment (91%), financial stability (94.8%), work-life balance (92.1%) and professional development opportunity (89.3%). Job variety (23%) was the least or not an important factor in this aspect.

Table 4.19: Factors that determines the number of sessions the participants will work in a week in the long term (N=944)

No	Item	Very important n (%)	Important n (%)	Less important n (%)	Not important n (%)
1	Childcare commitment	663 (70.2)	224 (20.8)	38 (4.0)	19 (2.0)
2	Other family commitment	569 (60.3)	312 (28.9)	47 (5.0)	16 (1.7)
3	Financial stability	707 (74.9)	188 (19.9)	36 (3.8)	13 (1.4)
4	Work life balance	687 (72.8)	208 (19.3)	35 (3.7)	14 (1.5)
5	Job variety	260 (27.5)	467 (27.5)	178 (18.9)	39 (4.1)
6	Further other intention	105 (11.1)	321 (29.8)	377 (39.9)	141 (14.9)
7	Professional development	411 (43.5)	432 (45.8)	90 (8.3)	11 (1.2)

1= Very important to 4= not important

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4.1.6   To determine the factors associated with the intention to leave among the dental therapists (Objective 3).

4.1.6.1   Univariate analysis (simple logistic regression)

Table 4.20 shows the crude odds ratio values for all possible factors of intention to leave. Indian was 4.22 times (95% CI: 1.58, 11.27) more likely to have an intention to leave as compared to the reference group "other ethnicity". Those who were in Grade U 29 (OR= 1.63, 95% CI: 1.13, 2.34) and those who foresaw working within the private sector in the next five years (OR=3.69, 95% CI: 2.00, 6.82) also had an increase odds of having the intention to leave. Those who worked within 11 to 20 years (OR= 0.48, 96% CI: 0.32, 0.72) or more than 20 years in the public sector (OR= 0.57, 96% CI: 0.35, 0.92) were less likely to have the intention to leave as compared to the reference group i.e. those who had 1 to 10 years of service. Meanwhile, diploma holders (OR=0.22, 95% CI: 0.08, 0.59) those who had high job satisfaction level (OR=0.83, 95% CI: 0.79, 0.87) and those who did not expect to still be a dental therapist in the next 5 years (OR=0.15, 95% CI: 0.09, 0.22) had lower odds of intending to leave as compared to their reference group.

All of these significant variables were included into the multivariate analysis together with other factors with the p-value of less than 0.25 (age, ethnicity, awareness score and job motivation score). Despite giving insignificant results, the researchers decided to include "current postings" into the multivariate analysis as there was an almost equal number of participants who were posted voluntarily or by request and this may potentially bear significant outcome.

Table 4.20: Association between various factors with the prevalence of high intention to leave among dental therapists using simple logistic regression (n=140)

Variables	Crude Odds Ratio	95% Confidence Intervals	Wald Statistics	df	P-value
Age (years old)					
20-29 years old	1.83	0.93,3.56	3.11	1	0.078
30-39 years old	1.10	0.57,2.09	0.07	1	0.781
40-49 years old	0.86	0.43,1.69	0.19	1	0.658
50-59 years old	Reference				
Ethnicity					
Malay	1.30	0.84,2.01	1.39	1	0.237
Chinese	122	0.53,2.82	0.23	1	0.631
Indian	4.22	1.58,11.27	8.23	1	0.004*
Others	Reference				
Workplace					
Dental clinic	1.35	0.84,2.17	1.56	1	0.21
Hospital	1.32	0.42,4.11	0.26	1	0.64
Others	Reference				
Education attainment					
Diploma	0.22	0.08,0.59	9.15	1	0.002*
Degree/Master/PhD	Reference				
Years in the service					
1-10 years	Reference				
11-20 years	0.48	0.32,0.72	12.51	1	0.000*
≥ 21 years	0.57	0.35,0.92	5.39	1	0.020*
Grade					
U 29	1.63	1.13, 2.34	6.92	1	0.009*
U 32 and above	Reference				

*p-value <0.05

Table 4.20, continued

Variables	Crude Odds Ratio	95% Confidence Intervals	Wald Statistics	df	P-value
Post basic course					
No	0.83	0.45,1.50	0.38	1	0.536
Yes	Reference				
Current postings					
Posted	1.17	0.82,1.66	0.71	1	0.400
Applied	Reference				
Awareness score	0.90	0.80,1.02	2.57	1	0.109
Job motivation score	0.83	0.62,1.10	1.64	1	0.201
Job satisfaction score	0.83	0.79,0.87	67.77	1	0.000*
Expected role in dentistry in 5 years					
Dental therapist	Reference				
Not in dentistry	0.15	0.09,0.22	83.02	1	0.000*
Sector they foresee working within the next 5 years (n=944)					
Public	Reference				
Private	3.69	2.00,6.82	17.42	1	0.000*

*p-value <0.05

4.1.6.2 Multivariate analysis; using multiple logistic regression

Table 4.21 shows that the significant predictors for having high intention to leave are educational attainment, years in the service, job satisfaction score and the type of sectors dental therapists foresaw of working in the next five years.

The odds of a diploma holder having the intention to leave were 0.24 times lower than among those with higher-level education level (OR=0.24, 95% CI=0.07, 0.86). Those who worked within 11 to 20 years were 0.51 times less likely to have an intention

to leave than the reference group of those who worked within 1-10 years (OR=0.51, 95% CI=0.30, 0.86).

Dental therapists with high job satisfaction score were 0.89 times less likely to have the intention to leave among the dental therapists (OR=0.89, 95% CI=0.84, 0.94). Those who foresaw working in the private sectors within the next five years were 4.14 times more likely to have the intention to leave as compared to those who wished to stay in the public sector (OR=4.14, 95% CI=2.18, 7.85).

Table 4.21: Predictors of high intention to leave among dental therapists in multiple logistic regression analysis (n=140)

Variables	Adjusted Odds Ratio	95% Confidence Intervals	Wald Statistics	df	P-value
Education attainment					
Diploma	0.24	0.07,0.86	4.789	1	0.029*
Degree/Master/PhD	Reference				
Years of service					
1-10 years	Reference				
11-20 years	0.51	0.30,0.86	6.35	1	0.012*
≥ 21 years	0.58	0.30,1.13	2.56	1	0.110
Job satisfaction score	0.89	0.84,0.94	15.55	1	0.000*
Sector foresee working within the next five years					
Public	Reference				
Private	4.14	2.18,7.85	18.86	1	0.000*

p-value <0.05; Model; Hosmer and Lemeshow test, $\chi2(6) = 3.73$, p = 0.714; Cox and Snell R2 = 0.045; Nagelkerke R2 = 0.098; Percentage of correct classification = 91.0 %. Area under the curve (ROC)=0.69

4.1.6.3   Job motivation and job satisfaction items being the predictors on the high intention to leave among dental therapists.

Table 4.22 – 4.23 shows the crude odds ratio values for all items of job motivation and job satisfaction scale towards the intention to leave. Odds ratios of below 1 indicated an increase in motivation and satisfaction in their job and simultaneously a less likelihood for the intention to leave. Except for self-disappointment and unhappy with work done (Table 4.22), all the items were found to be significantly correlated with the prevalence of high intention to leave. However, as the *p*-value of self-disappointment was less than 0.25, it was considered to be potentially significant, and hence it was included in the multivariate analysis together with other significant items.

Table 4.22: Association between job motivation items with the prevalence of high intention to leave among dental therapists using simple logistic regression analysis (n=140)

Variables	Crude Odds Ratio	95% Confidence Intervals	Wald Statistics	df	P-value
Job motivation					
I feel a sense of personal satisfaction when I do this job well	0.53	0.38,0.73	15.31	1	0.000*
I'm disappointed with myself if I do this job badly.	0.84	0.64,1.10	1.59	1	0.207
I take pride in doing my job to the best I can	0.56	0.40,0.79	10.75	1	0.001*
I feel unhappy when my work is not up to my usual standard	0.92	0.67,1.26	0.28	1	0.598
I want to feel satisfied when I look back at the work I did on that day.	0.71	0.51,0.99	4.19	1	0.041*
I try to think of ways of doing my job effectively	0.64	0.46,0.90	6.55	1	0.010*

Table 4.23: Association between job satisfaction items with the prevalence of high intention to leave among dental therapists using simple logistic regression analysis (n=140)

Variables	Crude Odds Ratio	95% Confidence Intervals	Wald Statistics	df	P-value
Job satisfaction					
Physical work	0.37	0.27,0.50	40.73	1	0.000*
Teammates	0.40	0.29,0.55	33.73	1	0.000*
Immediate boss	0.48	0.37,0.61	34.91	1	0.000*
Pay rate	0.57	0.44,0.73	20.33	1	0.000*
Relationship in workplace	0.33	0.24,0.44	54.71	1	0.000*
Well managed workplace	0.32	0.24,0.42	62.14	1	0.000*
Job safety	0.50	0.38,0.65	26.61	1	0.000*
Freedom to work	0.40	0.30,0.53	40.30	1	0.000*
Acknowledgement	0.39	0.30,0.52	45.26	1	0.000*
Work responsibilities	0.33	0.25,0.44	54.45	1	0.000*
Chances to use abilities	0.37	0.27,0.50	37.75	1	0.000*
Promotion opportunity	0.43	0.34,0.56	41.81	1	0.000*
Appreciation of suggestion	0.38	0.28,0.51	39.60	1	0.000*
Job variety	0.38	0.28,0.51	41.31	1	0.000*
Work hours	0.55	0.41,0.76	13.86	1	0.000*
Overall job satisfaction	0.22	0.15,0.32	65.67	1	0.000*

Table 4.24 shows the significant predictors / associated items in job satisfaction scale factors for high intention to leave are well managed workplace and overall perceptions of job satisfaction. Odds ratios with below 1 indicated an increase in job satisfaction and a less likelihood for intention to leave.

Dental therapists who were satisfied with how well the workplace was managed were 0.54 times less likely to have the intention to leave among the dental therapists (OR=0.54, 95% CI=0.38, 0.78). Those who were satisfied with promotion opportunity were 0.73 times less likely to have the intention to leave among the dental therapists (OR=0.73, 95% CI=0.54, 1.001) but this finding was not significant. Dental therapists who were satisfied with their overall job were 0.41 times less likely to have the intention to leave (OR=0.41, 95% CI: 0.26,0.64)

Table 4.24: Predictors of high intention to leave among dental therapists based on job satisfaction items (n=140)

Variables	Adjusted Odds Ratio	95% Confidence Intervals	Wald Statistics	df	P-value
Job satisfaction					
Well managed workplace	0.54	0.38,0.78	11/01	1	0.001*
Promotion	0.73	0.54,1.001	3.83	1	0.050
Overall job satisfaction	0.41	0.26,0.64	14.98	1	0.000*

p-value <0.05; Model; Hosmer and Lemeshow test, $\chi2(5) = 1.99$, p = 0.85; Cox and Snell R2 = 0.083; Nagelkerke R2 = 0.154; Percentage of correct classification = 87.9 %. Area under the curve (ROC)=0.72

4.2 Study 2: Parental acceptance of dental therapist employment in the private practices

In this sub section, findings are presented based on the study objectives. Descriptive results of the participants' sociodemographic characteristics, dental service utilization followed by their perceived oral health status are presented. Then, findings on the parental acceptance of dental therapist employment in private practices and the influencing factors are described.

4.2.1 Response rate

Of 1260 distributed questionnaire, 1047 returned the questionnaire, giving a response rate of 83.1%. However, 125 responses were excluded from any analysis as more than 20% of the items were not completed. Hence, only 922 data were included in the analysis.

4.2.2 Descriptive analysis

4.2.2.1 Sociodemographic characteristics of the participants

Most of the participants were mothers (62.5%) and of Malay ethnicity (93.2 %) and their mean age was 41.5 (SD ± 5.5) years (Table 4.24). Fifty-eight percent obtained tertiary education and almost 70% had a household income of less than MYR 6,200. About 70% of the participants lived in the urban locality.

Table 4.25: Sociodemographic characteristics of the participants (N=922).

Characteristics		n (%)
Age		Mean ± SD = 41.5 ± 5.5
		Median = 41.0
Gender	Male	346 (37.5)
	Female	576 (62.5)
Ethnicity	Malay	859 (93.2)
	Chinese	31 (3.4)
	Indian	23 (2.5)
	Others	9 (1.0)
Educational level	No formal education	6 (0.7)
	Primary school	75 (8.1)
	Secondary school	308 (33.4)
	College/University	533 (57.8)
*Income	More than RM12,500	71 (7.7)
	RM6,201 - RM 12,499	220 (23.9)
	Less than RM 6,200	631 (68.4)
Locality	Urban	660 (71.6)
	Rural	262 (28.4)

4.2.2.2 Dental service utilisation and perceived oral health status

Majority of the participants were aware of the presence of government dental clinic nearby their home (83.4%) and 64.1% indicated that public sectors were their preference for their children's dental treatment (Table 4.25). However, slightly more than half of them (55.9%) have never visited a dentist for the past 12 months with majority perceived their teeth (90.5%) and gum (91.5%) to be in a fair to a very good condition.

Table 4.26: Dental service utilisation patterns and perceived oral health status among the participants (N=922).

Variables	Response	n (%)
Dental service utilisation		
Dental clinic (government or private) near their house	Yes	769 (83.4)
	No	107 (11.6)
	Do not know	46 (5.0)
Preferred dental clinic for their son/daughter's dental treatment	Government dental clinic	591 (64.1)
	Private dental clinic	285 (30.9)
	Do not know	46 (5.0)
Ever visited a dentist for the past 12 months	Yes	407 (44.1)
	No	515 (55.9)
Perceived oral health status		
Condition of their teeth	Poor	37 (4.0)
	Fair	389 (42.2)
	Good	421 (45.7)
	Very good	24 (2.6)
	Do not know	51 (5.5)
Condition of their gum	Poor	19 (2.1)
	Fair	318 (34.5)
	Good	489 (53.0)
	Very good	37 (4.0)
	Do not know	59 (6.4)

4.2.3 To assess the parental acceptance of dental therapist employment in private practices (Objective 4).

Table 4.26 summarises the possible type of dental procedures that parents would allow dental therapist to perform on their children at a private dental clinic. More than three quarter (87.7%) 'agreed' or 'completely agreed' if their child received advice on oral hygiene care, obtained application of topical fluoride gel and paste (83.2%), have a simple cavity filled (79.8%), or have fissure sealant applied (74.3%) by the dental therapist. Slightly more than two-thirds agreed for dental therapist to conduct the following operative tasks on children: 'to get an injection to make their teeth and gums go numb' (63.9 %), 'to pull out milk teeth' (62.0%) and 'to have scaling and polishing done' (69.8%). Overall, three-quarter (76.4%) were comfortable and had high acceptance level for their child to be treated by a dental therapist at a private dental clinic.

Table 4.27: The type of treatment that parents would allow dental therapist to conduct on their children in the private sectors (N=922).

Treatment procedures	Completely disagree (1) n (%)	Disagree (2) n (%)	Agree (3) n (%)	Completely agree (4) n (%)	Mean (SD)
1.Seek advice on oral hygiene care	21 (2.3)	92 (10.0)	518 (56.2)	291 (31.6)	3.17 (0.69)
2.To have a simple cavity filled.	30 (3.3)	156 (16.9)	531 (57.6)	205 (22.2)	3.0 (0.72)
3.To get an injection to make their teeth and gums go numb.	90 (9.8)	243 (26.4)	450 (48.8)	139 (15.1)	2.7 (0.84)
4. To 'pull out' milk teeth.	65 (7.0)	285 (30.9)	455 (49.3)	117 (12.7)	2.7 (0.78)

5.To have protective coat (fissure sealant) done.	46 (5.0)	191 (20.7)	533 (57.8)	152 (16.5)	2.9 (0.74)
6. To apply topical fluoride gel and paste.	27 (2.9)	128 (13.9)	577 (62.6)	190 (20.6)	3.0 (0.68)
7. To have scaling and polishing done.	64 (6.9)	214 (23.2)	456 (49.5)	188 (20.4)	2.8 (0.83)
8.Overall, I am comfortable and would accept if my child is treated by a dental therapist.	40 (4.3)	178 (19.3)	504 (54.7)	200 (21.7)	2.9 (0.76)
Mean total acceptance score **(SD)**				5.21 (2.32)	

1= completely disagree to 4= completely agree

Table 4.27 shows findings on parents' perceptions of dental therapist employment in the private settings and the population that they perceived appropriate in receiving care from the dental therapist. Almost three-quarter (72.5%) perceived that dental therapists should be allowed to practice in the private dental clinic and about 57% would allow the dental therapists to treat their children. They also thought the type of population that is appropriate to receive dental care from the dental therapists at the private dental sectors are the toddler (73%), preschool (77%), primary schoolers (91.7%) and secondary schoolers (90.4%) groups.

Table 4.28: Parental perceptions of dental therapist employment in the private dental clinic (N=922).

Variables	Responses		
	Yes	**No**	
Generally, I think it would be a good idea to let dental therapists work in the private dental clinic in Malaysia	668 (72.5)	254 (27.5)	
	Yes	**No**	**Do not know**
	n (%)	**n (%)**	**n (%)**
I would allow my children to be treated by dental therapists at the private dental clinic	530 (57.5)	257 (27.9)	135 (14.6)
I think the following groups can be treated by a dental therapist at the private dental clinic (including my children) (n=530)			
Toddler	387 (73.0)	93 (10.1)	50 (9.4)
Preschool children	408 (77.0)	82 (8.9)	40 (4.3)
Primary school children	486 (91.7)	20 (3.8)	24 (4.5)
Secondary school children	479 (90.4)	24 (4.5)	27 (5.1)

4.2.4 Factors that influence parents' perceptions towards the use of dental therapist in the private sector (Objective 5).

This section presents the findings on the associations between parental various factors (sociodemographic characteristics, utilisation of dental health service and perceived oral health status) with their acceptance towards dental therapist providing dental services in the private dental practice.

The individual analysis for the prevalence of acceptance towards each of the seven types of dental procedures provided by the dental therapist in the private dental practice is presented followed by a summary table.

4.2.4.1 Factors associated with the prevalence of acceptance towards oral hygiene education (ohe) provided by the dental therapist in private dental practice.

Chi-square test was done giving three significant socioeconomic factors, two significant dental service utilisation factors, and both significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, only one factor was found significant in the model. Parents who chose private dental clinic were more likely to accept (OR=2.42, 95% CI=1.42, 4.13) dental therapist to give OHE towards their child in the private dental practice than the reference group which are the parents who chose the government dental clinic (Table 4.29).

Table 4.29: Factors influencing parental acceptance towards dental therapists providing oral health education to their children(OHE) (N=922)

Variables	Prevalence of parental acceptance towards dental therapist providing OHE to their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	Agree (n=877)	χ2 P-value	Adjusted OR (95% CI)	P-value
Socio-demographic characteristics					
Age (years old)					
<41 years old	51 (12.6)	353 (87.4))	0.090*	-	-
≥41years old	62 (12.0)	456 (88.0)		-	-
Gender					
Male	58 (16.8)	288 (83.2)	0.001*	-	-
Female	55 (9.5)	521 (90.5)		-	-
Ethnicity					
Bumiputra	109 (12.6)	759 (87.4)	0.263	-	-
Non-Bumiputra	4 (7.4)	50 (92.6)		-	-
Locality					
Urban	77 (11.7)	683 (88.3)	0.386	-	-
Rural	36 (13.7)	226 (86.3)		-	-
Education level					
No formal education and Primary school	13 (16.0)	68 (84.0)	0.008*	-	-
Secondary school	50 (16.2)	258 (83.8)		-	-
College/ University	50 (9.4)	483 (59.7)		-	-
Total household income					
< RM 6,200	80 (12.7)	551 (87.3)	0.378	-	-
RM6,201 - RM 12,499	28 (12.7)	192 (87.3)		-	-
> RM12,500	5 (7.0)	66 (93.0)		-	-

Table 4.29 continued

Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	92 (12.0)	677 (88.0)	0.777	-	-
No	14 (13.1)	93 (86.9)		-	-
Don't know	7 (15.2)	39 (84.8)		-	-
Preferred dental clinic					
Government	86 (14.6)	505 (85.4)	0.001*	Reference	
Private	18 (15.9)	267 (93.7)		2.42 (1.42,4.13)	0.001**
Don't know	9 (19.6)	37 (80.4)		0.74 (0.34,1.61)	0.451
Visit dentist past 12 months					
No	71 (13.8)	444 (86.2)	0.111*	-	-
Yes	42 (37.2)	365 (89.7)		-	-
Perceived oral health status factors					
Teeth condition					
Poor/Fair	61 (14.3)	365 (85.7)	0.102*		
Good/ Very good	44 (9.9)	401 (90.1)			
Don't know	8 (15.7)	43 (84.3)			
Gum condition					
Poor/Fair	56 (16.6)	281 (83.4)	0.006*	-	-
Good/ Very good	49 (9.3)	477 (90.7)		-	-
Don't know	8 (13.6)	51 (86.4)		-	-

*p-value >0.25 includes in the model, **p-value<0.05*
Model; Hosmer and Lemeshow test, χ2(3) = 1.40, p = 0.924.
Area under the curve (ROC)=0.64 (>0.5); Overall classified percentage = 87.7 %.

4.2.4.2 Factors associated with parental acceptance towards dental therapist providing restorative dental care on their children in private dental practice.

Chi-square test was done giving two significant socioeconomic factors, all three significant dental service utilisation factors, and one significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, four factors were found significant in the model.

Table 4.30 shows that parents who were younger that (aged less than 41 years old)(OR=1.65, 95% CI=1.17, 2.32), who chose private dental clinic for their child dental treatment (OR=1.97, 95% CI=1.31, 2.95) and who perceived of having good teeth condition (OR=2.04, 95% CI=1.07,3.90) were more likely to accept dental therapist providing simple cavity restoration to their child. However, parents who were unsure of dental clinic presence nearby their home were less likely to accept (OR=0.39, 95% CI=0.20, 0.74) dental therapist providing simple restoration compared to the reference group.

Table 4.30: Factors with influencing the parental acceptance towards dental therapists providing simple restoration to their children (N=922)

Variables	Prevalence of parental acceptance towards dental therapist providing simple restoration to their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	Agree (n=877)	χ2 P-value	Adjusted OR (95% CI)	P-value
Socio-demographic characteristics					
Age (years old)					
<41 years old	66 (16.3)	338 (87.4))		1.65 (1.17,2.32)	
≥41years old	120 (23.2)	398 76.8)	0.010*	Reference	0.004**
Gender					
Male	90 (26.0)	256 (74.0)	0.001*	-	-
Female	96 (16.7)	480 (83.3)		-	-
Ethnicity					
Bumiputra	173 (19.9)	695 (80.1)	0.462	-	-
Non-Bumiputra	4 (7.4)	50 (92.6)		-	-
Locality					
Urban	128 (19.4)	532 (80.6)	0.349	-	-
Rural	58 (22.1)	204 (77.9)		-	-
Education level					
No formal education and Primary school	18 (22.2)	63 (77.8)		-	-
Secondary school	64 (20.8)	244 (79.2)	0.808	-	-
College/ University	104 (19.5)	429 (80.5)		-	-
Total household income					
< RM 6,200	125 (19.8)	506 (80.2)		-	-
RM6,201 - RM 12,499	50 (22.7)	170 (77.3)	0.385	-	-
> RM12,500	11 (15.5)	60 (84.5)		-	-

Table 4.30 continued

Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	147 (19.1)	622 (80.9)		Reference	
No	21 (19.6)	86 (80.4)	0.004*	1.32 (0.78,2.26)	0.301
Don't know	18 (39.1)	28 (60.9)		0.39 (0.20,0.74)	0.004**
Preferred dental clinic					
Government	135 (22.8)	456 (77.2)		Reference	
Private	38 (13.3)	247 (86.7)	0.002*	1.97 (1.31,2.95)	0.001**
Don't know	13 (28.3)	33 (71.7)		0.92 (0.46,1.85)	0.812
Visit dentist past 12 months					
No	115 (22.3)	400 (77.7)	0.066*	-	-
Yes	71 (17.4)	336 (82.6)		-	-
Perceived oral health status factors					
Teeth condition					
Poor/Fair	85 (20.0)	341 (80.0)		Reference	
Good/ Very good	84 (18.9)	361 (81.1)	0.051*	2.04 (1.07,3.90)	0.030**
Don't know	17 (33.3)	34 (66.7)		1.92 (1.00,3.68)	0.051
Gum condition					
Poor/Fair	71 (21.1)	266 (78.9)		-	-
Good/ Very good	97 (18.4)	429 (81.6)	0.080*	-	-
Don't know	18 (30.5)	41 (69.5)		-	-

*p-value >0.25 includes in the model, **p-value<0.05
Model; Hosmer and Lemeshow test, $\chi2(8) = 21.4$, $p = 0.006$;
Area under the curve (ROC)=0.65 (>0.5); Overall classified percentage = 79.6 %.

4.2.4.3 Factors influencing parental acceptance towards dental therapist administering local anaesthesia to their children in the private dental practice.

Chi-square test was done giving four significant socioeconomic factors, two significant dental service utilisation factors, and one significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic

regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, four factors were found significant in the model.

Findings revealed that parents who were younger (OR=1.61, 95% CI=1.21,2.14) and lived in the urban (OR=2.94, 95% CI=2.17,3.98) were more likely to accept dental therapist administering local anaesthesia to their children in the private sector(Table 4.31). Meanwhile, parents who were not sure of which dental sectors to send their child for dental care were less likely to have accepted (OR=0.45, 95% CI=0.24,0.85) dental therapist administering local anaesthesia to their child in the private dental practice as compared to the reference group.

Furthermore, parents who perceived of having poor or fair (OR=2.04, 95% CI=1.13,3.69) and good gum condition (OR=1.91, 95% CI=1.08,3.39) were more likely accept dental therapist to administer local anaesthesia to their child in the private dental clinic

Table 4.31: Factors influencing parental acceptance towards dental therapists administering local anaesthesia to their children in the private dental settings (N=922)

Variables	Prevalence of parental acceptance towards dental therapist administering local anaesthesia to their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	Agree (n=877)	χ^2 P-value	Adjusted OR (95% CI)	P-value
Socio-demographic characteristics					
Age (years old)					
<41 years old	125 (30.9)	279 (69.1)		1.61 (1.21,2.14)	
≥41 years old	208 (40.2)	310 (59.8)	0.004*	Reference	0.001**
Gender					
Male	136 (39.3)	210 (60.7)	0.118*	-	-
Female	197 (34.2)	379 (65.8)		-	-
Ethnicity					
Bumiputra	310 (35.7)	558 (64.3)	0.307	-	-
Non-Bumiputra	23 (42.6)	31 (57.4)		-	-
Locality					
Urban	190 (28.8)	470 (71.2)	0.000*	2.94 (2.17,3.98)	0.000**
Rural	143 (54.6)	119 (45.4)		Reference	
Education level					
No formal Education and Primary school	40 (49.4)	41 (50.6)		-	-
Secondary school	121 (39.3)	187 (60.7)	0.004*	-	-
College/ University	172 (32.3)	361 (67.7)		-	-
Total household income					
< RM 6,200	230 (36.5)	401 (63.5)		-	-
RM6,201 - RM 12,499	79 (35.9)	141 (64.1)	0.905	-	-
> RM12,500	24 (33.8)	47 (66.2)		-	-

Table 4.31 continued

Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	261 (33.9)	508 (66.1)		-	-
No	54 (50.5)	53 (49.5)	0.003*	-	-
Don't know	18 (39.1)	28 (60.9)		-	-
Preferred dental clinic					
Government	217 (36.7)	374 (63.3)		Reference	
Private	90 (31.6)	195 (68.4)	0.004*	1.20 (0.88,1.65)	0.249
Don't know	26 (56.5)	20 (43.5)		0.45 (0.24,0.85)	0.013**
Visit dentist past 12 months					
No	195 (37.9)	320 (62.1)	0.214*	-	-
Yes	138 (33.9)	269 (66.1)		-	-
Perceived oral health status factors					
Teeth condition					
Poor/Fair	153 (35.9)	273 (64.1)		-	-
Good/ Very good	160 (36.0)	285 (64.0)	0.894	-	-
Don't know	20 (39.2)	31 (60.8)		-	-
Gum condition					
Poor/Fair	113 (33.5)	224 (66.5)		2.04 (1.13,3.69)	0.018**
Good/ Very good	190 (36.1)	336 (63.9)	0.038*	1.91 (1.08,3.39)	0.026**
Don't know	30 (50.8)	29 (49.2)		Reference	

*p-value >0.25 includes in the model, **p-value<0.05
Model; Hosmer and Lemeshow test, $\chi2(8) = 8.59$, p = 0.378;
Area under the curve (ROC)=0.67 (>0.5); Overall classified percentage = 67.7 %.

4.2.4.4 Factors associated with parental acceptance towards dental therapist performing dental extractions on their children's deciduous teeth in private dental practice.

Chi-square test was done giving four significant socioeconomic factors, two significant dental service utilisation factors, and both significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, three factors were found significant in the model.

Table 4.32 findings revealed that younger parents (OR=1.42, 95% CI=1.10,1.92), who are Bumiputra in origin (OR=2.44, 95% CI=1.38,4.29) and perceived of having good gum condition (OR=2.83, 95% CI=1.39,5.78) were more likely to accept dental therapist to extract their child's deciduous teeth.

Table 4.32: Factors influencing parental acceptance towards dental therapists performing dental extractions on their children's deciduous teeth in the private settings (N=922)

Variables	Prevalence of parental acceptance towards dental therapist performing dental extractions on their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	**Agree (n=877)**	**χ2 P-value**	**Adjusted OR (95% CI)**	**P-value**
Socio-demographic characteristics					
Age (years old)					
<41 years old	133 (32.9)	271 (67.1)		1.42 (1.10,1.92)	
≥41years old	217 (41.9)	301 (58.1)	0.005*	Reference	0.009**

Gender					
Male	149 (43.1)	197 (56.9)	0.113*	-	-
Female	201 (34.9)	375 (65.1)		-	-
Ethnicity					
Bumiputra	318 (36.6)	550 (63.4)	0.001*	2.44 (1.38,4.29)	0.002**
Non-Bumiputra	32 (59.3)	22 (40.7)		Reference	
Locality					
Urban	242 (36.7)	418 (63.3)	0.199*	-	-
Rural	108 (41.2)	154 (58.8)		-	-
Education level					
No formal education and Primary school	36 (44.4)	45 (55.6)	0.434	-	-
Secondary school	113 (36.7)	195 (63.3)		-	-
College/ University	201 (37.7)	332 (62.3)		-	-
Total household income					
< RM 6,200	243 (38.5)	388 (61.5)		-	-
RM6,201 - RM 12,499	82 (37.3)	138 (62.7)	0.838	-	-
> RM12,500	25 (35.2)	46 (64.8)		-	-
Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	289 (37.6)	480 (62.6)		-	-
No	42 (39.3)	65 (60.7)	0.843	-	-
Do not know	19 (41.3	27 (58.7)		-	-
Preferred dental clinic					
Government	223 (37.7)	368 (62.3)		-	-
Private	104 (36.5)	181 (63.5)	0.212*	-	-
Don't know	23 (50.0)	23 (50.0)		-	-

Visit dentist past 12 months					
No	204 (39.6)	311 (60.4)	0.245*	-	-
Yes	146 (35.9)	261 (64.1)		-	-
Perceived oral health status factors					
Teeth condition					
Poor/Fair	142 (33.3)	284 (66.7)		-	-
Good/ Very good	183 (41.1)	262 (58.9)	0.015*	-	-
Don't know	25 (49.0)	26 (51.0)		-	-
Gum condition					
Poor/Fair	124 (36.8)	213 (63.2)		1.95 (0.95,4.01)	0.070
Good/ Very good	194 (36.9)	332 (63.1)	0.029	2.83 (1.39,5.78)	0.004**
Don't know	32 (54.2)	27 (45.8)		Reference	

*p-value >0.25 includes in the model, **p-value<0.05
Model; Hosmer and Lemeshow test, χ2(6) = 7.71, p = 0.260;
Area under the curve (ROC)=0.61 (>0.5); Overall classified percentage = 64.1 %.

4.2.4.5 Factors associated with parental acceptance towards dental therapist applying fissure sealant on their children in the private dental practice.

Chi-square test was done giving three significant socioeconomic factors, two significant dental service utilisation factors, and none significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, four factors were found significant in the model.

The findings shows that younger parents (OR=2.42, 95% CI=1.75,3.35), who were of Bumiputra in origin (OR=1.99, 95% CI=1.10,3.59) and who preferred sending their children to a private dental clinic (OR=1.58, 95% CI=1.11,2.24) were more likely to accept dental therapist applying fissure sealant to their children (Table 4.33). However, parents who were unsure of the presence of a dental clinic nearby their home were less likely (OR=0.45, 95% CI=0.24, 0.87) to accept dental therapist applying fissure sealants to their children as compared to the reference group.

Table 4.33: Factors influencing parental acceptance towards dental therapists applying fissure sealant on their children in the private dental settings (N=922)

Variables	Prevalence of parental acceptance towards dental therapist applying fissure sealant on their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	Agree (n=877)	χ2 P-value	Adjusted OR (95% CI)	P-value
Socio-demographic characteristics					
Age (years old)					
<41 years old	69 (17.1)	335 (82.9)		2.42 (1.75,3.35)	
≥41years old	168 (32.4)	350 (67.6)	0.000*	Reference	0.000**
Gender					
Male	87 (25.1)	259 (74.9)		-	-
Female	150 (26.0)	426 (74.0)	0.763	-	-
Ethnicity					
Bumiputra	216 (24.9)	652 (75.1)		1.99 (1.10,3.59)	0.023**
Non-Bumiputra	21 (38.9)	33 (61.1)	0.022*	Reference	
Locality					
Urban	160 (24.2)	500 (75.8)		-	-
Rural	77 (29.4)	185 (70.6)	0.107*	-	-

Education level					
No formal education and Primary school	24 (29.6)	57 (70.4)		-	-
Secondary school	80 (26.0)	228 (74.0)	0.663	-	-
College/ University	133 (25.0)	400 (75.4)		-	-
Total household income					
< RM 6,200	158 (25.0)	473 (75.0)		-	-
RM6,201 - RM 12,499	61 (27.2)	159 (72.3)	0.733	-	-
> RM12,500	18 (25.4)	53 (74.6)		-	-
Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	190 (24.7)	579 (75.3)		Reference	
No	29 (27.1)	78 (72.9)	0.088*	1.21 (0.74,1.96)	0.447
Don't know	18 (39.1)	28 (60.9)		0.45 (0.24,0.87)	0.017**
Preferred dental clinic					
Government	165 (27.9)	426 (72.1)		Reference	
Private	60 (21.1)	225 (78.9)	0.093*	1.58 (1.11,2.24)	0.011**
Don't know	12 (26.1)	34 (73.9)		1.31 (0.65,2.67)	0.452
Visit dentist past 12 months					
No	139 (27.0)	376 (73.0)	0.315	-	-
Yes	98 (24.1)	309 (75.9)		-	-
Perceived oral health status factors					
Teeth condition					
Poor/Fair	107 (25.1)	319 (74.9)		-	-
Good/ Very good	116 (26.1)	329 (73.9)	0.910	-	-
Don't know	14 (27.5)	37 (72.5)		-	-
Gum condition					
Poor/Fair	94 (27.9)	243 (72.1)		-	-
Good/ Very good	125 (23.8)	401 (76.2)	0.273	-	-
Don't know	18 (30.5)	41 (69.5)		-	-

*p-value >0.25 includes in the model, **p-value < 0.05;
Model; Hosmer and Lemeshow test, $\chi 2(6) = 5.96$, p = 0.427;
Area under the curve (ROC)=0.64 (>0.5); Overall classified percentage = 75.3 %.

4.2.4.6 Factors associated with parental acceptance towards dental therapist applying topical fluoride on their children in private dental practice.

Chi-square test was done giving four significant socioeconomic factors: two significant dental service utilisation factors and both significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, two factors were found significant in the model.

Table 4.34 shows that parents who were younger (OR=1.62, 95% CI=1.12,2.32) and preferred to send their children to a private dental clinic for dental care (OR=2.00, 95% CI=1.30,3.07) were more likely to accept dental therapist applying topical fluoride to their child.

Table 4.34: Factors influencing parental acceptance towards dental therapists applying topical fluoride to their children in the private dental setting (N=922)

Variables	Prevalence of parental acceptance towards dental therapist applying topical fluoride to their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	Agree (n=877)	χ2 P-value	Adjusted OR (95% CI)	P-value
Socio-demographic characteristics					
Age (years old)					
<41 years old	54 (13.4)	350 (86.6)		1.62 (1.12,2.32)	
≥41years old	101 (19.5)	417 (80.5)	0.014*	Reference	0.010**
Gender					
Male	70 (20.2)	276 (79.8)	0.031*	-	-
Female	85 (14.8)	491 (85.2)		-	-
Ethnicity					
Bumiputra	143 (16.5)	725 (83.5)	0.273	-	-
Non-Bumiputra	12 (22.2)	42 (77.8)		-	-

Locality					
Urban	109 (16.5)	551 (83.5)	0.703	-	-
Rural	46 (17.6)	16 (82.4)		-	-
Education level					
No formal education and Primary school	14 (17.3)	67 (82.7)	0.199*	-	-
Secondary school	61 (19.8)	247 (80.2)		-	-
College/ University	80 (15.0)	453 (85.4)		-	-
Total household income					
< RM 6,200	107 (17.0)	524 (83.0)	0.225*	-	-
RM6,201 - RM 12,499	41 (18.6)	179 (81.4)		-	-
> RM12,500	7 (9.9)	64 (90.1)		-	-
Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	123 (16.0)	646 (84.0)	0.326	-	-
No	22 (20.6)	85 (79.4)		-	-
Don't know	10 (21.7)	36 (78.3)		-	-
Preferred dental clinic					
Government	116 (19.6)	475 (80.4)	0.005*	Reference	
Private	31 (10.9)	254 (89.1)		2.00 (1.30,3.07)	0.002**
Don't know	8 (17.4)	38 (82.6)		1.24 (0.56,2.76)	0.592

Visit dentist past 12 months					
No	97 (18.8)	418 (81.2)		-	-
Yes	58 (14.3)	349 (85.7)		-	-
Perceived oral health status factors					
Teeth condition					
Poor/Fair	81 (19.0)	345 (81.0)		-	-
Good/ Very good	65 (14.6)	380 (85.4)	0.218	-	-
Don't know	9 (17.6)	42 (82.4)		-	-
Gum condition					
Poor/Fair	70 (20.8)	267 (79.2)		0.96 (0.48,2.00)	0.899
Good/ Very good	73 (13.9)	453 (86.1)	0.023*	1.46 (0.73,2.91)	0.29
Don't know	12 (20.3)	47 (79.7)		Reference	

*p-value >0.25 includes in the model, **p-value<0.05
Model; Hosmer and Lemeshow test, $\chi2(6) = 14.60$, $p = 0.024$;
Area under the curve (ROC)=0.63 (>0.5); Overall classified percentage = 83.2 %.

4.2.4.7 Factors associated with parental acceptance towards dental therapist performing scaling and prophylaxis on their children in private dental practice.

Chi-square test was done giving five significant socioeconomic factors, all significant dental service utilisation factors but none significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, three factors were found significant in the model.

Table 4.35 shows that parents who lived in the urban areas (OR=2.18, 95% CI=1.60, 3.00) were more likely to accept dental therapist conducting scaling and prophylaxis to their children in the private sector. However, mothers (OR=0.01, 95% CI=0.50,0.90) and parents who attained up to primary school education (OR=0.54, 95% CI=0.33,0.88) were less likely to accept dental therapist conducting scaling to their child at the private dental clinic.

Table 4.35: Factors influencing parental acceptance towards dental therapists performing scaling and prophylaxis on their children in the private sector (N=922)

Variables	Prevalence of parental acceptance towards dental therapist performing scaling and prophylaxis on their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	Agree (n=877)	χ^2 P-value	Adjusted OR (95% CI)	P-value
Socio-demographic characteristics					
Age (years old)					
<41 years old	111 (27.5)	293 (72.5)		-	-
≥41 years old	167 (32.3)	351 (67.8)	0.118*	-	-
Gender					
Male	122 (35.3)	224 (64.7)		Reference	
Female	156 (27.1)	420 (72.9)	0.009*	0.01(0.50,0.90)	0.007**
Ethnicity					
Bumiputra	256 (29.5)	612 (70.5)		-	-
Non-Bumiputra	22 (40.7)	32 (59.3)	0.081*	-	-
Locality					
Urban	165 (25.0)	495 (75.0)		2.18(1.60,3.00)	0.000**
Rural	113 (43.1)	149 (56.9)	0.000*	Reference	

Education level					
No formal education and Primary school	39 (48.1)	42 (51.9)		0.54(0.33,0.88)	0.014**
Secondary school	86 (27.9)	222 (72.1)	0.001*	1.06(0.77,1.46)	0.702
College/ University	153 (28.7)	380 (71.3)		Reference	
Total household income					
< RM 6,200	189 (30.0)	442 (70.0)		-	-
RM6,201 - RM 12,499	65 (29.5)	155 (70.5)		-	-
> RM12,500	24 (33.8)	47 (66.2)	0.779	-	-
Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	219 (28.5)	550 (71.5)		-	-
No	44 (41.1)	63 (58.9)	0.026*	-	-
Don't know	15 (32.6)	31 (67.4)		-	-
Preferred dental clinic					
Government	190 (32.1)	401 (67.9)	0.133*	-	-
Private	73 (25.6)	212 (74.4)		-	-
Don't know	15 (32.6)	31 (67.4)		-	-
Visit dentist past 12 months					
No	169 (32.8)	346 (67.2)	0.047*	-	-
Yes	109 (26.8)	298 (73.2)		-	-

Perceived oral health status factors					
Teeth condition					
Poor/Fair	139 (32.6)	287 (67.4)		-	-
Good/ Very good	124 (27.9)	321 (72.1)	0.307	-	-
Don't know	15 (29.4)	36 (70.6)		-	-
Gum condition					
Poor/Fair	104 (30.9)	233 (69.1)		-	-
Good/ Very good	155 (29.5)	371 (70.5)	0.854	-	-
Don't know	19 (32.2)	40 (67.8)		-	-

*p-value >0.25 includes in the model, **p-value<0.05;
Model; Hosmer and Lemeshow test, $\chi 2(6) = 3.68$, p = 0.720;
Area under the curve (ROC)=0.62 (>0.5); Overall classified percentage = 70.6 %.

4.2.4.8 Factors associated with parental perceived comfortability of dental therapist providing dental services to their children in the private dental practice.

Chi-square test was done giving four significant socioeconomic factors, all significant dental service utilisation factors but none is significant perceived oral health status factors throughout the variables. These significant factors were included in the multiple logistic regression analysis for "Agree" vs "Disagree" on acceptance towards dental therapists. By using the forward stepwise method, three factors were found significant in the model.

Table 4.36 shows that younger parents (OR=1.40, 95% CI=1.62,1.92), who lived in the urban areas (OR=1.77, 95% CI=1.28,2.45) and experienced dental care for the past one year (OR=1.51, 95% CI=1.10,2.07) were more likely to feel comfortable with dental therapist to treat their child in the private dental clinic compared to the reference group.

Table 4.36: Factors influencing parents feeling comfortable with dental therapist providing dental care on their children in the private setting (N=922)

Variables	Prevalence of parental feeling comfortable with dental therapist providing dental care on their children			Factors influencing parental acceptance (Multiple logistic regression analysis)	
	Disagree (n=123)	Agree (n=877)	χ2 P-value	Adjusted OR (95% CI)	P-value
Socio-demographic characteristics					
Age (years old)					
<41 years old	83 (20.5)	321 (79.5)		1.40 (1.62,1.92)	0.036**
≥41years old	135 (26.1)	383 (73.9)	0.050*	Reference	
Gender					
Male	104 (30.1)	242 (69.9)	0.000*	-	-
Female	114 (19.8)	462 (80.2)		-	-
Ethnicity					
Bumiputra	203 (23.4)	665 (76.6)	0.461	-	-
Non-Bumiputra	15 (27.8)	39 (72.2)		-	-
Locality					
Urban	135 (20.5)	525 (79.5)	0.000*	1.77 (1.28,2.45)	0.001**
Rural	83 (31.7)	179 (68.3)		Reference	
Education level					
No formal education and Primary school	27 (33.3)	54 (66.7)		-	-
Secondary school	68 (22.1)	240 (77.9)	0.094*	-	-
College/ University	123 (23.1)	410 (76.9)		-	-
Total household income					
< RM 6,200	151 (23.9)	480 (76.1)		-	-
RM6,201 - RM 12,499	49 (22.3)	171 (77.7)	0.830	-	-
> RM12,500	18 (25.4)	53 (74.6)		-	-

Table 4.36 continued

Dental service utilisation factors					
Presence of dental clinic nearby home					
Yes	180 (23.4)	589 (76.6)		-	-
No	31 (29.0)	76 (71.0)	0.172*	-	-
Don't know	7 (15.2)	39 (84.8)		-	-
Preferred dental clinic					
Government	150 (25.4)	441 (74.6)		-	-
Private	56 (19.6)	229 (80.4)	0.161*	-	-
Don't know	12 (26.1)	34 (73.9)		-	-
Visit dentist past 12 months					
No	139 (27.0)	376 (73.0)	0.007*	Reference	
Yes	79 (19.4)	328 (80.6)		1.51(1.10,2.07)	0.011**
Perceived oral health status factors					
Teeth condition					
Poor/Fair	101 (23.9)	324 (76.1)		-	-
Good/ Very good	102 (22.9)	33 (77.1)	0.756	-	-
Don't know	14 (27.5)	37 (72.5)		-	-
Gum condition					
Poor/Fair	83 (24.6)	254 (75.4)		-	-
Good/ Very good	119 (22.6)	407 (77.4)	0.644	-	-
Don't know	16 (27.1)	43 (72.9)		-	-

*p-value >0.25 includes in the model, **p-value<0.05
Model; Hosmer and Lemeshow test, $\chi2(6) = 8.88$, p = 0.181;
Area under the curve (ROC)=0.61 (>0.5); Overall classified percentage = 76.4 %.

4.2.4.9 Summary of factors that influenced parental acceptance towards dental therapist providing oral healthcare on their children in the private dental clinic

Summary of significant factors of the acceptability of care provided by the dental therapist are reported in Table 4.37. In terms of the number of dental procedures accepted, younger parents were more likely to accept five dental procedures performed by the dental therapist on their children, except on oral hygiene education and performing scaling. In contrast, parents who preferred to send their children to a private dental clinic were more likely to accept four out of seven dental procedures except for three operative dental procedures namely administration of local anaesthesia, deciduous teeth extractions, and scaling. Meanwhile, parents who lived in urban areas and of Bumiputra origin were more likely to accept dental therapists performing two types of dental procedures on their children.

Parents who perceived having good or very good teeth condition were more likely to report a dental therapist restoring their child teeth acceptable. Furthermore, parents who perceived good and very good gum condition were more likely to accept dental therapist to extract their child's deciduous teeth. However, mothers and parents who attained primary school education were less likely to accept dental therapist performing scaling and prophylaxis to their children while those who were unsure of the presence of a dental clinic nearby home were also less likely to accept dental therapist restoring their child's teeth and performing fissure sealant. Meanwhile, younger parents who lived in the urban and had experienced oral healthcare the past one year were more likely to feel comfortable with the dental therapist providing dental care for their children

Table 4.37 Multiple logistic regression using stepwise method for factors associated with parent's acceptability of dental care provided by the dental therapist in a private dental clinic towards their child (N=922).

Dependent variable	Explanatory variables OR (95% confidence interval)									
	Sociodemographic factors					Dental service utilisation factors			Perceived oral health status factors	
	Younger parents	Urban	Mothers'	Lower Education level	*Bumiputera*	Had visit dentist for the past 12-months	Unsure of the presence of dental clinic nearby home	Preferred private dental clinic	Good teeth condition	Good gum condition
Giving oral hygiene education								2.42*** (1.42,4.13)		
Restore the child's teeth	1.65** (1.17,2.32)						0.39* (0.20, 0.74)	1.97*** (1.31,2.95)	2.04* (1.07,2.90)	
Administer local anaesthesia	1.61*** (1.21,2.14)	2.94*** (2.17-3.98)						1.20 (0.88.1.65)		
Conduct deciduous tooth extraction	1.42** (1.10,1.92)				2.44** (1.10-1.92)					2.83** (1.39,5.78)
Perform fissure sealant	2.42*** (1.75,3.35)				1.99* (1.10,3.59)		0.45** (0.24,0.87)	1.58* (1.11,2.24)		
Apply topical fluoride	1.62* (1.12,2.32)							2.00** (1.30,3.07)		
Perform scaling and prophylaxis		2.18*** (1.60-3.00)	0.01** (0.50,090)	0.54* (0.33,0.88)						
Comfortable and accept with dental therapist	1.40* (1.62,1.92)	1.77** (1.28-2.45)				1.51* (1.10,2.07)				

***p<0.001; **p<0.01; *p<0.05

Variables tested in the model and not found to be statistically significant with total household income factor.

4.3   Study 3: The private dentists' attitudes and perceptions and as well as their perceived barriers on the employment of dental therapist in the private practices

This subsection presents the findings of Study Objectives 1 and 6. Descriptive results of the participants' characteristics, the ownership and working experience in private practice followed by their acceptability towards dental therapists' employment in their practices are presented. Next, their awareness of the establishment of Therapist Division under the new Malaysian Dental Act 2018 is presented. Finally, their attitude, perception as well as their perceived barriers towards dental therapists' employment in the private practices are described.

4.3.1   Response rate

A total of 380 participants were invited to participate in this study.   Only 200 participants responded to this survey giving a response rate of 52.6%. Those who refused to participate gave the reasons that they were unaware of the new Dental Act 2018 or did not have the time to undertake any survey.

4.3.2 Descriptive analysis

4.3.2.1 Participants' characteristic

Table 4.38 shows the sociodemographic characteristics of the respondents. Most were females (59%) and Chinese (50.0%), with a median age of 36 ± 15 years old. About half of them (51.5%) practised in the Petaling district, and majority (81%) graduated from a university in Malaysia. Only about 18% had undergone a specialty training throughout their career.

Table 4.38: Characteristics of the participants (N= 200).

Characteristics	n (%)
Age	Median (IQR): 36.0 (30.0-45.0)
	Range: 25 - 70
Gender	
Male	82 (41.0)
Female	118 (59.0)
Ethnicity	
Malay	83 (41.5)
Chinese	100 (50.0)
Indian	16 (8.0)
Others	1 (0.5)
District of practice	
Urban	186 (93.0)
Rural	14 (7.0)
Place of graduation	
Malaysia	162 (81.0)
Overseas	38 (19.0)
Years after graduation	Range: 2-45
	Median (IQR): 10.0 (5.0-19.0)
Undergone specialty training	
Yes	37 (18.5)
No	163 (81.5)

4.3.2.2 Ownership of clinical practice and their working experience in private practice

Table 4.39 shows that slightly more than half indicated they were an owner or an associate of a clinic (58.5%) and 56.4% reported that their monthly income ranged from RM 21,000 to RM 40,000. The number of part-time dentists employed in their practice ranged from none to eight and for full time it ranged from none to ten. About 65% reported employing at least two dental auxiliaries in their clinic.

The median years of working in a private dental clinic was 6.0 ± 7.0 with 59% of them indicated that they had experiences working with a dental therapist.

Table 4.39: Ownership of clinical practice and their working experiences in private practice (N= 200).

Characteristics	n (%)
Owner/ associates of the clinic	
Yes	117 (58.5)
No	83 (41.5)
Clinic monthly income (n=117)	
<RM 20,000	16 (13.7)
RM 21,000- RM 40,000	66 (56.4)
> RM41,000 – RM 60,000	25 (12.5)
Others	10 (5.0)
Number of dentists employed in their practice (n=117)	
Part-time	
Range	0-8
Median (IQR)	0 (0 – 1)
0-1	89 (76.1)
More or equal to 2	28 (23.9)

Full time	
Range	0-10
Median (IQR)	1.0 (0 – 1)
0-1	89 (76.1)
More or equal to 2	28 (23.9)
Number of dental auxiliaries present in their practice (including dental surgery assistant, dental therapist and dental technician) (n=117)	
Range	0-8
Median (IQR)	2.0 (1.0-3.0)
0-2	77 (65.8)
More or equal to 3	40 (34.2)
Years of working experience in a private clinic	Median (IQR): 6.0 (2.0-15.0)
Experienced working with dental therapist	
Yes	118 (59.0)
No	82 (41.0)

4.3.2.3 The acceptability towards dental therapists' employment in private practices

About two-thirds (60.5%) of the participants revealed that they would not consider employing a dental therapist in their practice (Table 4.40). A total of 48 dentists (24%) were 'undecided' for this question.

Of those who considered or were undecided in employing dental therapist (39.5%), most would delegate the following dental procedures to the dental therapists: oral hygiene education (70.1%), application of topical fluoride and gel (63%), extraction of primary teeth (51.3%), and placement of fissure sealant (50.8%). About two-fifth (46.3%) would delegate scaling and polishing procedures to the dental therapists. Overall, only one-third would consider delegating some dental tasks to the dental therapist.

Table 4.40: The employment consideration and task delegation to the dental therapist (N=200).

Variables	n (%)
Perceived employment of a dental therapist in their practice	
No	121 (60.5)
Yes	31 (15.5)
Undecided	48 (24.0)
Dental procedures that private dentists were willing to delegate	**Mean percentages ± SD**
Giving oral health instruction	70.1 ± 27.2
Carry out Class I, II, III and V restorations	23.1 ± 23.6
Extraction of primary teeth	51.3 ± 32.4
Placement of fissure sealant	50.8 ± 30.5
Application of topical fluoride and gel	63.0 ± 31.5
Scaling and polishing	46.3 ± 28.9
Overall percentages of willingness for delegation of task to the dental therapist	35.7 ± 19.2

4.3.3 The private dentists' awareness of the establishment of therapist division under the Dental Act 2018 (Objective 1)

Table 4.41 lists the parameters used in assessing the private dentists' awareness on the provisions in the Dental Act 2018. Slightly more than two thirds (69%) of the participants were aware about the provision of the Therapist Division and 65% of them knew that a dental therapist must register with the MDC in order to practice. Only about half of them (51%) knew that dental therapists are allowed to work in private sector and that the dental therapist can be summoned if they worked with someone who did not register with the council (55.5%). Only 52% correctly acknowledged that the dental therapists require direct supervision from the dentists while carrying out a dental procedure.

The majority (88.5%) correctly answered on the population age group a dental therapist is allowed to treat but only 20% knew that taking dental x-ray is not a dental therapist job scope. More than two-third (70.5%) wrongly thought that dental therapists can place fissure sealant on adult patients and 67.5% incorrectly assumed that dental

therapists can perform subgingival scaling. Overall, the majority (88%) of the participants had low awareness on the provisions of Therapist Division in the Dental Act 2018 with their mean total score of 4.3 ± 2.5 out of ten items.

Table 4.41: Awareness of the Dental Therapist Provisions in the Dental Act 2018 (N=200)

Item	Correct (%)	Incorrect (%)
1. There is a provision of the Therapist Division.	138(69.0)	62 (31.0)
2. To be able to practice, a dental therapist must register themselves at the Malaysian Dental Council.	130 (65.0)	70 (35.0)
3. Dental therapists can only treat patients aged 17 years old and below.	23 (11.5)	177 (88.5)
4. Dental therapists are allowed to work at a private dental clinic	102 (51.0)	98 (49.0)
5. Dental therapists must work under the direct supervision of a dental surgeon.	104 (52.0)	96 (48.0)
6. A dental therapist can make a treatment plan on her own.	92 (46.0)	108 (54.0)
7. Dental therapists can place fissure sealant on adults' patients	59 (29.5)	141 (70.5)
8. All dental therapists can perform subgingival scaling on their patients.	65 (32.5)	135 (67.5)
9. All dental therapist can take dental x-ray as per instructed by the dental surgeon	40 (20.0)	160 (80.0)
10. Dental therapists can be fined if intentionally practising dentistry with individuals who do not have a valid dental practising certificate.	111 (55.5)	89 (44.5)
Level of awareness*	n (%)	
Low awareness	176 (88.0)	
High awareness	24 (12.0)	
Mean total awareness score ± SD	4.3 ± 2.5	
Median	4.0	

4.3.4   The private dentists' attitudes and perceptions as well as their perceived barriers on the employment of dental therapist in the private practices (Objective 6)

Table 4.42 shows findings on the private dentist's level of agreement towards statements that gauged on their attitude towards dental therapist. About half of the participants agreed with the statements: 'Dentists can work more effectively and efficiently using dental therapists in a team approach' (56.5%), 'In general patients want to be treated by dental therapists' (50.5%), and 'Using a therapist will increase a dentist's enjoyment of dental practice' (45%).

Meanwhile some had expressed unfavourable opinions towards the employment of dental therapists: 'Dental care will be less personalised if therapists are used for some treatment' (50.5%), 'If more use is made of therapists there will not be anything left for dentists to do' (48%), ' Dental therapist would disrupt dentist-patient relationship' (44%). Around two-third (35.5%) perceived that patients would have less respect for dentist when being treated by a dental therapist.

Table 4.42: Private dentists' attitude towards the employment of dental therapist in private dental clinic (N=200)

Item	Completely Disagree n (%)	Disagree n (%)	Agree n (%)	Completely Agree n (%)
If dental therapists are used for some treatments, I will not be able to personalise dental care to all my patients' needs.	34 (17.0)	65 (32.5)	78 (39.0)	23 (11.5)
If more treatment is delegated to dental therapists, there won't be anything left for dentists to do.	39 (19.5)	65 (32.5)	76 (38.0)	20 (10.0)
I think dental therapist would disrupt the dentist's relationship with patients.	29 (14.5)	83 (41.5)	73 (36.5)	15 (7.5)
I believe that using a dental therapist will increase a dentist's enjoyment of dental practice.	13 (6.5)	97 (48.5)	74 (37.0)	16 (8.0)
I think patients would have less respect for dentists once being treated by a dental therapist.	41 (20.5)	88 (44.0)	58 (29.0)	13 (6.5)
I feel that dentists can work more effectively/ efficiently using dental therapists in a team approach.	14 (7.0)	73 (36.5)	88 (44.0)	25 (12.5)
I feel that in general, patients want to be treated by dental therapists.	42 (21.0)	57 (28.5)	74 (37.0)	27 (13.5)

Table 4.43 shows that almost three-quarter (69.5%) of the participants perceived increase financial burden as their main barriers to employ dental therapist in their practice. Slightly more than half reported that lack of knowledge and skills among dental therapist (52%), poor patients' acceptance (52.6%) and dental therapists requiring additional supervision (51.5%) were the barriers of not employing a dental therapist.

Furthermore, slightly more than one-third perceived that there might be an additional administrative burden (40%) if they employed a dental therapist while some were worried about dental therapist work quality (38.0%), legislation issue (31%) and lack of space availability in their practice (35.5%).

Table 4.43: Private dentists' perceived barriers in employing dental therapist in their practice (n=200)

Perceived barriers	n (%)
Increase the financial burden (overhead cost)	139 (69.5)
Dental therapist's lack of knowledge and skills	104 (52.0)
Additional administrative burden	81 (40.5)
Poor patient's acceptance	104 (52.0)
The quality of care that the dental therapists provide	76 (38.0)
Legislation issue	62 (31.0)
Require additional supervisory responsibilities	103 (51.5)
Availability of space in my practice	71 (35.5)
Split treatment between operators	55 (27.5)
Dentist reluctance to delegate procedures	48 (24.0)
Others	16 (8.0)

For this question, participants were given the options to provide additional comments on their perceived barriers. Interestingly, 8% provided insight on few matters.

Perceived Barriers of employing a dental therapist – qualitative aspect

1) Oversupply of dentists

Three participants stated that they would not employ a dental therapist as there are adequate numbers of dentists in Malaysia:

"Dentists already in oversupply condition, no need for the service of dental therapists"

(Participant #3)

"So many young unemployed dentists around. Hiring them better than hire therapist".

"Oversupply of dentist in the market"

2) Employment rate of dentist

One participant was concerned about new dentist employment rate if they were to employ a dental therapist:

"Dental graduate's unemployment rate will increase"

3) Dental therapists' clinical and communication skills

Some perceived dental therapists' clinical and communication skills would complicate dental care:

"Increase chances on human errors and increase the chain of communication which will lead to misunderstood orders or instruction amount dentist, dental nurse and patients"

"Lack of soft skills of the dental therapists will affect number of patients to the clinic".

4) Inadequate number of patients in the clinic for delegation

Two participants commented on the lack of patients in their clinic as their barriers in employing dental therapist.

"Not enough patients"

<div align="right">(Participant #12)</div>

"Not enough patients coming"

<div align="right">(Participant #13)</div>

5) Reputations of clinic

One participant was worried about clinic's reputation:

"The reputation of the private clinic would go down when the patients were to be treated with a dental therapist, not the dentist if the patient realised the truth"

<div align="right">(Participant #16)</div>

6) Lack of knowledge of the dental therapist roles and responsibilities

Two participants seemed unsure about the roles and responsibilities of a dental therapist:

"I do not really understand what dental therapists actually do"

<div align="right">(Participant #5)</div>

"Hygienists are preferred".

<div align="right">(Participant #4)</div>

7) Negative perceptions towards dental therapist

Another one participant viewed dental therapists negatively:

"They are same as the fake dentist only this one is legal by law".

<div align="right">(Participant #16)</div>

Table 4.44 shows that less than a quarter (23.5%) of the participants thought a dental therapist would have a useful contribution in the private practice while more than half were undecided (55%) and the remaining perceived differently (21.5%). They suggested that RM 15.90 ± 6.61 per hour is the appropriate salary for a dental therapist working in the private clinic.

Table 4.44: Private dentists opinion on dental therapist contribution and appropriate per hour salary (N=200).

Characteristics	n (%)
I think a dental therapist would give a useful contribution to the private dental practice	
Yes	47 (23.5)
Undecided/ Maybe	110 (55.0)
No	43 (21.5)
Suggestion for an hour salary for the dental therapist who work in the private clinic (n=190)	RM ± SD
Median (IQR)	15.0 (10.0 – 20.0)
Range	4 – 40

PHASE 2 FINDINGS

4.4   Study 4: SD Modelling for Malaysian dental therapists' professional role and its impact on future dental workforce dynamics

4.4.1   Introduction

This sub section presents the findings of the operational research (OR) which involved building a System Dynamic model and testing a range of scenarios. It reports on the outputs of baseline models followed by the outputs from scenarios' testing in order to explore the dynamics of Malaysian dental therapists over 15 years (2015-2030).

4.4.2   Baseline model output

Firstly, the model outputs for the need/demand and supply sub-models are presented using the current level of dental demand across the age-bands; toddler (T), pre-school (PS), primary school (1s), secondary school (2s), adult (A) and elderly (E). Next, the comparison of outputs between the models' projections is presented.

4.4.2.1   Need/demand model

The parameters for the population's demand for dental services by age-bands across sectors were modelled for the next ten years from 2015 based on population data in Appendix K.

4.4.3.1.1 Forecasting the volume of the population across age-band

Figure 4.1 illustrates the demographic changes for the Malaysian population based on 1.7% birth rate and a 5.1% death rate.
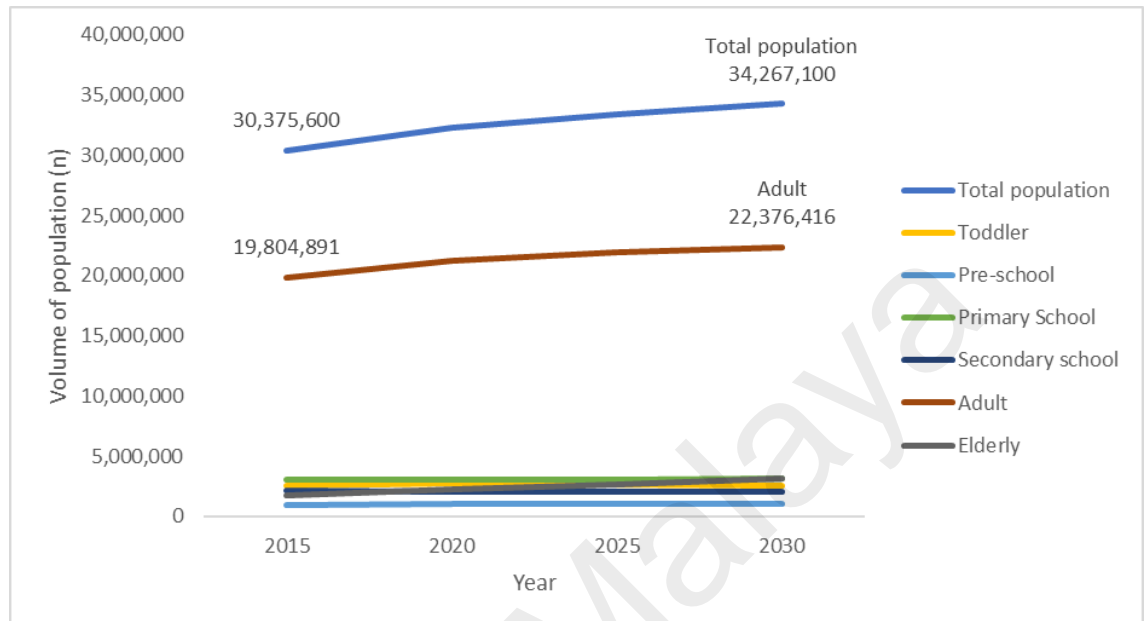
Figure 4.1: Forecasting the volumes for total population across age-bands, 2010-2030, started with the year 2015 data.

- *Modified from (Che Musa, 2017)*
- Modified rates were used for the birth, death and proportion of age-band, 2015-2030 (Appendix K)
- (Age proportion: Toddler: 8.5%-7.4%; Preschool: 3.3%-3.0%; Primary school: 10.1%-9.1%; Secondary school: 7.1%- 6.0%; Adult: 65.8%- 65.2%; Elderly: 5.8%-9.3%)

Based on the projection above, an increase of 12.8% of the total population in Malaysia is expected from 2015 until 2030. However, a decrease in the proportion of the population can be seen across the age band except for the elderly group, as mentioned in the footnote.

4.4.3.1.2 Forecasting the total clinical hours demands by age-band based on the current demand level

i) Total clinical hours demand

Following the simulation, Figure 4.2 illustrates the overall total clinical hours demand for dental care. Results show that the demand for clinical hours is expected to increase by over 25.1% from 33.49 million in the year 2015 to almost 41.88 million hours by 2030 for all age bands.
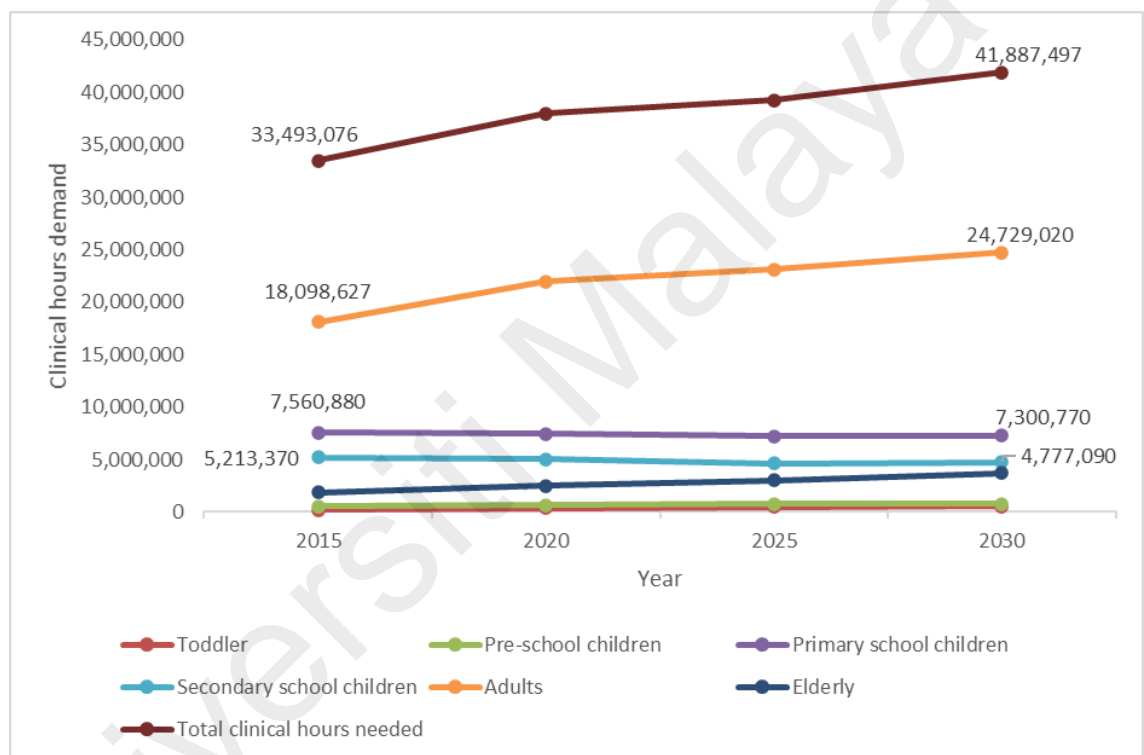
Figure 4.2: Forecasting the total clinical hours demand for dental care by age-band, 2015-2030 (based on current demand level)

- *Modified from (Che Musa, 2017)*
- Started with the year 2015 data
- Prevalence and incidence of oral health needs are assumed to reduce by 5% in 2025; based on the disease trend and re-treatment.
- % of clinical hours demand: Toddler: 14.8%-40.1%; Preschool: 29.0%-51.7%; Primary school: 98.8%-100%; Secondary school: 92%- 100%; Adult: 11.8%- 26.6%; Elderly: 11.2%-19.6%)

ii) Demand for dental therapist and dentist

There is an increase in clinical hours demands towards dental therapist by 24.6% in the
year 2030 as illustrated in Figure 4.3 below.
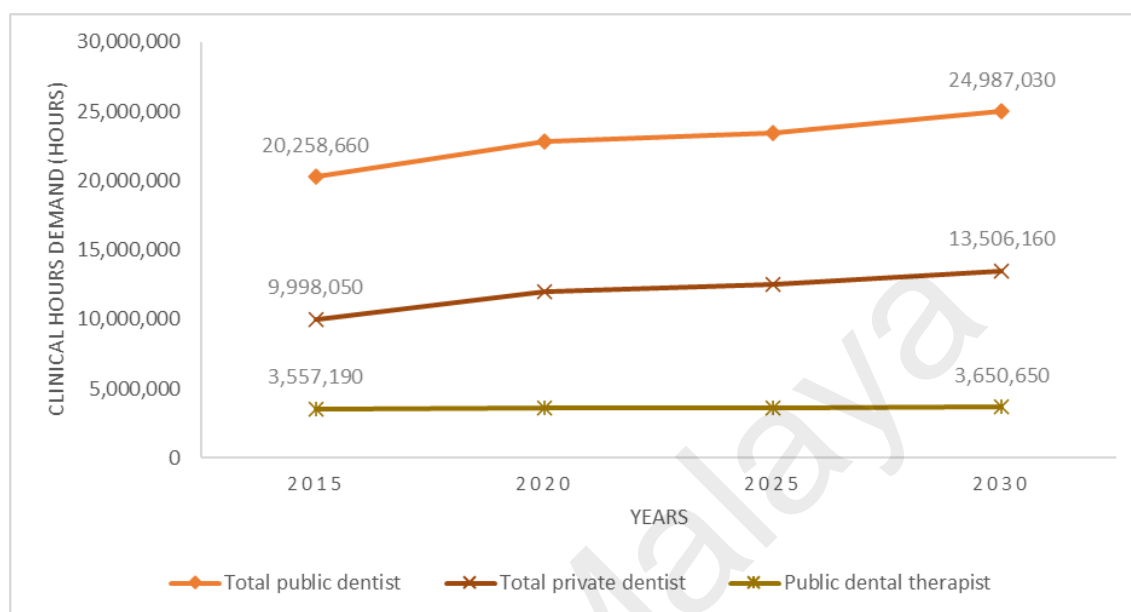
**Figure 4.3: Forecasting the clinical hours demand for dental therapist, dentist
(public-private), 2015-2030 (current demand level)**

- *Modified from (Che Musa, 2017)*
- Total public dentist; Generalist and specialist in public sector
- Total private dentist; Generalist and specialist in private sector
- No private dental therapist at present

4.4.2.2 Supply model

The workforce that contributes to the total clinical hours supply; the dentist (public-
private) and dental therapist are explored.

4.4.2.2.1 Forecasting the total volume for workforce type

i) Forecasting the total volume of dental therapist and dentists

Figure 4.4 illustrates that the future total volume for the dental therapist is expected to increase by 12 % in the year 2030.
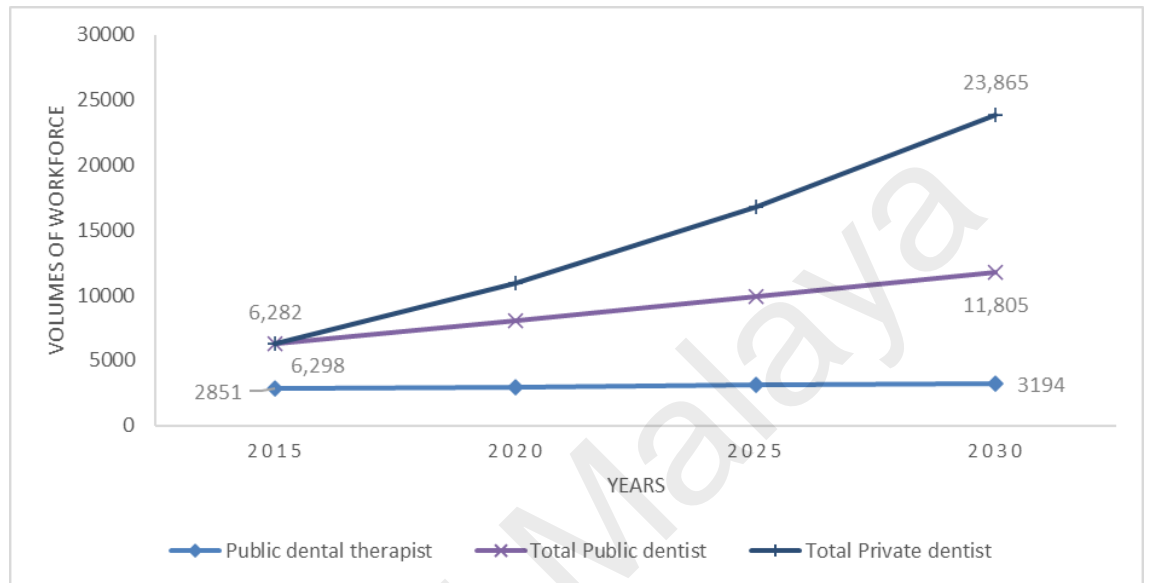
Figure 4.4: Forecasting trend of future volume for dental therapist, dentist (public-private), 2015-2030

- *Modified from (Che Musa, 2017)*
- Dentists: an average of additional 55 new graduates annually; 0.5%-1% attrition rate (retired, etc.); 0.1%-0.5% returning rate; 95 entered postgraduate training annually (MDC and MOH data)
- Dental therapists: 1.0% attrition rate (retired, etc.); 0.1% returning rate; 50 student intakes annually (trend analysis of MOH data)
- Total public dentist; Generalist and specialist in public sector
- Total private dentist; Generalist and specialist in private sector
- No private dental therapist at present

4.4.2.2.2 Forecasting the total clinical hours supply for workforce type

i) Clinical hours supply for dentists and therapists

Figure 4.5 shows that there is an increase in the clinical hours supply of dental therapists by 12 %, from 33.0 million in 2015 to 37.0 million hours by 2030.
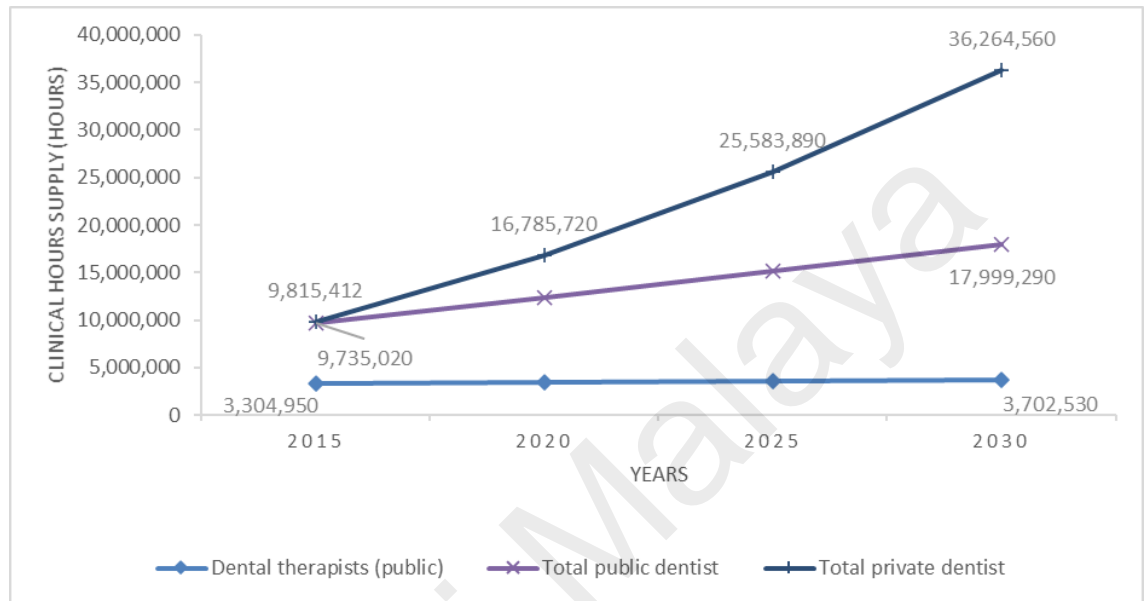
Figure 4.5: Forecasting the total clinical hours supply for dental therapist, dentist (public-private), 2015-2030

- *Modified from (Che Musa, 2017)*
- Public dentist/dental therapists: 100% working full-time
- Conversion of volumes of workforce type into whole clinical hours supply for dentists and therapists
- Total public dentist; Generalist and specialist in public sector
- Total private dentist; Generalist and specialist in private sector
- No private dental therapist at present

4.4.2.3 Comparison between the need/demand and supply model projections

Comparison of outputs between the model projections were made to identify the gap in clinical hours either used or non-used hours. There is a non-used clinical hour if the hours supplied by the workforce are not being used. These gaps were divided with %WTE per individual workforce at 5-year intervals and then converted to the workforce volume needed.

i) Forecasting the used and non-used clinical hours demand for all clinicians dental workforce based on the current demand level

Figure 4.6 shows the potential non-used clinical hours that are expected to occur by 2025 for both the dentists and dental therapists. The model shows that there is an oversupply of the dental therapist by year 2025 onwards. There will also a potential of oversupply of the overall workforce is expected to occur start by year 2020.
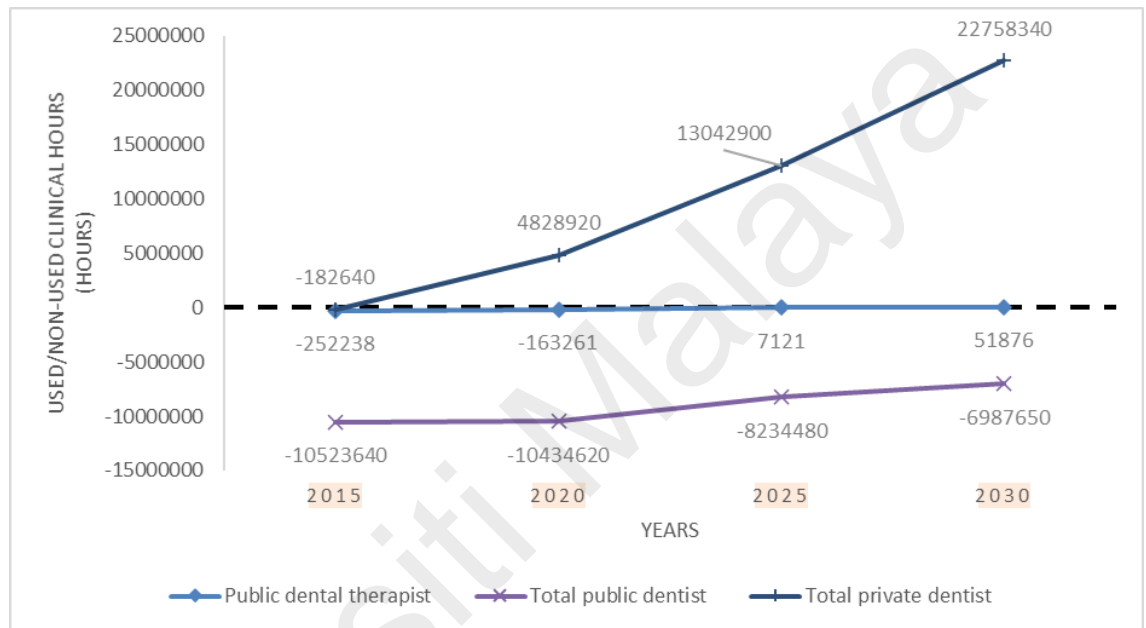
Figure 4.6: Forecasting the used and non-used clinical hours demand for dental therapist, dentist (public-private); 2015 to 2030.

- *Modified from (Che Musa, 2017)*
- Based on total clinical hours supply **minus** total clinical hours demand
- Total public dentist; Generalist and specialist in public sector
- Total private dentist; Generalist and specialist in private sector
- No private dental therapist at present

ii) Forecasting the workforce volume needed from the used/non-used clinical hours

Table 4.45 shows the findings of workforce volume needed following the conversion of used/non-used clinical hours into the potential of undersupply and oversupply of the workforce.

The outputs suggest a possibility of there being an overcapacity of the total number of dental therapists in the year 2025 and 2030 of +6 and +45, respectively. An oversupply of private dentists is also expected in years 2020 (+1356), 2025 (+3662) and 2030 (+6391); and most of the oversupply are from the private generalist. Contrarily, there is expected to be an undersupply of public dentists from the baseline throughout the projected year. Potential oversupply of volume is indicated in **bold** and (+)in Table 4.45.

Table 4.45: Forecasting the workforce volume needed for all clinician dental workforce across sectors, 2015-2030 (baseline model: current demand level)

Scenarios	Output	2015	2020	2025	2030
Dental therapists	Public dental therapist (**PuDt**)	-218	-141	**+6**	**+45**
	Private dental therapist (**PrDt**)	0	0	0	0
	Total dental therapist	-218	-141	**+6**	**+45**
Public Dentists	Public generalist	-2758	-2742	-1589	-790
	Public specialist	-4303	-4259	-3936	-3899
	Total Public dentist (PuD)	-7061	-7001	-5525	-4689
Private Dentists	Private generalist	**+919**	**+2257**	**+4379**	**+6926**
	Private specialist	-970	-901	-717	-535
	Total Private dentist (PrD)	-51	**+1356**	**+3662**	**+6391**
	Total Dentists	-7112	-5645	-1863	**+1702**

• *Modified from (Che Musa, 2017)*

iii) Workforce to population ratio (WPR)

The workforce to population ratio was calculated based on the total volume of the population divided by the total volume of the workforce type. As for dental therapist, the ratio was calculated based on the population of those below 16 years old. Table 4.46 shows that the ratio increased over time for both dentists and dental therapists. The WPR for dentist from 1:30973 in 2015 to 1:13687 in 2030 while for dental therapist the ratio improved from 1: 3090 in 2015 reduced to 1: 2742 in year 2030

Table 4.46: Forecasting the workforce to population ratio, 2015-2030

Output	2015	2020	2025	2030
Total dentists	30,973	23,899	18,450	13,687
Total dental therapists	3,090	2,968	2,862	2,742
Total dental workforce	34,063	26,867	21,312	16,429

- *Modified from (Che Musa, 2017)*
- Based on total population divided by the volumes of the workforce (Figure 4.4; Forecast volume total population / Figure 4.8; Forecast total clinical hour supply dental workforce)
- One workforce: no. of population

In summary, the baseline model shows that based on the current trends (without the introduction of Therapist Division in the Dental Act 2018), there is a possibility of there being an overcapacity of total dental therapist of only +6 and +45 in the year 2025 and 2030 respectively. Similarly, there is expected to be also an oversupply of private dentists, but at a far much larger figure as compared to the dental therapists, in the year 2025 (an oversupply of 3662 dentists) and 2030 (an oversupply of 6391 dentists). In the next section, the testing scenarios and their outputs are presented and compared with the baseline scenarios to examine the impact of shifting dental workforce across type of treatment, age groups and sector informed by the findings from Phase 1 study.

4.4.3   Scenario testing outputs

This section shows the five scenarios used to explore the likely impact of the implementation of Dental Act 2018 on dental therapist' future workforce dynamic. These scenarios were mainly informed by evidences of Phase 1 studies.

4.4.3.1   Comparison of scenarios output

This sub-section described each scenario (1 to 5) including the recommended scenario as described in

4.4.3.1.1 Scenario 1: Definitive baseline (S1)

The total dental workforce forecasted in the baseline model suggests the possibility of an oversupply of public dental therapists as early as in 2025, but the surplus is small at 6 in 2025 and 45 in 2030. For private dentists, it is expected that an oversupply of this type of workforce starts in 2020 throughout to 2030.

The model also indicates an undersupply of public dentists and total public dental practitioners (dentists + dental therapist) in all the years projected (Table 4.47). In contrast, an oversupply of total private dental practitioners is expected from 2020 (a surplus of 1356 workforce) to 2030 (a surplus of 6391 workforce).

Table 4.47: The projected number of different type of Malaysian dental workforce from the year 2015 to 2030 (baseline scenario 1)

Scenarios	Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
Scenario 1: Baseline	2015	-218	0	-7061	-51	*-7279*	-51
	2020	-141	0	-7001	**+1356**	*-7142*	**+1356**
	2025	**+6**	0	-5525	**+3662**	*-5519*	**+3662**
	2030	**+45**	0	-4689	**+6391**	*-4644*	**+6391**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector

4.4.3.1.2 Scenario 2: Optimising DT administrative/Oral health promotion roles in the public service (S2)

In this scenario, the volume of dental therapist and dentist required were forecasted if more administration task and oral health promotion work were delegated to public dental therapist. In this scenario, it is assumed that dental therapists are only allowed to work in the public sector. If the working time equivalence (WTE) for clinical tasks were reduced from 70% to 60%, there is a potential of undersupply of the public dental therapists compared to the baseline model across the simulation period (Table 4.48). Notably, the volume of total public and private dentists remains constant, while there is potential undersupply of the number of total public dental practitioners from (– 4644) to (- 5168) by year 2030.

Table 4.48: The projected number of different type of Malaysian dental workforce from the year 2015 to 2030 based on Scenario 2

Scenarios	Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
	2015	-218	0	-7061	-51	*-7279*	-51
Scenario 1:	2020	-141	0	-7001	**+1356**	*-7142*	**+1356**
Baseline	2025	**+6**	0	-5525	**+3662**	*-5519*	**+3662**
	2030	**+45**	0	-4689	**+6391**	*-4644*	**+6391**
Scenario 2:	2015	-730	0	-7061	-51	*-7791*	-51
Optimising	2020	-659	0	-7001	**+1356**	*-7660*	**+1356**
DT admin	2025	-507	0	-5525	**+3662**	*-6032*	**+3662**
role in the public service	2030	-480	0	-4688	**+6391**	*-5168*	**+6391**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector

4.4.3.1.3 Scenario 3: Optimising dental therapist clinical role at public setting (S3)

Table 4.49 illustrates scenario 3, where more clinical hours were delegated to DT for hygienist activities at the public sector. In this scenario dental therapist are expected to perform 100% scaling and polishing procedures to secondary age groups and are only allowed to work in the public sector. Under this proposed policy, there seems to be a shortage of the number of dental therapists working at the public sectors. But the shortages improved from -1172 in 2020 to -966 in 2030. Similarly, the potential number of undersupply for the public dentists improved by 34.9% in year 2030 as compared to the baseline model. Notably, the volume of private dentists remains constant.

Table 4.49: Volume needed for Malaysian dental workforce from the year 2015 to 2030 (Scenario 3)

Scenarios	Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
	2015	-218	**0**	-7061	-51	-7279	-51
Scenario 1: Baseline	2020	-141	**0**	-7001	**+1356**	-7142	**+1356**
	2025	**+6**	0	-5525	**+3662**	-5519	**+3662**
	2030	**+45**	**0**	-4689	**+6391**	-4644	**+6391**
Scenario 3: Optimising DT clinical role at public setting	2015	-1266	0	-6703	-51	*-7969*	-51
	2020	-1172	0	-6659	**+1356**	*-7831*	**+1356**
	2025	-982	0	-5209	**+3663**	*-6191*	**+3663**
	2030	-966	0	-4364	**+6391**	*-5330*	**+6391**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector

4.4.3.1.4 Scenario 4(a): Enhancing dental therapist clinical roles at the private setting in view of public dental therapist perceptions (s4a)

Under this scenario, dental therapists are allowed to work in the private sector and their migration rate from the public sector to the private sector was set at 8.3% (based on findings from Phase I). The projected model shows that the migration of DT to the private sector will increase the potential of undersupply of them at the public sector across the simulation period, from a shortage of 2796 in year 2020 to 3366 in year 2030. It will also lead to the potential oversupply of private dental therapists, starting from a surplus of 153 in 2020 to 221 in 2030. The model also indicates an oversupply of private dentists in all the years projected, from a surplus of 1581 dentists in 2020 to almost 7000 in 2030 (Table 4.50). Interestingly, the migration of DT to the private sectors improved the shortages of public dentists slightly across the simulation years, when compared with the baseline scenario.

Table 4.50: The projected number of different type of Malaysian dental workforce from the year 2015 to 2030 based on Scenario 4a

Scenarios	Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
	2015	-218	0	-7061	-51	-7279	-51
Scenario 1: Baseline	2020	-141	0	-7001	**+1356**	-7142	**+1356**
	2025	**+6**	0	-5525	**+3662**	-5519	**+3662**
	2030	**+45**	0	-4689	**+6391**	-4644	**+6391**
4 (a): 8.3% of public DT preferred to do work at private sector	2015	-2235	**+101**	-6703	**+106**	*-8938*	**+207**
	2020	-2796	**+153**	-6659	**+1581**	*-9455*	**+1734**
	2025	-3055	**+199**	-5209	**+3890**	*-8264*	**+4089**
	2030	-3366	**+221**	-4364	**+6632**	*-7730*	**+6853**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector
- Privatisation rate for dental therapist, 8.3%

4.4.3.1.5 Scenario 4(b): Enhancing dental therapist clinical roles at the private setting in view of private dentist perceptions (S4b)

For this scenario, it is assumed that 15.5% of dentists accepted the employment of dental therapists in the private practice and were willing to delegate dental procedures tasks to dental therapists; the proportion set was based on the findings from Phase I. Based on this simulation, there will be a potential undersupply of the dental therapists at the public sectors across those simulation periods; from a shortage of 2829 in 2015 to 3835 in 2030. As expected, the introduced policy lead to a potential oversupply of private dental therapists and private dentists as early as in 2015 (Table 4.50). The surplus of private dental therapist (+204) is higher than that of private dentists (+93) in 2015, but the ratio of private dental therapist to private dentist improves in 2030. Private dentist acceptability towards dental therapist would somehow improve slightly the problem of undersupply of public dentist across the simulation years, as compared to the matching years in the baseline scenario. Not surprisingly, the migration of dental therapist to private settings create oversupply of the total number of private dental practitioners; an increment of almost 280% from 2020 to 2030. (Table 4.51)

Table 4.51: The projected number of different type of Malaysian dental workforce from the year 2015 to 2030 based on Scenario 4b

Scenarios	Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
Scenario 1: Baseline	2015	-218	0	-7061	-51	-7279	-51
	2020	-141	0	-7001	**+1356**	-7142	**+1356**
	2025	**+6**	0	-5525	**+3662**	-5519	**+3662**
	2030	**+45**	0	-4689	**+6391**	-4644	**+6391**
4 (b): 15.5% of private dentists willing to delegate work to DT	2015	-2829	**+204**	-6703	**+93**	*-9532*	**+297**
	2020	-3454	**+283**	-6659	**+1555**	*-10113*	**+1838**
	2025	-3628	**+326**	-5209	**+3858**	*-8837*	**+4184**
	2030	-3835	**+344**	-4364	**+6592**	*-8199*	**+6936**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector
- Privatisation rate for dental therapist; 15.5%

4.4.3.1.6 Scenario 4(c): Enhancing dental therapist clinical roles at a private setting in view of parental perceptions (S4c)

For this scenario, it is assumed that 76.5% of parents allow dental therapists to perform dental procedures on their children in the private practice; the proportion set based on the findings from Phase I. The output indicates a potential undersupply of the dental therapists at the public sector across those simulation periods with a shortage of 2792 in year 2020 to 3358 in year 2030, a 20% increase of staff deficit across that decade. Parental positive acceptance will also lead to a potential oversupply of private dental therapists where a surplus of 161 and 234 are observed in year 2020 and at the end of the simulation period respectively (Table 4.52).

Table 4.52: Volume needed for Malaysian dental workforce from the year 2015 to 2030 (scenario 4c)

Scenarios	Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
Scenario 1: Baseline	2015	-218	0	-7061	-51	-7279	-51
	2020	-141	0	-7001	**+1356**	-7142	**+1356**
	2025	**+6**	0	-5525	**+3662**	-5519	**+3662**
	2030	**+45**	0	-4689	**+6391**	-4644	**+6391**
4 (c): *76.4%* of parents accept DT to treat their children at private sector	2015	-2233	**+109**	-6703	**+81**	*-8936*	**+190**
	2020	-2792	**+161**	-6659	**+1574**	*-9451*	**+1735**
	2025	-3050	**+210**	-5209	**+3881**	*-8259*	**+4091**
	2030	-3358	**+234**	-4364	**+6621**	*-7722*	**+6855**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector
- Privatisation rate for dental therapist; 15.5%

4.4.3.1.7 Scenario 5: Optimising dental therapist admin/promotion role in the private service (S5).

Looking at the output produced for Scenario 4 where the clinical roles of dental therapists is introduced to the private sector, the distribution of dental therapist across sectors and other type of workforce is seemed to be fairly acceptable to address (i) the need and demand of the population and (2) addressing the career expectation of dental therapist in Malaysia. This final scenario testing is the proposed scenario which was aimed to provide more working hours supply for the oral health promotion and administration works for the private dental therapist to reduce the potential of oversupply of dental therapist at the private sector.

In this model simulation, the work time equivalence (WTE) in private sector was reduced from 90% to 60% while the privatisation rate was set at 8.3%.

The output (Table 4.53) illustrates that when the roles of OHP is enhanced, the surplus of dental therapist in 2030 is **118**, much lower than what was presented in Scenario 4a (**a surplus of 221**). While for total private dental practitioners, the rate of oversupply is also slightly reduced, a surplus of **6750** in this scenario as compared to Scenario 4a (**+6853**). Nevertheless, there is potential number of undersupply for the total public dental therapist and dentists as compared to the baseline model.

Table 4.53: The projected number of different type of Malaysian dental workforce from the year 2015 to 2030 (Scenario 5: The proposed scenario)

Scenarios	Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
Scenario 1: Baseline	2015	-218	0	-7061	-51	-7279	-51
	2020	-141	0	-7001	**+1356**	-7142	**+1356**
	2025	**+6**	0	-5525	**+3662**	-5519	**+3662**
	2030	**+45**	0	-4689	**+6391**	-4644	**+6391**
Scenario 5: Optimising DT OHP role in the private service (4a +FTE Pr TH 0.6)	2015	-2235	**+63**	-6703	**+106**	*-8938*	**+169**
	2020	-2796	**+86**	-6659	**+1581**	*-9455*	**+1667**
	2025	-3055	**+113**	-5209	**+3890**	*-8264*	**+4003**
	2030	-3366	**+118**	-4364	**+6632**	*-7730*	**+6750**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector
- Privatisation rate for dental therapist; 8.3%
- WTE for private dental therapist was reduced from 90% to 60%

4.4.3.2   Summary of scenario testing

To summarise, Table 4.54 compiles and compares the required workforce volume for the entire workforce types across the baseline and their four main alternative scenarios

Table 4.54: Outputs for volume needed for all clinician dental workforce across baseline, alternative and recommended scenarios

Scenarios		Year	Public dental therapists (PuDt) (n)	Private dental therapists (PrDt) (n)	Public dentists (PuD) (n)	Private dentists (PrD) (n)	Total public dental practitioners (n)	Total private dental practitioners (n)
Scenario 1: Baseline		2015	-218	0	-7061	-51	*-7279*	-51
		2020	-141	0	-7001	**+1356**	*-7142*	**+1356**
		2025	**+6**	0	-5525	**+3662**	*-5519*	**+3662**
		2030	**+45**	0	-4689	**+6391**	*-4644*	**+6391**
Scenario 2: Optimising DT admin role in the public service		2015	-730	0	-7061	-51	*-7791*	-51
		2020	-659	0	-7001	**+1356**	*-7660*	**+1356**
		2025	-507	0	-5525	**+3662**	*-6032*	**+3662**
		2030	-480	0	-4688	**+6391**	*-5168*	**+6391**
Scenario 3: Optimising DT clinical role at public setting		2015	-1266	0	-6703	-51	*-7969*	-51
		2020	-1172	0	-6659	**+1356**	*-7831*	**+1356**
		2025	-982	0	-5209	**+3662**	*-6191*	**+3662**
		2030	-966	0	-4364	**+6391**	*-5330*	**+6391**
Scenario 4: Enhancing DT clinical role at private setting	4 (a)	2015	-2235	**+101**	-6703	**+106**	*-8938*	**+207**
		2020	-2796	**+153**	-6659	**+1581**	*-9455*	**+1734**
		2025	-3055	**+199**	-5209	**+3890**	*-8264*	**+4089**
		2030	-3366	**+221**	-4364	**+6632**	*-7730*	**+6853**
	4 (b)	2015	-2829	**+204**	-6703	**+93**	*-9532*	**+297**
		2020	-3454	**+283**	-6659	**+1555**	*-10113*	**+1838**
		2025	-3628	**+326**	-5209	**+3858**	*-8837*	**+4184**
		2030	-3835	**+344**	-4364	**+6592**	*-8199*	**+6936**
	4 (c)	2015	-2233	**+109**	-6703	**+81**	*-8936*	**+190**
		2020	-2792	**+161**	-6659	**+1574**	*-9451*	**+1735**
		2025	-3050	**+210**	-5209	**+3881**	*-8259*	**+4091**
		2030	-3358	**+234**	-4364	**+6621**	*-7722*	**+6855**
Proposed scenario (S5): Optimising DT admin role in the private service		2015	-2235	**+63**	-6703	**+106**	*-8938*	**+169**
		2020	-2796	**+86**	-6659	**+1581**	*-9455*	**+1667**
		2025	-3055	**+113**	-5209	**+3890**	*-8264*	**+4003**
		2030	-3366	**+118**	-4364	**+6632**	*-7730*	**+6750**

- *Modified from (Che Musa, 2017)*
- Based on used/non-used clinical hours divided by %WTE of workforce type in a year
- Public dentists = public generalist and specialist
- Private dentist = private generalist and specialist
- Total public dental practitioners = public dentist and dental therapist
- Total private dental practitioners = private dentist and dental therapist
- Oversupply is indicated by volumes in **bold** and with **positive (+)** sign
- No Dental therapist available in the private sector
- Scenario 2: ↓ WTE Public DT: 60%, WTE rate (private) similar to baseline
    - Scenario 3: Delegation of scaling (100%) activities to public DT at secondary age group
    - Scenario 4a: 8.3% of public DT preferred to do work at private sector (Phase 1).
    - Scenario 4b: 15.5% of private dentists willing to delegate work to DT (Phase 1)
    - Scenario 4c: 76.4% of public accept DT to provide dental to the children (Phase 1)
    - Scenario 5: ↓ WTE Private DT: 60%

Series of scenarios conducted to illustrate model simulation using various values informed by current trends, e.g., demand-supply and findings from phase 1 study. The assumption is that the dental therapist employability in the private dental clinic is accepted by the private dentist as well as by the public with optimum clinical and promotion work across sectors. The simulated model findings show the numbers needed for the dental therapist in private sector range from **101** to **344** while the surplus of private practitioners range from **207** to **6936.** However, as for the public dental therapist, the supply is in the optimum value range from **2235** to **3366.**

4.5   Summary of the main findings

4.5.1   Objective 1: To describe the dental therapists' and private dental practitioners' awareness on the establishment of Therapist Division under the new Malaysian Dental Act 2018.

1. More than two-thirds of both participants (79.1% dental therapist and 69% private dentist) were aware of the provision of Therapist Division in the Dental Act 2018.

2. Majority (96.8%) of the dental therapists and about two-thirds of private dentists (65%) knew that the former must register with MDC in order to practice

3. Only 7% dental therapist and 11.5% of private dentists were aware of the age limit in the dental therapist scope of practice

4. Majority of dental therapists (71.2%) were aware that they are allowed to work in the private sector, and 58.9% were aware of the need for direct supervision. While for the private dentists, about half of them were aware that dental therapists can work in private sector (51%) and that they require direct supervision (52%),

5. More than four-fifth of dental therapists correctly acknowledged the roles of dental therapists particularly the regulations on placing fissure sealant (88.8%) and performing dental x-ray (87.3%). In contrast, only a quarter of private dentists correctly answered on questions related to the dental therapists' clinical remit.

6. Majority of the dental therapists (94.8%) were aware that they can be fined if they worked with someone who did not register with the council. While for the private dentists, only half of them aware about this.

7. The mean total awareness score for the ten items was 4.3 ± 2.5 for the private dentists and 6.4 ± 1.4 for the dental therapists. This shows that dental therapist had a higher awareness of the Therapist Division stipulated in the Dental Act 2018 as compared to the private dentists.

4.5.2 Objective 2: To identify dental therapists' job motivation, job satisfaction, intention to leave and perceptions of employment in private practice

1. Majority of the participants were satisfied with their physical work (92%), teammates (94.2%), opportunity to use abilities (91.7%), job variety (92%) and work hours (92.7%).

2. About four-fifth responded as being satisfied with the immediate boss (84%), relationship in the workplace (84%), workplace management (80.6%), freedom to work (84.5%), acknowledgement received (85%), work responsibilities (84.5%) and credit given on the suggestions made by them (81%).

3. Almost one-quarter felt dissatisfied with their pay rate (75.6%), job safety (78.8%) and promotion (79.5%).

4. Overall, the mean score for job satisfaction amongst dental therapists was 12.7 ± 3.4 (for 15 items)

5. About one-quarter (21.5%) of the participants ever thought of leaving their post and only a small number intended to seek another job in different organisation (8.3%).

6. More than one-tenth would leave their post when they get another job (11.5%) and 11.9% planned to leave their profession for a different career.

7. Of all, 13% had high intention of leaving their job as a dental therapist.

8. More than two-thirds (67.2%) of the participants expected to still be a dental therapist and one-fifth (20.4%) expected to be as a post-basic dental therapist.

9. Seven percent of participants considered working in the private sector in the next five years

10. More than three-quarters planned to work full time with a mean of 8 ± 2.4 sessions of working a week

4.5.3 Objective 3: To determine the factors associated with the intention to leave among the dental therapists.

1. The significant predictors / associated factors for high intention to leave are:

a. Educational attainment: The odds of diploma holders in having intention to leave are 0.24 times lower than among the higher level educated dental therapist.

b. Years in the service: Those who worked within 11 to 20 years are 0.51 less likely to have the intention to leave than the reference group.

c. Job satisfaction score: Participants with high level of job satisfaction were 0.89 less likely of having intention to leave.

d. Sector they foresaw working in the next five years: Those who foresaw working in the private sector within the next five years were 4.14 times more likely to have the intention to leave than those who wished to stay in public sector.

2. The significant predictors / associated items in job satisfaction scale factors for high intention to leave are:

a. Workplace management: (OR=0.54, 95% CI: 0.38,0.78)

b. Overall job satisfaction: (OR=0.41, 95% CI: 0.26,0.64)

4.5.4 Objective 4: To assess the parents' acceptance of dental therapists' employment in private practices

1. More than three-quarter 'agreed' or 'completely agreed' if their child received advice on oral hygiene care (87.7%), a simple cavity filling (79.8%), and topical fluoride gel and paste application (83.2%) from the dental therapists.

2. Slightly more than two-thirds agreed on their child receiving operative task from the dental therapists: to get an injection to make their teeth and gums go numb (63.9 %), to 'pull out' milk teeth (62%) and to have scaling and polishing done (69.8%).

3. Overall, about three-quarter (76.4%) of them were comfortable and accepted if their child was to be treated by a dental therapist in the private dental clinic.

4. Almost three-quarter (71.4%) of the participants accepted more than or equal to 5 out of 7 treatments provided by the dental therapist and they were categorised as having a high level of acceptance towards dental therapist providing dental care to their children in private dental clinic.

5. Almost three quarter (72.5%) perceived that dental therapist should be allowed to practice in the private dental clinic and about 57% would give the permission or would allow the dental therapists to treat their children.

4.5.5 Objective 5: To determine factors that influence parental acceptance towards the use of dental therapist in the private sector.

1. Younger parents were more likely to accept five dental procedures performed by the dental therapist except them giving advice on oral hygiene care and performing scaling procedures to their children.

2. In contrast, parents who preferred sending their children to a private dental clinic for dental care were more likely to accept four out of seven dental procedures except for three operative dental procedures, namely local anaesthesia administration, deciduous teeth extractions, and scaling and polishing.

3. Meanwhile, parents who lived in urban and bumiputra were more likely to accept dental therapists providing two types of dental procedures on their children.

4. Parents who perceived having good or very good teeth condition were more likely to report a dental therapist restoring their child teeth acceptable. Furthermore, parents who perceived having good and very good gum condition were more likely to accept dental therapist to extract their child's deciduous teeth Parents who perceived of having a 'good' or 'very good' teeth condition were more likely to accept a dental therapist restoring their child teeth.

5. Mothers and parents who only attained primary school were less likely to accept dental therapist performing scaling and prophylaxis to their children

4.5.6   Objective 6: To describe private dentists' attitudes and perceptions as well as their perceived barriers on the employment of dental therapist in the private practices.

1. About half of the participants agreed with the statements:

- 'Dentists can work more effectively/efficiently using dental therapists in a team approach' (56.5%),

- 'In general patients want to be treated by dental therapists' (50.5%),

- 45% agreed that 'Using a therapist will increase a dentist's enjoyment of dental practice'.

2. Some had expressed unfavourable opinions towards the employment of dental therapists:

- 'Dental care will be less personalised if therapists are used for some treatment' (50.5%),

- 'If more use is made of therapists there will not be anything left for dentists to do' (48%),

- 'Dental therapist would disrupt dentist-patient relationship' (44%).

3. Around two-third (35.5%) perceived that patients would have less respect for dentist when being treated by a dental therapist.

- 15.5% of the participants revealed that they would consider employing a dental therapist in their practice.

4. About 70% of the participants perceived a potential increase financial burden as their main barriers to employ dental therapist in their practice.

5. Slightly more than half reported that lack of knowledge and skills among dental therapist (52%), poor patients' acceptance (52.6%) and dental therapists requiring additional supervision (51.5%) were the barriers

6. Slightly more than one-third perceived that there might be an additional administrative burden (40%) if they employed a dental therapist, while some were worried about dental therapist work quality (38.0%), legislation issue (31%) and lack of space availability in their practice (35.5%).

4.5.7 Objective 7: To model the future dynamics of dental therapist in Malaysia in relation to the population need and demand.

The supply and need/demand for dental care among age-bands across sectors: toddler (T), pre-school (PS), primary school (1s), secondary school (2s), adult (A) and elderly (E).

The baseline model shows that there is a:

- Potential for a balance between supply and need/demand projections for both public dental therapists, public dentists and private dentists across the simulation years (2015, 2020, 2030)

- Potential for an oversupply of public dental therapists and private dentists in 2025 and 2020; and an undersupply for public dentists throughout the simulation period

The implication of dental therapist expectations on future working patterns (working in the private sector and part-time mode) and profile (clinical vs. administration/oral health promotion) on the dental workforce volume needed in the country for Malaysian dental workforce was assessed in a series of testing scenarios.

The findings from the scenario testing:

i.   In scenario 2, the assumption was, the dental therapists are only allowed to work in the public sector and their clinical tasks were reduced from 70% to 60%. Simulation revealed there will be a potential undersupply of the public dental therapists across the simulation period compared to the baseline model.

ii. In scenario 3, when of the used of public dental therapist is fully optimised to perform scaling and prophylaxis among secondary schoolchildren, the simulation showed a potential of an undersupply of both public dental therapist and public dentist but improved by year 2030.

iii. In scenario 4, the migration of dental therapist to private sector is assumed to be between 8.3% to 15.5% (based on Phase 1 findings). Not surprisingly, migration of dental therapist to private settings create oversupply of the total number of private dental practitioners while potential undersupply of the dental therapists at the public sector across those simulation periods

iv. For final policy testing in optimising the private primary dental care, it was found that, there will be a potential oversupply of private dental therapist and total private practitioner. The overall increment of oversupply is expected at 8.7 % and 38.9 % for the latter by year 2030.

CHAPTER 5: DISCUSSION

5.1   Introduction

This chapter discusses the findings based on the objectives of this study, and how they may be able to fill the existing gaps in the discipline. Possible explanations and implications of this research are also provided along with the strengths and limitations.

5.2   Response rate

The response rate obtained was 96.3% from the dental therapists, 83.1% from the parents and 52.6% from the private dentists. It is interesting to see the variety of response rates among the three different populations.

Response rates have always been shown to be low for health professionals as compared to the general public. In addition, most reviews have indicated that the response rates amongst health professionals have been declining in recent decades, from 80% before 1960 to around 42% in 2012 (Funkhouser et.al., 2017). However, previous surveys conducted on dentists have obtained response rates above 80% (Sutton, Ellituv & Seed, 2005; Mutyabule, & Whaites, 2002; McCrea 2008), most of which were on European and African dentists. Previous study conducted among Malaysian private dentist have shown low response rates of between 36.0% and 50.3% (Chin et al., 2016; Yusof et al., 2008). Another study by Ly et al. (2019) that used a postal survey only achieved a response rate of 38%. Hence, the response rate of 52.6% obtained in this study can be considered as acceptable as it is close to the average seen across local studies. Lack of time, perceived lack of importance, concerns about confidentiality, and concern about bias of the survey, have been reported as reasons for the low response rate amongst health professionals (Funkhouser et al., 2017). In our study, the questionnaire was given personally to the dentists at their clinic premises and we

recorded their reasons if they declined to be involved. Most cited that they were unfamiliar with the research topic and did not have the time to do so.

The response rate among the dental therapists were higher (96.3%) compared to the census in the previous study (76.8%) by Abu Bakar et al. (2015). The high response rate among the dental therapists was probably because they were interested and familiar with the topic. The online method used to disseminate the questionnaire with the assistance of their immediate principal may have played a role for the high response too (Lefever, Dal & Matthíasdóttir, 2006; Nulty, 2008; Teo, 2013; Turner et al., 2012).). As for the parents, the high response rate obtained was possibly due to the assistance provided by the class teachers who supported and encouraged the parents to complete the survey. Evidently, the response rates from surveys conducted on parents have always been overwhelming especially when the research topics were on their children's health (Al-Zahrani, 2019; Duangthip, Gao, Chen, Lo & Chu, 2019; Suma Sogi et al., 2016).

5.3 The dental therapists' and private dentists' awareness on the establishment of the therapist division under the new Malaysian Dental Act 2018

This study was one of the first to demonstrate the awareness on the establishment of Therapist Division under the Malaysian Dental Act 2018, among two key stakeholders of the Malaysian dental fraternity: the dental therapists and the private dentists. The result showed that more than two-thirds of the participants (both the dental therapists and the private dentists) were aware with the provision of the therapist division under the Dental Act 2018 and knew that similar to other professionals, dental therapists must also register before they can practice in the sector.

With the implementation of this regulation, dental therapists working at either the public or private sectors are guaranteed to be competent, adequately skilled, and

compliant with the set standards prior to serving their clientele (WHO, 2016). The participants of this study seemed to be well informed about the establishment of the Therapist Board that will place the dental therapist profession at par with their medical nurse colleagues.

Only about half of the dentists surveyed were aware that dental therapists are allowed to work in the private settings. In contrast, the majority or almost three quarters of the dental therapists were aware that they are now legally allowed to work in the private sector that allows for their career advancement within the job scope, a finding which is similar to their UK counterparts following the introduction of the new developments that influenced the practice of dentistry (Godson 2009). The possible career advancement and the opportunity to work in different settings with a possible increment in the salary are certainly news that one would take notice of. However, although few were aware of dental therapists' expansion of roles to the private settings, dental specialists in Malaysia have voiced out their interest in employing dental therapists in their private clinic and were keen on the use of post basic dental therapist to perform clinical procedures (Malaysian Dental Council, 2018).

In terms of supervision, only slightly more than half of both dentists and dental therapists were aware that the latter require direct supervision when working at the private dental settings. When working at the public dental clinic, dental therapists in Malaysia operate under the direct supervision of a dentist, particularly during the provision of dental care. However, in the school dental service they exercise indirect supervision. If there is any concern about any diagnosis of a disease or uncertainty of dental treatment, the case will be referred to the dentist (Public Services Commission of Malaysia, 2020). This has been practiced ever since the profession was introduced to the Malaysian dental fraternity but the dental therapists in this study may have perceived that the setting of the private and school dental service is similar where they are given

the freedom to decide on the treatment plan. About 40% of dentists in this study reported that they have never worked with a dental therapist before (Table 4.28) and the unfamiliarity with the supervision requirement of a dental therapist may explain why most of them had low knowledge or awareness in this aspect.

In the previous Dental Act, dental therapists are only allowed to treat the children up to 17 years old. Under the new act, the age restriction has been increased to 18 years old. The age difference of only one year between the new and old acts is probably the reason why both dental therapists and dentists in this study seemed to be unaware of the revision. An earlier local census conducted before the new act was implemented reported that most of the dental therapists had positive perspective of their clinical roles to children under the age of 17, and were not keen to expand their responsibilities to other age groups (Abu Bakar et al., 2015). As mentioned, Abu Bakar et al. (2015) study was conducted before dental therapists are permitted to work in the private settings. The new regulations may allow dental therapists to undertake a more advanced and challenging role in their career as an 18-year-old person who has left school environment may have different oral health needs. In most countries that use dental therapist in their service, the main roles of the dental therapists are mainly to serve children. Some other countries like New Zealand and Australia had extended the population this workforce may treat which may include the adult group. Most dentists were supportive with the dental therapists providing the care for children but there was resistance in delegating adult care to them. Nash, Mathu-Muju and Friedman (2018) in their review concluded that this could be due to safety issue and competencies as well as the complexity of an adult oral health care and other ethical issue concerns. In Victoria, Australia, two studies conducted to evaluate the effectiveness of dental therapists in providing care to adult aged above 26 showed positive results. 95% of restorations placed by the dental therapists on patients aged between 26 to 82 years old were

considered satisfactory and the standard were similar to that of young dentists (Calache et al. 2009). Dental therapists in Victoria with a university qualification were found to have a high knowledge in oral examination and dental restoration and were considered as clinically competent to provide care to adults of all ages (Calache & Hopcraft, 2012). These studies show that dental therapist are able to provide safe and effective dental care to adults, if they are trained well. In addition, looking at a greater context, if the use of dental therapist in Malaysia is to be extended to the adult population, they can focus on the prevention activities such as oral health promotion or fluoride application, and this will equitably benefit the population including the dentists, provided legal enforcement is appropriately executed.

In this study, the private dentists had an overall lower mean awareness score of the Therapist Division in the new dental act as compared to the dental therapists who scored two points higher. The fact that only about two-fifths of the private dentists had working experience with dental therapists may explain why they were oblivious with the dental therapists scope of practice including the type of patients and clinic settings that the latter are allowed to work on/in. This is also reflected in the result of one open-ended question on barriers of dental therapist's employability in a private dental clinic: "*I do not really understand what dental therapists actually do*". A series of roadshows have been held nationally by the Malaysian Dental Council (MDC) following the endorsement of the Dental Act 2018 in June 2018. The event served as a platform that allowed dental practitioners across the sectors to gain insight and understanding on the new Act. It was reported that the roadshow attracted the public dentists more than the private dentists (MDA, 2018). The poor attendance among the private dentists during the events is a plausible explanation for the lack of awareness that was depicted from the findings of this study.

In some countries, dentists were worried that the expansion of roles may make dental therapists to be hungry for more powers and would overstep the boundaries limited to them (Nash et al., 2018). The issue of illegal dental practice has been taken seriously in the new Dental Act 2018. One related question regards the legal enforcement was included where participants were queried whether they knew that a dental therapist must work with someone with a valid practising certificate. About 90% of dental therapists were aware of this regulation as compared to 50% of private dentists. In Malaysia there are many cases highlighted in the media about individuals without dental backgrounds performing dental procedures to the public (The Star, 2017; Malaysian Dental Association, 2017). The possibility of dental therapists also providing their professional services illegally without direct supervision is worrying the private dentists. It is feared that there may be cases of misconduct or abuse of power which would tarnish their profession and the reputation of the dental fraternity as a whole. There are regulations under the Private Healthcare Facilities and Services Act 1998 that applies to curb individual practicing dentistry on unregistered premises. The existence of the new Dental Act serves to strengthen the existing laws and prevent such incidents from happening further as the Act applies to individual practice illegal dentistry. Furthermore, the majority of dental therapists have been known to have a "timid" and "obedient" traits as a government servant that has been instilled with the government sign-off phrase "*Saya yang menjalankan amanah*" or '*I who obey orders*' (Public Services Commission of Malaysia, 2018) and it is perceived that they will not flout any rules stipulated in the new Act.

In summary, both dental therapists and private dentists in this study were unaware of some of the information stipulated in the Dental Act 2018, hence specific measurement must be taken to enlighten this issue to the workforce. A continuing professional development in a series of talks can be organised so they will constantly be updated

with the rules and regulations to ensure there is no breech or misconduct occurring in the future.

5.4 Dental therapists' job motivation, job satisfaction, intention to leave, and their perceptions of employment in private practices

5.4.1 Job motivation and job satisfaction

In this study, the Warr-Cook-Wall scale was used to measure job motivation and job satisfaction. It was found that the majority of participants (>90%) indicated having high job motivation as the mean score shown of >3 for each item (Table 4.13).

Of all six items in the scale, the highest score was on "take pride in doing my job to the best I can" (3.64 ± 0.49) while the lowest score was on "disappointed with myself if I do this job badly" (3.41 ± 0.63). This finding shows that the dental therapist does reflect on what they have been through daily. When one looks back at what is being done daily and knows how to improve work performance, fatigue will be reduced. So, if self-assessment is made, this makes their work more meaningful. As a result, it will reduce work exhaustion and be more motivated (McKnight et al., 2009).

Based on univariate analysis found four-item to be associated with high intention to leave; "feel a sense of personal satisfaction when I do this job well", "take pride in doing my job to the best I can", "want to feel satisfied when I look back at work I did on that day" and "try to think of ways of doing my job effectively". However, when multivariate analyses were conducted, none of these items was significant and did not prove to be the predictor of intention to leave among the dental therapist (Table 4.22). These positive attitudes portrayed by the dental therapist will consequently produce better services, high job performances, and low turnover (Falola, Osibanjo & Ojo, 2014). A motivated worker is indicating that adequate human resources have been

practice at district levels that might influence them to stay and not leaving their current position (Bonenberger et al., 2014). Identifying the right motivation factors also lead to continuous improvement and competitive advantage resulting in high job satisfaction (Slimane, 2017).

As for job satisfaction, the finding showed that more than four-fifths of the participants were satisfied with their physical work condition (i.e. location of practice, workroom/building and medical and non-medical equipment). This finding is in accordance with a past local study (Abu Bakar et al., 2015) and studies among physicians in Malaysia and Indonesia (Chew et al., 2013; Maharani, Afief, Weber, Marx, & Loukanova, 2019). It could be due to the decent facilities that the Malaysian dental provider has made available, especially for the school dental services as reported in their annual report (2018).

About four-fifths of participants in this study responded as being satisfied with their immediate superiors and colleagues, which is similar to a study by Knox, Warhurst, Nickson and Dutton (2015). When employees feel they have a positive working relationship with supervisors and colleagues, they feel motivated to focus on achieving the company objectives with an aim to achieve greater satisfaction in their lives. Satisfaction with the superior indicates a healthy relationship between the superior and the subordinates, which contributes a feeling of active involvement of the former and provides an enjoyable workplace environment for the dental therapists. This is a fundamental aspect from the perspective of Timmreck (2001), which highlights the value and obligation of middle managers to foster workers' personal and professional development. Good interpersonal relationships are essential for work environment satisfaction (Longo, 2009). In fact, professional satisfaction can be enhanced not only through positive relationships with colleagues, but also through support from the management team (Cortese, Colombo & Ghislieri, 2010).

By comparison, our study shows similar findings in which almost one-quarter of our participants felt dissatisfied with their pay rate and promotion (Abu Bakar et al., 2015; Kruger et al., 2007; Singh, 2009) that typically leads to a greater intention to leave their organisations (Rich, 2015; Smokrović, Žvanut, Bajan, Radić & Žvanut, 2019). Finance is always associated with the value of work. Abu Bakar et al. (2015) in their studies prior to the implementation of the Dental Act 2018 reported that dental therapists had the issue of dissatisfaction with the pay rate. This shows that the monetary factor plays an important indicator to a person's satisfaction towards their job that later may jeopardise their work and outcome. In the public sectors, Malaysian dental therapist basic pay scale ranging from RM1800 for Grade U29 to RM3590 for grade U 36 and this does not include the other allowances that they receive monthly. Recent revision by local authority, total household income of less than RM 4360 is categorized as below poverty level (B40) (Ministry of Housing and Local Government, 2020) and it is not surprising to understand why the dental therapists were not happy with their salary. Although the Dental Act has been approved since 2018, data on dental therapist's salary at the private settings is still unknown. However, our study indicated that dentists perceived the appropriate salary for dental therapist at the private settings is RM15 per hour (Table 4.44). If the working hours is similar, dental therapist will receive about RM2600 if they work in the private sectors, which is higher than what has been offered by the government. There is a possibility that dental therapists who were not satisfied or motivated towards their job at the public sectors leaving their current profession to seek others that offer a better remuneration.

Apart from that, this study also reported that the majority of the participants perceived satisfaction with acknowledgement by their superiors at work and having variety in their daily tasks. These are in contradicting with studies among the UK dental nurse (Turner et al., 2012). It has been shown that dental therapists' tasks variety as well

as recognition by the dentists are predictors of job satisfaction as presented in literature and case studies (Richards, 2011; Turner et al., 2011a). In the Malaysian Ministry of Health, a yearly assessment is conducted to all employees where those who perform well and excel in their tasks are given acknowledgement and gratuity as to boost their motivation to perform better in the future (Public Services Commission of Malaysia, 1993).

5.4.2   Intention to leave and perceptions of employment in private practices

The intention to leave construct was based on the cognitive process of 'thinking', 'intending', 'leaving' and "planning'. Almost one-quarter of participants in this study have thought of leaving their post. This finding is similar to what had been reported by Forbes et al. (2014) which investigated the impact on GDC registration towards UK dental nurses. Their thoughts must not be taken lightly as the intention to leave will result them to continuing their services in an organisation or otherwise. Even though only 8.3% of them intended to seek another job in a different organisation and 11.9% planned to venture into a different career, the condition will be harmful to the Ministry and the profession itself. If we convert the proportions into numbers, this will mean that more than 200 and 300 of them will leave the public sector and the profession. Indirectly, it will cause workforce imbalance and become hazardous to the Ministry of Health considering that there are less than 100 dental therapist graduates per year.

Moreover, this study also revealed that slightly more than four-fifth of the participants expected that they still be a dental therapist in the next five years regardless of sector to work in. However, only seven percent of them foresee working in the private sector. From this finding, it is assumed that the dental therapists are satisfied with their current job in the public sector. In light of this new Act that permits them to work in the private sector, those who are interested can now mobilise themselves across

sectors where they can now provide the service that dental therapists have long been contributing to the public sector. At this moment, it is not clear whether dental therapists can keep their work at the public and at the same time work part time at the private settings. If this is allowed, they can maximise their income and ensure their careers become more dynamic.

5.5   Factors associated with the intention to leave among the dental therapists

To the best of our knowledge, this study constitutes the first analysis on the effect of job motivation, job satisfaction, and dental therapists' intention to leave. This matter has been not extensively studied unlike for the medical nurses in Malaysia (Alam & Mohammad, 2010; Omar, Anuar, Ahmad, Ismail, & Din, 2015, Ramoo et al., 2013).

In this present study, referring to findings in Table 4.21, multivariate regression analysis performed on various factors found that the educational level as one of the significant predictors in having the intention to leave where diploma holders were 0.24 times less likely having the intention to leave than those with a higher educational level. This finding contradicts the finding among nurses in Florida, USA, which reported that undergraduate degree holders are more likely to consider leaving the nursing profession (Borkowski, Amann, Song & Weiss, 2007). A few studies among nurses in Asian countries, however, reported that educational level was not a predictor for intention to leave (Chan, Luk, Leong, Yeung & Van, 2009; Liu et al., 2012), including for the Malaysian nurses (Omar et al., 2015). A minority of this study's participants (n = 18) indicated that they hold a bachelor's degree. Among these participants, six indicated that they had the intention to leave the public sector, whereas seven of them expressed intention to leave the profession. These results are similar to the research of Shields and Ward (2001), which found that the more educated the nurses were, the more likely for

them to be dissatisfied with their jobs and have the intention to leave. People who have higher level of education may feel that their skills are valuable in the general labour market and that they can expand their abilities to the other professions and exercise what they have obtained in their degree education.

Furthermore, our study also discovered that those who worked within 11 to 20 years were 0.51 times less likely to have the intention to leave than those who worked within 1-10 years. This finding contradicts what has been reported by Omar et al. (2015) where nurses with longer work experience had plans to leave the organisation, they were currently working in. However, our finding is similar with Turner et al. (2012) who reported that UK dental nurses who were younger or those with least experiences had higher intention to leave. If dental therapists who only had a short working experience leave the public sector, this will negatively affect the profession and the Ministry in the long run as such attrition may disproportionally involve younger dental therapists, inducing loss of investment in training. Referring to our finding in Table 4.18, 11.1% envisaged working part-time as their long-term plan was to work in dentistry regardless either public or private sectors and almost three-quarters of them indicated that childcare commitment, financial stability, and work-life balance were very important factors that determine the number of sessions they will work in a week in the long term. Based on this finding, it is recommended that dental therapists be given the opportunity to work part-time as other professionals in Malaysia as this may indirectly refrain them from leaving the organisation or worst, their profession.

Job satisfaction has been the most robust determinant of health professionals' intention to leave throughout the literature, and has been reported as explaining most of the variance in intention to leave (Chan et al., 2008; Goetz et al., 2012; Turner et al., 2012; Omar et al., 2015; Chew et al., 2013; Maharani et al.,2019; Bonengerber et al., 2014). In our study, job satisfaction was measured on a Likert scale where higher scores

signify higher satisfaction towards their job. It was discovered that dental therapists with high job satisfaction were 0.89 times less likely to have the intention to leave. Meanwhile, the final item for the job satisfaction scale of WCW accounts for the overall job satisfaction the participants have towards their current job. The finding from this study shows that those who were satisfied with their overall job were 0.41 times less likely to have the intention to leave. This portrays their perceived satisfaction on overall job that correspond to their high satisfaction score calculated over the 15 items. Majority (>90%) of the participants in this study were satisfied with their physical work, colleagues, working hours, chances to use abilities, and acknowledgement for the job done. Employees in Malaysia are usually subject to eight working hours either in the public or private sectors. In 2016, the government servants were introduced to flexible working hours. There are four elapses available starting at 7.30 am and alternating every half hour until 9 am (Public Services Commission of Malaysia, 2016). For example, if a person clocks in at 8 a.m. they will finish work at 5 p.m. This makes it easier for employees to schedule their time and thus have a positive work-life balance and will be less likely to leave the profession. Based on our findings, family commitment and work-life balance are rated as the most important factors that determine their long-term working session.

Apart from that, almost all participants in this study indicated that they took pride in doing their job and they wanted to feel satisfied with the work they did on that particular day. Subsequently, these motivations lead to high satisfaction towards the jobs done and consequently, their job was acknowledged by their superiors. A study by Nor (2015) among senior dental officers who managed the dental workforce in the district reported that the majority of them perceived positively and acknowledged the clinical work conducted by the dental therapists, especially the preventive treatment for their patients. The finding suggests that in order to maintain dental therapists' satisfaction at work, the

Ministry of Health may need to improve their effort to promote this workforce, as employee retention is crucial because it can impose immense burdens on organisations. Loss of productivity during recruiting and training of new employees have financial and organisational implications for organisations that do not attempt to minimise turnover (Society for Human Resource Management, 2016). Therefore, the implementation of the Dental Act 2018 which allows dental therapists to work in private dental clinics will mobilise and maximise dental therapists' level of engagement in their profession. These efforts will indirectly benefit the dental therapists by increasing their satisfaction as they have more opportunities to use their skills and capabilities in the private sector.

In this study, the participants have also been gauged on their future career expectation where the majority predicted that they will remain in the field of dentistry either in public or private sector and as clinician or educator, for the next five years. As expected, the finding shows that those who foresaw working in the private sector within the next five years were 4.14 times more likely to have the intention to leave as compared to those who envisioned to stay in the public sector. As observed in one open-ended response from the participants in this study, the reason for their intention to leave was for a better income This can also be seen as almost a quarter of all participants were dissatisfied with their current pay as government dental therapists. The issue of payroll has been voiced out since the first survey conducted by Abu Bakar et al. (2015). In the Malaysian system, remuneration in the public sector for the workforce was made directly from the Ministry of Finance and was never under the control of Ministry of Health. Not only does money help people meet their basic needs, it is also influential in satisfying the upper level of need. Employees often see pay as a reflection of how management interprets their contribution to the organisation. Fringe benefits are also significant but not as powerful. However, in this study, pay is an insignificant predictor of intention to quit. Nevertheless, with the expansion of places to practice in the private

sector under the new regulation, it is hoped that it can give the dental therapists more chances to expand their income in addition to their earnings in the public sector.

Regression analysis was also performed towards components of job motivation and job satisfaction against the high intention to leave among the dental therapists. The analysis revealed that there were three components of job satisfaction items in the WCW scale which were significantly associated with high level of intention to leave among the dental therapists, as shown in Table 4.23. Odds ratios below 1 indicate an increase in job satisfaction and a less likelihood for intention to leave. Dental therapists who were satisfied with their workplace management were 0.54 times less likely to have the intention to leave. This outcome is in line with the result obtained in a study among nurses of public and private hospitals in Macao by Chan et al. (2008). Factors that influenced this finding may be due to the quality of dental clinic facilities supported by the local government that affect the dental therapists' ability to perform their tasks that eventually boost their motivation and satisfaction (Ingersoll et.al, 2002; Chan et al., 2008). Apart from that, it has been found that close supervision (Williams, Whyte & Green, 1966; Stefanidis, Banai & Richter, 2013) and centralised decision-making (Birnbaum & Wong 1985; Hoffman & Shipper, 2012) are positively linked to job satisfaction. In Malaysia, policies are formulated by the top management level which is then implemented by the personnel including dental therapists. Furthermore, implementation at the subordinate level, for example at district level, is under the responsibility of a Senior Dental Officer (SDO). In local human resource management (HRM), the SDO's 'decision space' serves as main retention factors, such as pay, access to higher education, and promotions that are under the power of the state and district administration. However, being mid-level managers, they are accountable for managing the staff under their care particularly in terms of determining district posting, supervision and evaluation staff performance under their care is conducted, as well as

recommending staff for career advancement. This shows that the workplace is well-managed, which in turn makes their subordinates feel satisfied and choose to stay instead of leaving the organisation. Evidence documented by WHO (2010) indicates that if successfully implemented, these 'decision spaces' positively affect productivity in the workplace through improved motivation and job satisfaction. Providing a fair and equitable set of procedures and policies is paramount for an organisation to avoid discrimination and dissatisfaction among the personnel.

Dental therapists in our study who were satisfied with job promotion opportunity were 0.73 times less likely to have the intention to leave among the dental therapists, but the finding is not significant (p>0.05). Tzeng (2002) studied the intention to leave among nurses in Taiwan and reported promotional opportunity as one of the predictors. When Malaysian dental therapists started their work in the public sector, they are offered grade U29. As they progress, their performance will be annually evaluated by their leaders, and those who achieve excellent appraisal will be offered a promotion to a higher grade. Uniquely, this system applies to all Malaysian supporting healthcare workforce including the dental therapists. After 13 years in public service, they will be offered for a time-based promotion to a higher grade from their current position together with the assessment made by their superiors. Nevertheless, they have the option to reject that promotional offer (Ministry of Health, 2018).

In summary, dental therapists surveyed in this study were satisfied with their job while a quarter had dissatisfaction towards the pay rate and promotion opportunity. However, it does not act as a significant predictor for them having an intention to leave. Interestingly, our multivariate analysis showed that the education attainment, years of service, having a high job satisfaction score and those foresaw working in private sector within the next five years were the predictors of them having the intention to leave. While, based on the components of job satisfaction items in the WCW scale, these

participants portrayed having a well-managed workplace and overall satisfaction towards their job being the predictors for them to leave their current position.

5.6   Parental acceptance of dental therapist employment in private practices

The main findings revealed that dental therapists providing treatment to children in private practices were regarded as acceptable to the majority of parents. The results are hardly surprising, as dental therapists have been introduced to the community even before Malaysia gained its independence in 1957. The high acceptance level reported is possibly due to the participants' personal experiences in receiving care from a dental therapist themselves through the school's dental services. The possible positive experiences gained may have translated into their willingness to allow dental therapists to provide dental care to their children as well. Past experiences of healthcare have been shown to be related to future acceptance and satisfaction (Roblin, Becker, Adams, Howard & Roberts, 2004). A high degree of social acceptance on the expanded role of dental therapists have also been observed elsewhere (Dyer & Robinson, 2008; Philips et al., 2016; Dyer et al., 2010), but the acceptability of dental therapists providing care to children in these studies is low nevertheless.

Participants in our study regarded dental therapists providing both preventive and restorative dental care for their children as highly acceptable. The acceptability of dental therapists conducting invasive clinical procedures such as extractions of deciduous teeth and provision of a local anaesthetic, was high at more than 60% each. Ever since dental therapists were introduced to the Malaysian dental workforce, they have been legally allowed to perform invasive dental treatments such as teeth fillings, primary teeth extractions, and infiltration anaesthesia administration on children up to 17-years-old. Parents in this study may be familiar with the job scopes of dental therapists, which explains why most of them would accept dental therapists providing invasive treatment

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to their children. This contradicts studies conducted in the UK (Dyer & Robinson, 2008; 2009; Dyer et al., 2010) as the study participants were concerned with the dental therapists' competencies and qualifications. A review of the global literature on dental therapists indicated that dental therapists are technically competent and are able to operate safely and appropriately within their defined scope of practice (Nash et al., 2014). A systematic review conducted by Galloway et al. (2002) concluded that although studies included in their analysis were of poor quality and were predominantly published in the 1970s, the positive evidence on the competency of dental auxiliaries were consistent. However, the conclusion was based on a combined assessment of the expanded duty dental assistant, dental hygienist, expanded duty dental hygienist, and dental therapist who have different job scopes and training. Nevertheless, that review confirmed that when dental therapists or auxiliaries are trained to undertake a wide range of clinical duties for both preventive and restorative care, their performance is comparable to dentists and dental students.

The poor acceptance towards dental therapists shown in most previous studies may change through dentists' influence and support (Dyer & Robinson, 2008). Dental therapists who are trusted by dentists to perform specific dental treatments or procedures will be more likely to gain patients' automatic trust and confidence. Nevertheless, as professional health providers, dentists understandably would want to protect their profession from disrepute. Dentists have voiced their fear that dental therapists would be obsessed with power as their roles expand. Under the new Dental Act 2018, all dental therapists need to register annually with the Malaysian Dental Council (Dental Act, 2018). These regulations will restrain dental therapists from overstepping the boundaries enforced by the legislation.

5.7   Factors that influence parental acceptance towards the use of dental therapist in the private sector

Parental acceptance towards dental therapists seemed to be associated with their sociodemographic status, perceptions towards oral health and dental utilisation behaviour.

In the multivariate analyses, younger parents and participants who preferred going to the private dental sector were more likely to accept dental therapists providing at least four out of seven dental procedures to their children. The former was also more likely to have an overall positive perception towards dental therapists. Similarly, a study in the UK reported that their younger participants were more willing to accept their child's oral health care by a dental therapist (Dyer & Robinson, 2009). As younger mothers have been reported to be more likely to use the internet in accessing dental related information (Bernhardt & Felter, 2004), they probably have the recent knowledge and awareness towards the availability and professional competencies of the dental therapists (Dyer & Robinson, 2009).

In addition, the young participants in the current study may still remember their recent encounters with the dental therapists at their schools, which explain the reasons why they are more receptive towards the use of dental therapists in the private sector. The younger Malaysian population has also been reported to have been dental attendees in the private sector (Chu & Raja Latifah, 2001), and it is not surprising that they are comfortable with the prospect of the dental therapists' new roles. The acceptance of people in the older age group towards the use of auxiliaries in the general health care has not been overwhelming (Roblin et al., 2004). This is probably due to them having an unclear picture of the role and capability of the dental therapists, which consequently restricts access to the dental workforce (Dyer & Robinson, 2009).

Participants in our study who reported preferences over the private sector were more supportive towards the expansion of dental therapists' roles on children. This contradicts with past studies (Dyer & Robinson, 2009; Dyer et al., 2010), which reported that people with public service perceptions were found to be more willing to accept care provided by dental therapists as compared to those who had preferences over the private service. The latter was reported to have the standpoint of a consumer who prefers to be treated by a dentist if the cost for treatment is the same (Dyer & Robinson, 2009). Acquiring dental care from the private dental sector may meet some people's personal expectations and they may want their children to also experience the same level of care.

Furthermore, private service users are, at most times, able to access health care sooner which gives parents some flexibility in arranging dental appointments for their children; a criteria which may be deemed more important than the type of workforce providing dental care (Owusu-Frimpong, Nwankwo & Dason, 2010).

Parents who live in the urban areas are two times more accepting of a dental therapist to administer local anaesthesia and perform scaling and prophylaxis as part of curative and preventive dental care; as a whole, they have indicated that they are comfortable and would accept the idea of dental therapists providing care for children in the private sector. A study conducted in an urban academic setting in Malaysia reported that patients from the urban area preferred to seek curative and preventive treatment compared to the relief of pain and discomfort (Jaafar, Nasir, Mumin, Elias & Sabri, 2018). The easy accessibility to an abundant number of clinics near their town (Md Bohari, Kruger, John & Tennant, 2019) with adequate public transport facilities in an urban area may have an influence on the access to dental services (Wen, Lee, Chang, Ku & Li, 2017; Heaton, Smith & Raybould, 2004).

Furthermore, people living in cities are more likely to procure dental treatment, in particular restorative work, as they place more weight on the essentialness of getting dental care in comparison to rural dwellers (Heaton et al., 2004). Urban living is also characterised by busy and full schedules. The availability of private dental clinics offering extended operating hours could be another reason why these clinics are preferred over public clinics that only run during office hours. Another reason is probably due to the shorter waiting time for certain dental procedures as compared to the public dental clinics (Oral Health Program, 2016). This indirectly informs private dental practitioners that uncomplicated dental care could be delegated to a mid-level provider while they can focus more on complex dental treatment. Participants who had good and very good perceptions of their own oral health were more likely to accept dental therapists restoring and extracting their child's deciduous teeth. These findings contradict with those reported in the US, where they failed to prove the relationship (Self et al., 2018). In our setting, a dental therapist is introduced to complement and to team up with a dentist in managing the oral health care of the population and they concentrate on providing care to the school children. With the newest expansion of the current Act, a dental therapist can serve in the private sector under the supervision of a dentist to increase the accessibility of care and choice of services that can be widely spread across Malaysia.

Most of the proxies who participated in this study were mothers. The finding is consistent with other studies where mothers have been shown to be more responsive to taking part in research, and they play a more critical role than fathers in child development (Abanto et al., 2011; Kramer et al., 2013). However, our findings show that mothers were less likely to have a high level of acceptance, and they were less likely to accept dental therapists in performing scaling and prophylaxis to their children in a private dental clinic. Dental fear is one of the barriers found among antenatal

mothers in Malaysia in utilising dental services (Saddki, Yusoff & Hwang 2010) and this could be the reason for the low level of acceptance among mothers in this study.

5.8   The private dentists' attitudes and perceptions and as well as their perceived barriers on the employment of dental therapist in the private practices

This study was conducted among the private dentists in the state of Selangor. It was found that the participants in our study had positive attitudes towards dental therapists' employment in the private sector, where half of them agreed that "*dentists can work more effectively/efficiently using DTs in a team approach*" and disagreed that " *If more treatment is delegated to dental therapists, there won't be anything left for dentists to do*".

A study by Cardaciotto, Herbert, Forman, Moitra & Farrow (2008) among University students in Pennsylvania concluded that when one has experience working either positively or negatively with a particular person and know their job scope, practice in the field, their skills, and competencies, it may shape one's attitude towards that particular person regardless of place or location that they eventually will meet in the future. In reference to this, two-third of participants in this study who were reported to have experience working with dental therapists had a positive reception and attitude towards dental therapists' employment in private clinics. However, this study did not gauge the public dentists' perception which may differ. Hence, a study in the future is recommended to address this matter.

From the finding, almost one-fifth of the private dentists are considering employing dental therapists to be part of their team. This finding is inconsistent with what was found among UK dentists on the eve of the mid-level dental therapists' entry into the private practice (Gallagher & Wright, 2003). After five years of service, Jones et al.

(2007) and Ross et al. (2007) reported a significant increase in the acceptance of dentists towards the therapists and both teams have concluded on the importance of educating the dentist to increase the dental therapists' employability in their practice.

The possible reason for the low acceptance might be due to the uncertainty about the roles and responsibilities of a dental therapist in the private sector as portrayed by participants in this study. This matter has also been raised by participants in a qualitative study conducted among the key stakeholders in Malaysia (Che Musa, Bernabe & Gallagher, 2018). Hence, clear guidelines may change this view which in return may increase the uptake of dental therapist employment in the private sector.

The main barriers perceived in employing dental therapists in the private sector are the increase in the overhead cost, having negative perception on dental therapists' knowledge and skills, as well as the burden of additional supervisory responsibilities. These findings are in accordance with the UK dentists (Gallagher & Wright, 2003). Even though our participants have a positive attitude towards the employment of dental therapists in their private dental practice, finances play a vital factor for the dentists to spend their revenue such as to employ a dental therapist. Besides, the mushrooming of the new dental clinic per area especially in the big city (Md Bohari et al., 2019) and the slow uptake of patients towards private dental care (Institute for Public Health, 2020) might be the reason why private dentists are reluctant to add in another type of workforce to their team. Furthermore, they might have felt that the tasks permitted to dental therapists are simple and can be easily done by themselves.

Interestingly, half of our participants perceived that poor patients' acceptance are among the primary barriers in employing the dental therapists. Their perception was proven wrong by our study among the parents of the school children in which they have a high acceptance towards dental therapists to provide dental treatment to their children.

In a univariate analysis conducted to see the factors associated with dental therapists' employability, it is shown that the private dentists' attitude to employ a dental therapist in their sector was significantly related with the ownership of the private clinic. It is evident in various industries that the manager is the key person in determining the direction of an organisation to achieve the company's objective. It can be concluded that staff recruitment depends on the willingness of the manager to accept or to expand their company (Elbourn, Schulz, Ashton & Foxcroft, 2017).

5.9 The future dynamics of the dental therapists in Malaysia (2015-2030) in relation to the population need and demand based on SD Modelling

5.9.1 Baseline model output

The development of the SD model was based on various multiple sources, as mentioned previously. Research findings in Phase 1 that involved surveys on dental therapists, private dentists and parents of the schoolchildren and baseline data supported by relevant literature reviews provide numerical evidence tested and examined in the modelling on both the baseline model [Scenario 1] and alternative scenario models [Scenario 2 to 5].

Baseline model mainly integrated data from the existing and relevant document whereas the alternative working time equivalent (WTE) [Scenario 2 to 5], treatment delegations based on current trends and findings from Phase 1 studies [Scenario 3 to 5] and privatisation of dental therapists [Scenario 4 and 5] were sequentially tested in the four main alternative scenario models.

5.9.1.1 Need demand model

This model was developed by considering the pattern and trend of demand based on the Malaysian population age group, from toddlers to the elderly. It also forecasted the volume of population across age groups incorporating the modified rate for birth, death, and age proportion every five years in the span of 15 years (2015 – 2030). The total oral health demand was assumed constant until it reduces by 5% by year 2030 (Institute for Public Health, 2015; Oral Health Division Ministry of Health, 2017; Oral Health Division Ministry of Health Malaysia, 2013).

Findings from Phase I showed that about 30.9% parents preferred their child to be treated at private dental clinic while 69.1% preferred government clinic. This finding is almost similar to the results of the national oral health surveys for adults and elderly people (NOHSA) which claimed that about two-thirds of adults preferred to seek oral care from public facilities (Oral Health Division Ministry of Health Malaysia, 2013). Hence, the level of sector preference, either public or private was based on this data. Since parents/adults were the proxies for the school-age children; therefore, the demand is assumed to be the same as adult population across age band.

From the findings, the model suggests based on age band the results showed that a decrease in proportion across age except for the elderly group. Cumulatively, in overall, there is an increase of slightly more than 10% of the total population volume by age band. This output was similar to what has been reported by the Department of Statistics Malaysia (2012). Malaysia is becoming an aging country (Chan et al., 2019). It is believed this is due to the better healthcare facility provided by the government as well as general improvement in quality of life (Licher, 2019). The utilisation of healthcare increases as reported by a recent local survey, even though the uptake for dental visit is not promising (Institute for Public Health, 2020).

This model also suggests an increase of slightly more than 25% in clinical hours demand across age bands contributed possibly by the increasing trend among the elderly. Suggestively, it is assumed that people will seek dental treatment when they are diagnosed or if they perceived of having poor oral health. Hence, the increase in clinical hours demands the clinicians to fulfil them. Factors such as the growing population, notably among the elderly (Department of Statistics Malaysia, 2012), would generate a high prevalence of treatment needs (Oral Health Division Malaysia, 2009; Oral Health Division Ministry of Health Malaysia, 2013b; Oral Health Program Ministry of Health, 2017) and are also the cause of the high demand.

It was found that under the simulation of this need-based model, the demand for the dental workforce of both dental therapists and dentists across sectors has also increased. This finding contradicts the previous literature (Che Musa, 2017) and also seems to contradict the findings from the nationwide surveys which shows that the prevalence of dental caries is decreasing and should somehow stipulate a reduction in the demand for dental care. A possible reason was due to the increase prevalence of gingival disease among school children since 2016 (Oral Health Program, 2017) which requires periodontal intervention and the use of ICDAS index in the Ministry of Health for dental charting as compared to the previously used DMFT (Oral Health Program, 2018). By using this new system, white spot lesions (ICDAS 1 and 2) are now charted, and these translates to need and demand for dental treatment. In addition, preventive activities have been strengthened in the Ministry of Health and these include fluoride therapy, fissure sealants which interpret the increase of demand shown in the model.

5.9.1.2 Supply model

The development of the supply model was based on parameters such as the trend in training, the attrition rate, any policy implemented that could affect dental workforce

dynamics, the total volume of dental workforce, together with the working time equivalent (WTE). It forecasted the clinical hours supply and the total volume of dental therapists and dentists across sectors in the country.

Following the simulation, the future total volume is expected to increase for both the dental therapists and dentists. This model also illustrates an increase in clinical hours supply by the year 2030. This data suggests that the dental workforce has in tandem increased for both parameters as similarly reported in the earlier work by Samah et al. (2014) and Che Musa (2017). Due to the compulsory service policy, new graduates are only obliged to work in the public sector in their early career (Malaysian Dental Council, 2015). As permanent position in the public sector is limited, we assumed that many dentists would migrate to the private sectors, creating a supply to that section. Besides, public dentists are permitted to work in the private sector on a part-time basis (Ministry of Health, 2006). The Ministry of Health recently introduced the concept of a dedicated dental team where dental therapists are specifically trained to deal with gingivitis in school children, the elderly, patients with disabilities, toddlers, and pre-schoolers (Oral Health Programme, 2019). This policy seems to justify the increase volume of dental therapists observed in the public sector by 2030.

5.9.1.3   Comparison of need and supply model (Use-unused clinical hours)

The used and non-used clinical hours are contributed by the changes in the demand for clinical hours. In this study, the baseline simulation suggests that there will be an oversupply of private dentists and public dental therapists by 2030. Dentist oversupply in Malaysia has been predicted (The Star, 2016) and this is mainly due to the overproduction of graduates (Che Musa, 2017) which has caused a surge of capacity or an overflow of dentists to the private sector. The consequence of overcapacity in graduates is unemployment upon graduating, and this is detrimental to the country,

which will lead to loss of productivity and further impacting the economy. The problem seems to accumulate as it is forecasted that there will be an oversupply of dental therapists by 2030. Hence, specific measures are needed to overcome this issue. One of the measures is by reducing the number of dental students' intake, closing of some dental schools or creating job opportunities for the workforce (Dessler, 2013).

The role of dental therapists should be expanded especially in low income and rural settings to enhance access to care. Dentists should be trained as oral physicians to allow them to cope with the projected increase of elderly and patients with special needs (Gallagher & Wilson 2009). Training at dental schools should also shift from restoration to prevention, as well as enhancing programs that promote training in remote areas (Australian Dental Association, 2018). This is supported by findings from Phase 1 of this study where most dental therapists reported preferring preventive work in private dental clinics, and the dentists surveyed had the same perceptions too. Therefore, it can be predicted that the future job scopes of dental therapist in both the public and private settings might shift more on the preventive and oral health promotional work.

5.9.2   Alternative scenarios to test for possible policy implication

With the recent changes in the legislation where dental therapists are permitted to provide their skills in the private sector, it is believed that there will be uncertainties with the future profile and dental health-care services in Malaysia. In order to achieve optimal utilisation for potential oversupply or undersupply of clinical hours in meeting the current and future demands of the population, it is therefore critical to conduct scenario testing in this study to provide different pictures of the future in the most reliable way (Garreth, 1999) for better workforce planning.

It is imperative to acknowledge that uncertainties of the parameters observed may adversely affect the outcome of any modelling. Nevertheless, scenario testing is

necessary to offer more reliable outcomes across all prospects of the future even though some are more favourable than others (Van Greuningen et al., 2012). In addition to that, no single workforce projection and modeling can produce a picture-perfect and correct forecast (NHS Scotland, 2006). Hence, this study embraced and tested evidence from earlier studies to examine the insinuations of privatisation and clinical/admin-OHP roles of dental therapists in shaping the future of the dental workforce and working patterns among dental teams in Malaysia.

Based on our findings among dental therapists who have the intention to leave the public sector, their wish to provide preventive dental work in the private sector coincides with our survey among private dentists who shared their willingness to delegate preventive procedures to dental therapists should they be employed in the practice. This shows that the demand for dental therapists to work in the private sector has existed and it must be handled with precaution as a glitch can jeopardise human resource management.

Consequently, this data was used to inform the conceptual model and scenarios of the future (Morecroft and Sterman, 1994; Sterman, 2000) and to capture all related workforce behaviours (Luna-Reyes, Diker & Andersen, 2012). Acceptability of treatment and treatment rates as perceived by parents of schoolchildren and public dental therapists were carefully considered and selected to model the different scenarios. Relevant documents, including the recently introduced Dental Act 2018, were used to test the 'mental model' at all stages. This is to ensure that the model is adequate and valid as conducted by other SD modellers (Forrester & Senge, 1980; Luna-Reyes et al., 2012). This is most important in the conceptualisation and formulation phases (Ford & Sterman, 1998; Kopainsky & Luna-Reyes, 2008), even though some may argue that it has more impact at later stages of model development (Luna-Reyes & Andersen, 2003).

The gathering of evidence is to ensure the adequacy and confidence of the model, thus improving its structural and behavioural validity.

A series of scenario testing was conducted based on the aim to optimise dental therapists' clinical and/or oral health promotion (OHP) roles at either in the government or private sector. Findings from Phase 1 showed that 8.3% of dental therapists had the intention to leave and 15.5% of private dentists had positive acceptability towards dental therapists' employment. This data was used to inform the migration rate used in this testing.

The baseline output showed that there is a potential of oversupply of public dental therapists by 2025 and private dentists as early as 2020, while there may be an undersupply of total public dentists and total public practitioners by 2030.

5.9.2.1 Optimising dental therapists' oral health promotion (OHP) and admin role in the public service (S2)

Owing to the fact that the baseline scenario showed the possibility of oversupply among public dental therapists beginning 2025, the WTE was reduced from 70% to 60% by stressing more on oral health promotion and administrative work by the dental therapist. Modelling showed that there will be potential undersupply of the public dental therapists, but which may improve by 2030.

As for the total number of public dentists, the numbers remain unchanged as the baseline scenario. The policy implemented in this scenario testing is in line with what is practised by some dental therapists working at the Federal Territory of Kuala Lumpur and Putrajaya (FTKL) where some of them are assigned to carry out full OHP tasks and are known as the "Dedicated OHP Team". The formation of this team aims to empower the community to take good oral health self-care. This team has aided in the increment number of community service in the oral health promotion program in FTKL in 2017

(Oral Health Programme, 2019). This promotional work carried out by dental therapists is impressive; however, it is suggested that monitoring and evaluation should be emphasised on the workload among dental therapists as this may trigger job dissatisfaction in addition to their existing clinical work.

5.9.2.2 Optimising dental therapists' clinical role at public setting (S3)

In this scenario, an assumption was made on "what if" dentists delegate some of clinical tasks to the dental therapist i.e. delegate scaling and prophylaxis tasks of secondary schoolchildren. The finding shows that this scenario has the potential to increase undersupply of public dental therapists, thus improving the volume in Scenario 2. It also further improved the potential oversupply of the dentists across sectors over the simulated period. Several aspects need to be considered to optimise the role and future profile across the dental team members in Malaysia with respect to work delegation and pattern in general, and the availability of employment posts at the public sector specifically.

A local study by Abdul Aziz (2014) reported that the number of dentists needed decreased and the requirement for dental therapist increased when some periodontal procedures were delegated to dental therapists in different skill mix scenarios. It has been suggested in the literature that by delegating clinical work to the dental therapist, the dentist may focus on more complicated dental work (Mathumuju, 2016; Macey et al., 2016; Turner & Ross, 2017) and concentrate on delivering their skills to more vulnerable patients such as special needs children (Innes & Evans, 2013).

With Malaysia becoming an ageing country in as early as 2030 due to the improvement of quality of life among the citizens, it is recommended that the job scope of the dental therapist be extended to increase the age group that they may serve, e.g. to

treat the young adults' group conducting hygienist work. The dentist can focus more on treating the elderly, antenatal mothers, or other vulnerable populations in treating periodontal diseases that are on the rise (Oral Health Program, 2017).

5.9.2.3 Enhancing dental therapist clinical role at the private setting (S4)

Based on our finding among dental therapists who have the intention to leave the public sector, their wish to provide preventive dental work in the private sector gives evidence of respective private dentists' counterparts in delegating the procedures should they be employed in that sector. This shows the demand of opportunity for them to work at the private sector.

Scenario 4's output indicates a potential undersupply of dental therapists in the public sector and potential oversupply of dentists and therapists at the private sector. The primary intervention of this policy is to allow movement of therapists into the private sector and rectify the primary issue related to the unattractive salary and limited skills and opportunity at the public sector especially after a certain period of time. The policy has the potential to advocate strengthening primary dental care especially in the private sector, as the emerging workforce has high expectations of working in this sector, particularly in providing the full aspect of dental services.

Nevertheless, this simulation policy should be handled with precaution as a glitch will jeopardise the human resource management. First, private dentists are keener to delegate preventive work compared to operative procedures (Table 4.40). The possible reason as portrayed by the private dentists in this study is that they may have a negative perception towards dental therapists' clinical and communication skills that could complicate dental care. Secondly, the potential undersupply of dental therapists in the public sector may further jeopardise the significant performance of the dental public

sector in reducing the prevalence of oral diseases among children as has been positively observed in the last three decades in Malaysia (Oral Health Program, year).

Therefore, such potential movement in this scenario should be treated with caution. A similar policy applied to the dentist's counterpart such as compulsory service (Malaysian Dental Council, 2015) should be applied for them or to limit the number of dental therapists working in private sector to counter the potential undersupply in the public sector. The compulsory service is believed to assist and consolidate their skills and knowledge post-training (Che Musa et al., 2020). This can ensure the people's safety and protection should they plan to work in the private sector in the future.

5.9.2.4 Optimising dental therapist oral health promotion (OHP) and admin role in the private setting (S5)

This final scenario testing is the proposed scenario as illustrated in Table 4.53. It indicates potential minimal oversupply of private dental therapists in 2030 but at a much lower volume. However, the potential undersupply of private dental therapists remains constant.

The current employment for the dental therapists is nowadays based on contract employment as there has been no new post since 2015, which is similar to their dentist counterparts (Ministry of Health Malaysia, 2016). The movement of dental therapists to the private sector based on their expectations is deemed to occur in the future should they not be offered a permanent post in the public sector after completing their contract of employment. Such action requires modelling their potential role at the private sector such as in delegating the oral health promotion activities and administration role to them.

The addition of dental therapists in the private sector will give the opportunity for group practices. Being part of the team will eventually allow for the workforces'

survival and competitiveness (Malaysian Dental Council, 2014). As seen in the medical counterpart, group practices have fairly transformed the Malaysian private market recently where their target has shifted from providing treatment to delivering preventive care. For example, there are groups of medical practices that extend home visits to the elderly or vulnerable groups instead of providing treatment at the clinic or hospital. This scenario may influence the private dental sector to emulate the benefit of providing dental services to the community and indirectly stimulate dental tourism. With the introduction of the new dental act that has imposed strict regulations to the dental fraternity, this will consequently uplift the professionalism in Malaysian dentistry which consequently may boost dental tourism in the future (Malaysian Dental Council, 2018).

Furthermore, to reduce the possible oversupply of private dentists, it is proposed that the dentist-dental therapist coupling could enhance teamwork which will further intensify the vitality of the profession as well as dental services in the country. This gives strong support to the authorities so that this field can be at par with the medical counterpart. However, it must be emphasised that the dental therapists' services be geared towards dental hygiene activities so that this coupling is more robust, whereby the dentist can focus on providing complex dental treatment whilst the therapist does the preventive and promotion work.

This can be implemented by joint education between dental therapist and dentist. Few studies in the UK including of Wanyonyi, Radford and Gallagher (2014) suggest dental therapist students to practise alongside dental students as a team. This approach provides greater experience for them in treating children in providing preventive rather than invasive care and give insights on better teamwork during their professional careers in the future. Current dentistry education in Malaysia separates the training between dentist and dental therapist. With this proposed move, it will offer better understanding into their future practice in work delegation especially the preventive procedures apart

giving implications for their future training. This will enhance the coupling teamwork between them that may later positively contribute to the dental fraternity.

Finally, based on the findings of various policy testing, it is a rational argument to allow dental therapists to work in the private sector despite the potential shortage of dental practitioners, provided that their scope of work is expanded to do more hygiene work in the private sector and that they have undergone mandatory service in the government sector. Thus, suggestively, it is appropriate for them to venture into different job prospects and be given the opportunity to diversify their source of income through the private sector which are aligned with the requests they have voiced in this study. However, as a provider, few things need to be taken into account before allowing them to enter the private sector, for example, obliging them to serve in the public sector upon completing their studies.

In order to engage employees long-term, there needs to be a culture that fights career stagnation and role immobility. Allowing dental therapist to move within the system (public – private) and find their niche, will allow them to reinvent their skillsets in a great way to help them grow and retain. The operational modelling has evolved and has become a sophisticated tool for workforce modelling over the past three decades. It is believed it will continue its benefits in influencing policy makers in the future to adopt and adapt this technique to cater the population growth, changing oral health needs and the shape of the evolving private sector as well as other parameters. Corresponding to the existence of this OR modelling allows the assessment and simulation of future scenarios which may reflect real life situation.

5.10 Strength and limitations of the study

5.10.1 Strengths

Recent changes in legislation in the fraternity have regulated dental therapists and provide permission for them to work in the private sector, which will create a dynamic workforce. Hence, it is timely and important to investigate the expansion of places to practice for dental therapists. To the best of our knowledge, this is the first study that investigated three different populations simultaneously compared to other studies that only assessed one population at a time.

This study employed a cross-sectional study design where it involved snapshot observations at a specified population on some topics at the defined time points before triangulating the findings. Thus, the main strength of this study is in determining the perceptions of dental therapists on working in the private sector at the national level and the intention to leave the government sector. Next, Phase 1 assessed the willingness of private dentists to employ and delegate dental tasks to dental therapists and the acceptance of the public towards dental therapists in providing dental care. Besides, it also provided insights and data for the modelling study in Phase 2 to determine dynamic changes and other possible outcomes that may affect the workforce in the future (Yu & Tse, 2012). The triangulation of data from Phase 1 and the existing data had strengthened the results obtained in Phase 2.

The response rate obtained from the three surveys ranged from 'acceptable' (private dentists) to 'excellent' (dental therapists), and the rates are comparable to previous studies (Yusof et al., 2008; Chin et al., 2016; Abu Bakar et al., 2015). The proportion of participants is similar to the proportion of dental therapists in the country that can be used to generalise the population of dental therapists in Malaysia.

Furthermore, this study employed a validated scale (Warr-Cook-Wall) on job motivation and job satisfaction that has been used worldwide in various fields of studies

(Chew et al., 2013; Turner et al., 2012). The reliability and validity tests revealed that they are reliable to describe the dental therapist population in this country. Additionally, the items used in supporting the awareness of the Dental Act 2018 among dental therapists and private dentists obtained an acceptable reliability testing.

This study applied factor analytic procedures to the responses of the large samples of dental therapists. However, the single-factor solution, especially on the WCW scale, could only be applied to the dental therapists because it could not generalise other workforces due to variations in the range of individuals, work, family, community, and country-specific characteristics and conditions.

Uniquely, this study had linked job satisfaction and intention to leave besides presenting the predictors of the intention to leave among the dental therapists using multivariate regression analysis that were not explored in previous local studies. The participants were required to provide their perceptions to work in the private sector following the new Act. Thus, this study had fill in the gaps and served as evidence to inform policymakers for better human resource management.

This research employed and modified the System Dynamic model developed by Che Musa (2017) in forecasting the dental therapist workforce. This research integrated important views on the employability of dental therapist in the private sector provided by the consumer (the public) together with inputs from provider namely the private dentist and dental therapist themselves. Findings from this study expand the work of Che Musa (2017) as well as examined and tested the dynamic interactions of clinician dental workforce related to patient utilisation in primary care across sectors in general. Remarkably, it has filled the gap by earlier work conducted by other local researchers, too (Ab Murat, 2012; Samah et al., 2014; Che Musa, 2017).

Furthermore, evidence such as motivations and career expectations are believed to improve the flow of stocks and provide a more accurate projection of human resources

(Hornby, 2007). In this model, utilisation rate (Nasseh & Vujicic, 2015) that varies by age-band was employed as an indicator to calculate and determine the clinical hours demand for dental care in high level and details. While some researchers advocated a GP referral letter and bed occupancy as their main indicator (Cooper & John, 2012; Roberfroid et al., 2009), this study primarily adopted the utilisation rate of the dental facilities. Nevertheless, the dental utilisation may be inclined by a number of factors including those incomplete data or factors namely, age, sex, morbidity rate, illness, availability of services, and professional judgement that may alter the model productivity.

Lastly, the use of SD modelling is advantageous to this study because the interface is user-friendly and easy to comprehend and explained to others. Apart from that, the use of Vensim over Stella assisted the researcher to run the model effectively. Being a pioneer, it has evolved and become a sophisticated tool for workforce modelling over the past three decades (Vensim, 1985). Furthermore, it can analyse the SD modelling to explain the causal relationships and feedback. Another strength of SD modelling is its ability to simulate broader and multifaceted problems in mimicking the real world, including examining the scenarios specifically for policy testing (Meadows, 1980; Wolstenholme, 1990; Coyle, 1997; Tako, 2008). This is a distinct feature from other models, including discrete event simulation (DES). Hence, the use of SD modelling with quantitative surveys can provide information on the recent changes in the dental fraternity and the future dynamic of the dental workforce that is guided by the Dental Act of 2018.

In conclusion, the strengths of this study were contributed by all the studies in Phase 1. It had achieved the aims of this study. Next, the study hypothesis was addressed accordingly using the appropriate design. Finally, the components from Phase 1 had

provided sufficient input to facilitate the modelling. However, this study has limitations that will be discussed in the next section.

5.10.2 Methodological limitations

This present study has its flaws, and it encountered several limitations. First, it is cross-sectional in nature and is not meant to test the hypothesis and find any causal relationship of the variables due to time ambiguity (Sedgwick, 2014).

Secondly, this study used a questionnaire survey that was designed to obtain accurate input from the participants. There was potential bias in Phase 1 because participants may provide superficial answers to the researchers (Sedgwick, 2015). Due to this reason, the researcher had to be cautious when interpreting the results. For the survey of dental therapists, the questionnaires were distributed by their immediate principal and there was a possibility of avoiding negative answers, such as their dissatisfaction with their job or their intention to leave. The researcher assured their confidentiality and received the responses directly from the participants through the online platform.

The generalisability of the study on the private dentists was compromised due to the low response rate (52.6%). Besides, this study did not perform non-response analyses due to the lack of data on non-responders. This result is similar to a local study conducted on a private dentist who employed different approaches (Yusof et al., 2008; Chin et al., 2016). Yusof et al. (2008) distributed the questionnaires in two stages: 1) face-to-face administration of questionnaires survey among dentists who attended a local conference, and 2) postal. Despite implementing the dual approach, the response rate is similar to this study. Chin et al. (2016) used both postal and online approaches but received a lower response of 36%. As a result, this study decided to use a different method, but it also obtained a low response. Another limitation is the inability of this study to generalise its findings for parents and dentists because the survey was conducted in Selangor. Although the rural areas were included, the rural areas in

Selangor are different from the other parts of the country because Selangor is the most developed and richest state in Malaysia (Habibullah, Din, & Sanusi, 2017). Hence, the perceptions in this study may portray a different view. It is recommended to conduct a further study to a larger scale area by employing different sampling methods.

Initially, it was difficult for a newcomer or an outsider to apprehend either the conceptualisation process or the transition between stages during model development in SD Modelling due to formalisation. Conceptualisation is one of the most important phases in SD model development as it forms the foundation for the analysis process. Indeed, it was one of the most challenging aspects of developing this model and try to understand which aspects were should be improved for the validity of study. However, this process unveiled the areas that are difficult to extract parameters, from the available evidence and can further recommend areas for future research inquiry. This matter points to another area of skill development required for simulation modelling. Nevertheless, with the search in the literature, coaching and ongoing practice, the complexity overcame and eventually simulating various model behaviours becomes straightforward.

Data used in the SD model were informed by findings from parents and private dentist located only in Selangor. If a national survey had been considered in this study, the findings may differ as the perceptions of parents and private dentists from other areas may be influenced by their sociodemographic and cultural background. With this limitation, findings of this study must be carefully interpreted.

Moreover, the need, supply, and demand data required for the modelling in this study were out-dated, and they imposed challenges on the accuracy. For example, the data of the adult age group were obtained from epidemiological findings, which were dated ten years ago. Besides, the national surveys of the school children only reported the data needed for the dental care of children aged 6, 12, and 16 years old in which the

extrapolation activities were needed to close the gap. It ignored the potential differences in the treatment needed for other age groups within the same age band. The trajectory activity has been used by many institutions to determine the demand of care for the public and private sector (Institute for Public Health, 2012) and the projection works (OECD, 2011). Although the data used to project demands among school children may not be ideal, the forecasted volume was within the acceptable range for the Malaysian context.

CHAPTER 6: CONCLUSION

This section begins by presenting the conclusions of this study. After the introduction of the new Dental Act of 2018, three cross-sectional surveys were conducted on three different populations and the SD modelling in this study intended to explore the future workforce dynamics of dental therapists in both public and private sectors in Malaysia.

The findings from the survey revealed that more than two-thirds of the participants (dental therapists and private dentists) were aware of the provision of the Therapist Division under the Dental Act 2018. Another study showed a high acceptance among the parents of schoolchildren towards dental therapist employment in private settings, and these findings were used to model the workforce dynamic in Malaysia. This model integrates the behavioural component, namely job motivation, job satisfaction, career expectation, the intention to leave by the dental therapists, and the acceptance of both the public people and private dentists as the employer.

The dental therapists in this study revealed that they were highly motivated and satisfied with their current job, but only a few of them were dissatisfied with their pay rate, job safety, and job promotion. These possibilities had influenced their intention to leave in which about one-tenth of them intended to leave due to several predictors such as educational attainment, years of service, and the sector they foresee to work within five years. Meanwhile, the parents had high acceptance towards dental therapists in providing oral care to their children with the following predictors: living in urban areas, the younger generation, and Bumiputera. For the private dentists, less than a third of them considered employing dental therapists in their private practice in which the main barrier for employment is the increased financial burden.

The views from these important stakeholders in accepting the dental therapist workforce in the private practice besides the extensive calibration and validation described in Chapter 3 had provided more accurate forecasting of the human resources

in general. It also provides evidence on the number of dental therapists needed in this country.

In the SD modelling, a series of simulations were conducted for the scenarios and were compared with the baseline. The results reveal several potentials from year 2015 to 2030: undersupply of the public dental therapists, oversupply of the private dentists, oversupply of the private dental therapists, and improved undersupply of the public dentists. There is the uncertainty of the working delegation and privatisation for the future dental workforce and presence of workforce gap across the Malaysian dental clinicians which is influenced by the career expectation of dental therapists, their working patterns, and the privatisation rate. It is predicted that the extension of place to practice under the Dental Act 2018 will not be successful unless it is accompanied by the acceptance of various stakeholders, i.e., patients and private dentists towards dental therapists in providing oral healthcare to their clients. This situation might change the current oral healthcare service structure in Malaysia besides providing benefit to the Malaysian dental fraternity in a broader area, which will increase the dental service availability across the sector.

CHAPTER 7: RECOMMENDATION

1) Future research

i. A research among public dentists' perception with regards the mobilisation of public dental therapist to the private sector. It may help to provide an insight regards dental therapists' roles and responsibilities, their skills, competencies, and education requirements to prepare them to work in different sector.

ii. Factors such as barriers of dental therapist employment in the private clinic, dental therapists' career expectation, and the willingness to pay for the treatment provided by the workforce were not included in the current SD modelling. These parameters may change the model output. Hence, it is suggested to include them in future studies.

iii. Further study to determine the direction of dental therapists after the implementation of the Dental Act 2018, gauge their perceptions on working in the private dental clinic, and explore what is lacking in terms of their education and knowledge application to practice well in the private sector. These suggestions will provide insights on their curriculum and dental therapy education in Diploma level.

iv. It is interesting to explore the views of dental therapy educators in terms of training and current curriculum and what should be included in preparing the graduates of dental therapy in equipping them with updated knowledge to be at par level with their medical counterpart.

v. Based on the aim and objective of this study, SD modelling only examined dental therapists and dentists as a general workforce without segregating the post basic dental therapist and dental specialist. Thus, this model can serve as a steppingstone for the subsequent modelling to explore matters on the

specialisation within the workforce and how it has an impact on the workforce needed in the future.

vi. This study provides information for modelling and forecasting the volume of the dental workforce needed in the country. The model can be used for subsequent modelling when incorporating new data. The current model in this study uses outdated epidemiological data which was published in 2010 particularly because there is no recent nationwide data on oral health status. Therefore, the modelling for human resource management should be conducted regularly to keep up with the dynamicity of the workforce.

vii. This study did not explore any health economic assessment that associates the barriers among the private dentists in employing dental therapists. This assessment might indirectly have an implication on the use of dental service. These economic aspects should be considered in future studies.

2) Training and education

i. Phase 2 in this study involved model construction that required special training. Modelling and analysis of simulations were complex and time-consuming, and it was lead through time and practice. Focusing solely on it led to inappropriate simulation analysis. In addition, effects from simulation were hard to comprehend. Since most simulation outputs are essentially random variables (usually based on random inputs), it may be difficult to determine that if an observation is the result of interrelationships or randomness between systems.

ii. Further disseminating of information regarding Dental Act 2018 and the legal impact should be presented in the form of continuous professional development (CPD) to the dentists, especially among the private dentists.

iii. Due to the demographic trends of decreasing child population and potential of reducing demand for the therapists there may be an oversupply of dental

therapists in future; this necessitates action to lessen the volume in training, and/or shift in their scope of practice towards health promotion and education or to increase in their patient-base from children to adults under direct supervision.

iv. Given there is potential oversupply of dentists in future, there is an essential to reduce the Malaysian dental student intake and possibly regulatory the number of international graduates.

Policy and practice

i. Dental therapists should be allowed to work in the private sector on a part-time basis and the opportunity to work part-time as other professionals in Malaysia. This approach might indirectly refrain them from leaving the organisation or worst, their profession.

ii. Newly graduate dental therapists should be regulated and undergo compulsory service before being absorbed in the government sector. The existing policy can only be applied to dentists who must undergo compulsory service/training with the Ministry of Health (MOH) before they are given the freedom to choose their path in career.

iii. Dental therapists who hold a bachelor's degree or above will be given the opportunity for a better position in the service, i.e., Sister And Matron, provided that they obtained good scores from their superior and have the quality to be a leader.

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LIST OF PUBLICATIONS AND PAPERS PRESENTED

Manuscript accepted (In Press)

1. Zakaria NA, Ab-Murat N, Che Musa MF, Johari MZ (2020). A study on parental acceptance towards the use of dental therapists in the Malaysian private sectors.

Malaysian Journal of Medicine and Health Sciences

Conferences presentation/Abstract

1. Zakaria NA, Ab-Murat N, Che Musa MF. Parental acceptance towards the use of dental therapists in the Malaysian private sectors – A quantitative study. 12th Postgraduate Conference 2019, Faculty of Dentistry, University of Malaya, 18-19 October 2019. (Poster).