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Perception of stakeholders on current perfusion education in Malaysia

Rafiq Sumardi Omar*
National Heart Institute, Kuala Lumpur, Malaysia**,** Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia
*Corresponding author email: rafiqnurse@gmail.com

Foong Chan Choong
Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

Vinod Pallath
Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

Nur Ain Mahat
Faculty of Medicine, University of Cyberjaya, Selangor, Malaysia

***Abstract*---**Perfusionist is known as a certified medical technician liable for extracorporeal oxygenation of the blood during open-heart surgery. Current curriculum is believed to be at par and is aligned with the National Occupational Skills Standard, however, the scope of perfusion practice keeps changing with the advancement of technology and procedures, and there is a demand for specialty area such as extracorporeal membrane oxygenation (ECMO). Therefore, current curriculum should be re-evaluated by taking consideration from multiple stakeholders' perception on current needs, content, educational strategies, teaching methods, assessment methods, and curriculum management. Hence, this study aimed to explore perception of stakeholders in evaluating current perfusion education in Malaysia. In the context of the present study, stakeholders of perfusion education in Malaysia were referred to the private providers, manager, educators, advance diploma holders, perfusionist, and pensioners. This was a qualitative study which involved in-depth interview approach. A total 10 stakeholders participated in this study, chosen though purposive sampling. The interview was guided by semi-structured questions to explore participant's perception. The participants were approached by the list obtained from the Malaysian Perfusionist Society (MAPS). The interviews were conducted face-to-face or virtually. Interviews were conducted in English and Malay languages. The Malay conversation was transcribed into English. The ethical approval was obtained from University of Malaya research ethic committee. The interview transcripts were analyzed using

thematic analysis to address four components of Daniel Stufflebeams's conceptual model for programme evaluation: Context, Input, Process, and Product (CIPP). Based on the findings, in terms of the context code, perfusion programme can be improved by competency acquisition, proper accreditation, having longer duration of study, benchmarking the curriculum, and integrate simulation-based training. In terms of input evaluation, the strengths of the institutions were having sufficient cardiac cases and certificate recognition. However, few weaknesses were identified, namely the programme was not at par with international standard, lack of clinical experience among trainees due to time constraint, and non-comprehensive syllabus. For the process evaluation, modifications to improve perfusion educations such as upgrading existing diploma to degree level, encourage critical thinking through evidence-based practice, reduce knowledge and practice gap, and to have single exit exam which serve as standard assessment. As for the product evaluation, current perfusionist trainees were less competent and the scopes of perfusion need to be widened to cater for the advancement of perfusion. In conclusion, it is hoped that further steps can be taken to improve the quality of perfusion education in Malaysia, including the absorption of competency-based education where the number of cases collected should be the priority to qualifying individual perfusionist. This can be done through the three mechanisms which are the training centres should have adequate number of clinical cases to provide learning opportunities for the students, prolonging the duration of study, and providing interdepartmental or inter hospital rotation clinical placements.

***Keywords*---**Perception, stakeholders, perfusion education, Malaysia.

Introduction

Perfusionist is known as a certified medical technician liable for extracorporeal oxygenation of the blood during open-heart surgery (American Society of ExtraCorporeal Technology, 2019). Perfusion education in Malaysia has begun with the unstructured training, that is on-job training initiated in 1970s by University of Malaya Medical Centre (UMMC). On-job training is referred to a training provided at the workplace that is given to a paid employee who are still engaged in productive work (Resources, n.d.).

Currently, there are two perfusion education training in Malaysia, one is Graduate Certificate of Cardiovascular and Thoracic Science (GCCVTS) programme offered by National Heart Institute/ *Institute Jantung Negara* (IJN), another one is from Ministry of Health (MoH), which aims to provide training to their own staff. Perfusion education in Malaysia, especially GCCVTS which has been certified by MQA, intended to provide academic training specialized in cardiovascular and thoracic sciences to various healthcare professionals in the region. Also, to provide trainees with the opportunity to augment their capability in advanced specialization skills in the same area. Perfusion education was

developed by a team member of subject experts and curriculum developer experts with specialization in curriculum development and instructional technology in education.

Just like other medical education, perfusion education is a dynamic process, and the curriculum of medical institutions need to undergo multiple reviews and amendments to cope with the continuous changes in the medical field and the educational context (Toomasian et al., 2003). A good curriculum is never a one-off initiative (Glatthorn et al., 2001). Revisiting it regularly allows the institutions to review how things are progress and make rooms for improvement for new topics that are relevant today. Getting input from many stakeholders will help to identify the gaps that need to be addressed and look at the bigger picture of perfusion education (Merkle, 2010). Getting data from stakeholders is important to give insight and determine whether the programme is successful through the measurable outcomes (Glatthorn et al., 2011).

Across the processes of internationalization, there has been a large-scale movement of people across countries as they pursue their educational objectives (Malaysian Qualifications Agency, 2014). For instance, *Institute Jantung Negara College* (IJNC) has offered this Graduate Certificate in Cardiovascular and Thoracic Science (Perfusion Technology) to the international candidates and according to Malaysian Perfusionist Society (MAPS) in 2021, there are some Malaysian perfusionists who are working internationally. These factors have led to the need for rapid development of perfusion education (MQA,2014). To support the achievement of this educational goal, the contexts such as governance, curriculum, teaching and learning activities, assessment, support services, academic staff, and educational resources as well as programme monitoring, and review practices should be aligned accordingly (Malaysian Qualifications Agency, 2014).

According to previous study, the stakeholder participation in higher education quality evaluation was limited and poorly conceptualized (Meyer & Bushney, 2009). The result also in consistent with prior study by Ali-Musa et al. (2018) in investigating the perception of perfusion educators and other stakeholders on the cardiovascular perfusion training programmes conducted in South Africa. Although the notion of stakeholder engagement has been well reported in business literature (Wheeler & Sillanpaa, 1997), it has not yet been fully implemented in the field of education. As for Malaysian perfusion education, to the best of knowledge of the present researcher, to date there is no program evaluation done by considering multiple stakeholders, documented feedback, and benchmarking current education content with existing international education (informal interview with GCCVTS program leader, 2021). This study would contribute to the betterment of perfusion education in Malaysia. Hence, this study aimed to explore the perception of stakeholders in evaluating the current perfusion education in Malaysia. In the context of the present study, stakeholders of perfusion education in Malaysia were referred to the private providers, professional associates, manager, educators, advance diploma holders, perfusionist, and pensioners. The Daniel Stufflebeams's conceptual model for programme evaluation which include Context, Input, Process, and Product (CIPP)

is used to address the evaluation as it serves as a comprehensive framework for managing evaluations of any programs.

1. Materials and Method

This is a qualitative study that involved in-depth interview approach, guided by a set of semi-structured questions based on the topic designed to explore respondent's perception. The interview has been conducted among 10 stakeholders of perfusion education in Malaysia, selected by purposive sampling. The stakeholders were coming from various levels, such as in education, medical device industry, managerial, clinical perfusionist, pensioner, and freelance perfusionist. The other inclusion criteria were having at least 5 years of working experience in perfusion and being registered with Malaysian Perfusionist Society (MAPS). Interviews have been conducted via physical meetings at IJN or virtual meetings through Google meet platform. The participants were approached according to the list obtained from the MAPS. They were called beforehand to schedule an interview at their own convenience. The sessions have been recorded with the participant's consent for future reference. Verbal and writing consent were obtained, and all names were replaced with pseudonyms at the time of interview and reporting. Interviews were conducted in English and Malay. Malay transcriptions were transcribed into English, performed by the present researcher, who is a native speaker of Malaysian and is also well-versed in English. The interviews were conducted within 20 to 45 minutes. Ethical approval was obtained from UM research ethic committee (MRECID.NO: 2021611-10226).

The information on social-demographic data including respondents' age, highest educational qualification, institution that awarded perfusionist qualification, working experience, current designation, and teaching experience were collected at the beginning of the interviews by filling up the forms. Semi structured questions on the perception of perfusion education in Malaysia, guided by the CIPP model were used.

In current study, trustworthiness has been achieved by member checking process. After text were translated and transcribed, it was given to the participants to undergo confirmation, addition, and removal of some text. After the agreement and confirmation by some of the participants, thematic analysis was done, which supported by several codes. The emerging themes were again checked by the participants to see for any arisen feedback and subsequently reaching for participant validation. Then, the process was continued with writing the discussion. On the last phase of member checking, the discussion was shown to some of the participants back for their comments. As a results, participants were agreed on the discussion part with no comments, and it is deemed to be valid and reliable.

Data were analyzed manually. Transcriptions were read and texts that appeared to be the potential perception on perfusion education were highlighted. Codes were developed based on the highlighted paragraphs. After having the codes, an analysis grid (spreadsheet) was developed using Excel integrating all major categories involving interviewee at one side and the categories on top. The researcher filled in all the statement with coded reference against each statement.

To ensure the accuracy of the transcription, the researcher assessed the transcripts while comparing them to audio files. If there were some discrepancies, such as spelling errors and abbreviations' interpretation, the corrections were made in the transcripts.

Result

The stakeholders were coming from private and public practices, who involved in perfusion education in Malaysia as program developer, subject matter expert, manager, educator, clinical preceptor, and clinical lab simulation instructor. Five of them were the members of alumni from current existing perfusion program in Malaysia namely Graduate Certificate in Cardiovascular and Thoracic Sciences: Perfusion Technology (GCCVTS-PT) and Advance Diploma in Cardiovascular and Health Science: Perfusion (ADCH-P). The participants were perfusionist working from various regions in Malaysia with the experience ranges between 7 to 29 years.

Thematic analysis produced four themes describing the perception of stakeholders on current perfusion education in Malaysia, namely 1) context, 2) input, 3) progress and 4) product with its respective codes (as shown in Table 1).

Table 1 Quotes from interview transcripts

Themes	Codes	Participant	Quote number (Q)	Quotes
Context	Competency acquisition	R8	1	"Theory examination and hands on examination must be pass"
		R9	2	"For qualified, 150 cases are not enough if its only just as tagging or shadowing. The trainee should perform at least 150 to 200 cases alone and independently."
		R10	3	"A perfusionist is qualified to perform their duty when they have performed adequate number of cases or clinical experience and also after they pass their last clinical or practical test before they will be given fully accreditation to be perform as perfusionist."
	Proper accreditation and certification	R1	4	"Perfusionist should have academic qualification from accredited institution such as from university of Ministry of Health (MoH) but required to approved by Malaysian Accreditation Qualification

Themes	Codes	Participant	Quote number (Q)	Quotes
				(MQA) agency."
		R1	6	"Our society Malaysian Perfusion Society (MAPS) has plan to create a skill programme from the National Occupational Standard (NOSS) in which I think it is a good plan. We need to combine both theoretical foundation through education and skill-based learning through technical and vocational training (TVET) or on the job to have best requirement to be a Perfusionist in Malaysia."
		R1	7	"The most important thing for academic is it must be approved by MQA."
		R1	8	"MQA approval"
	Prolong duration of study	R4	10	"perfusionist should qualified in 2 years' time, with a strength of knowledge and skill with a certain criterion that being listed in education program"
		R6	11	"I think perfusionist needs to undergo at least 1 year of basic perfusion science programme like going to college, followed by a year of clinical placement. Which means two years which comprise of theoretical education first then followed by clinical because I think a person need to understand basic knowledge for certain profession before applying it."
		R5	12	"No. The time frame is too short"
		R10	13	"Its not enough because the duration is too short, and the trainee cannot cope with syllabus and their practical session"
		R7	14	"No. Need at least two years"
		R8	15	"Not enough, at least 2 years job training."
		R2	16	"I think 2-3 years program is

Themes	Codes	Participant	Quote number (Q)	Quotes
				better. I have experience to work in international hospital where they are not accepting my certificate because of the duration of study is too short even though I have provided evidence that I already work as perfusionist for more than 10 years. This should be looking seriously."
		R3	18	"No. They need more time to be independent and confident to practice."
		R4	21	"Prolong the curriculum to be at least 2 years"
	Benchmark the curriculum	R1	22	"I think we should compare our program from overseas standard. You can refer American Board of Cardiovascular Perfusion (ABCP), Australian and New Zealand Cardiovascular Perfusion (ANZCP), and from India University which provide degree in Perfusion. The University of Harvard and Australia are also have similar program. We should compare our program with them and at the end we should create our programme according to local situation. We need to benchmark with that international standard. Current benchmark is degree program."
		R6	24	"We can also follow the curriculum that has been used by other established perfusion board from another country such USA, Australia, New Zealand and so on."
	Integrate simulation-based training	R10	26	"This curriculum can be improvised with the integration of more complete equipment and teaching material. They can improve by providing advance equipment to make sure that

Themes	Codes	Participant	Quote number (Q)	Quotes
				the trainee can be trained outside of operation theatre in a regular manner. As for examples, the "mock run" (assessment and learning through simulation) system itself is complete and synchronized with what they learn from theory and practical. So that whatever they learn from theory and practical can be implemented and practice."
Input	Enough cardiac cases	R5	27	"The strength of this program is it has lots of cardiac cases as exposure to trainee."
		R9	28	"Strength, is we have number of cases"
	Certificate recognition	R1	30	"No Degree level, however, well-structured by Ministry of Health (MoH) which is Advance Diploma in Cardiovascular and Health Science (ADCH)."
		R1	31	"The programme also like current GCCVTS has got approval from MQA. Next, current certificate can prove that you are qualified perfusionist."
	Education is not at par with international standard	R1	32	"it's supposed to be the pre-entry level in perfusion carrier is at degree level same as international standard. You cannot expect perfusionist to be lower than degree qualification"
	Lack of clinical experience among trainee due to time constraint	R2	34	"Lack of on job training. less exposure to the student"
		R3	35	"there is not enough time allocated for more numbers of cases collection. Some of trainee is struggled to achieve the target. Some of them quit halfway. Some of them just collect the case even though

Themes	Codes	Participant	Quote number (Q)	Quotes
				they are in tagging with senior and not perform the procedure by themselves. Observation only is not enough to be count in their logbook. They need to learn by doing and assess of what they are doing. Not just observe."
	Non comprehensive syllabus	R2	38	"non-comprehensive structured programme"
Process	Upgrade to degree level	R1	40	"University standard. I think most of paramedic training already towards university level. Even MoH also has transfer their training to university level now because they want the programme to recognized fully."
		R3	41	"Add more credit hours and upgrade from diploma to first degree level"
		R5	42	"Yes. There is a need to modify current perfusion program to be at least Bachelor's degree level"
	Encourage critical thinking through evidence-based practice	R3	44	"Yes. Especially on skills mastering, critical thinking, and evidence-based practice. They need to include research subject in the syllabus because most of our work involve evidence-based practice. They need to know on how to extract information from the journal."
		R5	45	"Yes. Upgrading a perfusion program will improve the skills, knowledge, and critical thinking of perfusionist"
	Reduce knowledge and practice gap	R2	47	"Standard curriculum will help the students to adapt well in perfusion no matter where they serve"
		R6	48	"I think it's very important. I agree with the standardisation of perfusion programmes because it is safe to know that from where or wherever you

Themes	Codes	Participant	Quote number (Q)	Quotes
				graduated you still received the same amount of knowledge; you know the essential knowledge for perfusion. Doesn't really matter where you graduated from as long as you need to have certain basic knowledge, everyone knows the same things."
	Single exit exam serves as standard assessment	R3	51	"Yes, very important as it will provide standard evaluation process"
		R6	53	"If the curriculum is standardized, it means the assessment also need to be standardized and the candidate could answer the single exit exam without any problem."
		R10	54	"In my opinion, it is very good because it can be a benchmark and last checklist on the trainee before they go out to the working world or real practice"
Product	Widen scope of perfusion	R1	55	"in the future perfusionist responsibility will become widen. That's why you need to have a standard perfusionist up to a level of cardiothoracic surgeon or anesthetist."
		R5	56	"Not really. Perfusionist practice is very wide. Its cover area of non-cardiac application. In our practice we need to perform many procedures out of cardiac surgery such as apheresis, cancer therapy, blood management, and also respiratory management. We need to learn other things outside the training as current program is more focus on cardiac surgery."
		R1	58	"in the future perfusionist responsibility will become widen."
		R10	60	"From my opinions. It's a no..it

Themes	Codes	Participant	Quote number (Q)	Quotes
				is because world nowadays is more advanced. The scope is keep changing...evolving. And we see the case (disease and procedure) also has become complicated and hard. The treatment scope is more widened to deal with new case (diseases), as for examples the current Covid-19 pandemic where during old days our ECMO machine, we just focus on cardiovascular related problems and currently we need to create new system to face that pandemic. I mean to support the pandemic and to deal with other problems and to cope with other non-cardiac case. The scope is widening but the learning is still the same. It should be improvised"
	Less competent	R1	61	"No, still on job training."
		R2	62	"No. They still need senior to observe them"
		R8	64	"No because during trainee, we just depend on the number of 'pump run' as our minimum standard to be qualified. In my opinion lots of qualified perfusionist is not competent, as for example, not everybody can handle ECMO machine."
		R10	65	"In order to fulfil all the tasks given, I think they are not competent because perfusionist job scope is very wide. If I want to talk about the learning and education system, its not comprehensive and do not cover many other aspects such as respiratory laboratory tasks, extracorporeal membrane oxygenation (ECMO) or other respiratory support system. They are still not ready for task

Themes	Codes	Participant	Quote number (Q)	Quotes
				out of cardiac surgery. After qualified they still need to learn new things on how to handle the machine."

1.1 Context

Competency acquisition: Stakeholders specified in competency acquisition, perfusionist should have "passed theory and practical examination" (R8:Q1, R10:Q3). Also, to have at least "150 to 200 cases" (R9:Q2), and all procedures need to be conducted independently. **Proper accreditation and certification**: The stakeholders suggested that perfusionists should be qualified through proper accreditation and certification, which can be achieved by the Malaysian Accreditation Qualification (MQA) approval (R1:Q4, R1:Q7, R1:Q8). One of the stakeholders agreed on the planning by the National Occupational Standard (NOSS) in creating a "skill programme" (R1:Q6) related to perfusion. **Prolong duration of study**: Stakeholders agreed that current perfusion education is "too short" (R5:Q12, R10:Q13, R2:Q16) and suggested to have the minimum of "2 years" (R4:Q10, R7:Q14, R8:Q15, R4:Q21) program which consists of "1 year of theoretical and 1-year of clinical placement" (R6:Q11). One of the stakeholders had difficulty to work at the international hospital due to the short duration of study albeit already having 10 years of perfusion experience (R2:Q16). The prolong duration of study also needed to equip perfusionist to be competent, "independent and confident" (R3:Q18). **Benchmark the curriculum**: Perfusion curriculum can be improved by benchmarking, as supported by several stakeholders. The benchmarking can be based on the "American Board of Cardiovascular Perfusion (ABCP), Australian and New Zealand Cardiovascular Perfusion (ANZCP)" or others from the international standards (R1:Q22). Can also be compared to "USA, Australia, and New Zealand: (R6:Q24). **Integrate simulation-based training**: The way perfusion curriculum can be improved also by the integration of simulation-based training. This can be done through the "mock run" (R10:Q26) which consists of "complete and advance equipment" (R10:Q26). This is to make sure that the trainees can be trained outside of operation theatre in a regular manner.

1.2 Input

Enough cardiac cases: As for the strength of current perfusion program, there are "lots of cardiac cases" available at the institution as exposure to the trainees (R5:Q27, R9:Q28). **Certificate recognition**: The following strength is the existing of "Advance Diploma in Cardiovascular and Health Science (ADCH)" which is a well-structured certificate (R1:Q30). Same goes to the "Graduate Certificate in Cardiovascular and Thoracic Science (GCCVTS)" (R1:Q31) which has gotten the approval from MQA. **Education is not at par with international standard**: The weakness of current perfusion education is it is not at par with the international standard, where one of the stakeholders revealed that Malaysian education should be "at degree level" (R1:Q32). **Lack of clinical experience due to time**

constraint: Stakeholders revealed that the trainees were "lack of on job training" (R2:Q34), due to "not enough time allocated for more numbers of cases collection" (R3:Q35). The observation of cases without performing the procedures indecently should not be counted in the logbook. **Non comprehensive syllabus**: In addition, non-comprehensive syllabus also is one of the weaknesses identified (R2:Q38). Perfusion area is not efficiently covered during the training.

1.3 Process

Upgrade to degree level: Current perfusion programme can be modified to better prepare perfusion graduates to meet new expectations by upgrading "diploma into degree level" (R3:Q41, R5:42, R1:Q40). Hence, more credit hours will be added to cover extensive knowledge and skills. **Encourage critical thinking through evidence-based practice**: As mentioned by the stakeholders, current perfusion program can be enhanced by accentuating on the "critical thinking and evidence-based practice" (R3:Q44). As most of decision making in perfusion works need evidence-based practice. This can be achieved by introducing research subject in the syllabus. Stakeholders stated that perfusionists need to know "how to extract information from the journal" (R3:Q44, R5:Q45). **Reduce knowledge and practice gap**: The stakeholders agreed that standardization of curriculum is "good" (R6:Q48) in reducing knowledge and practice gap (R2:Q47) among perfusionist. They need to know the essential knowledge of perfusion. Furthermore, one of the stakeholders emphasized on the importance of clinical practice also. **Single exit exam serves as standard assessment**: Single exit exam is regarded as "standard evaluation" (R3:Q51, R6:Q53, R10:Q54) process in determining the minimum standard of theory and practical before entering real practice. If the curriculum is standardized, therefore the assessment also needs to be standardized.

1.4 Product

Widen scope of perfusion: Majority of the stakeholders agreed that current perfusion education is not adequately prepared the perfusionist for the expectation of modern practice as current practice is "very widen" (R5:Q56, R1:Q55, R1:Q58). It covers non-cardiac surgery application such as performing apheresis, cancer therapy, blood management, and respiratory management (R5:Q56). The stakeholder also mentioned about the expansion of the perfusion field, fitting into current situation, for instance in this Covid 19 pandemic where they need to cater for non-cardiac management as well (R10:Q60). **Less competent**: Majority of the stakeholders mentioned that the newly qualified perfusionists at their own hospital are not competent enough to fulfill all the tasks given, based on the idea the "senior still need to observe them" while performing procedures (R2:Q62). The other statement was based on not all perfusionist can "handle ECMO machine" (R8:Q64, R10:Q65).

Discussion

1.5 Context

Context evaluation provides information about the strengths and weaknesses of a total system to assist in planning improvement-oriented objectives at each level of the system. As mentioned by the participant, no established accreditation and certification for perfusion education, also supported by statements perfusionist career should have an entry requirement of degree level which is at par with the international standard. This is in congruent with the American Academy of Cardiovascular Perfusion, stated the perfect characteristics for an effective Perfusion Education Program include to establish the minimum of a bachelor's degree for entry into the perfusion profession (American Society of ExtraCorporeal Technology, 2019). The other alternative is to have a minimum of 15 years of clinical perfusion experience and to progress with appropriate advanced degrees, and to be certified by the Cardiovascular Perfusion Board. Additionally, perfusionists in Canada had a new criterion, where the candidate must have a baccalaureate degree to qualify for credentialing (Belway et al., 2017). It is noted that both years of experience and level of education have been shown to influence the clinical expertise and patient outcome

The improvement of perfusion educational structure is imperative to produce high quality perfusionists in Malaysia, as explained by the participants. Formal perfusion educational programs primarily were based on the serial perfusion educational model (SPEM), where the relationship between didactic and clinical education occurred spontaneously in the same institution, which is the hospital. Through this, the hospital providing most of the income for the educational programme, thus counterbalance the programme expenditures. The programme faculty educators and instructors were paid mainly as perfusion health care providers and secondarily as perfusion educators. On the other hand, the distributed perfusion education model (DPEM) is university based. Perfusion students are registered in the university setting for their didactic education which can also include the internet-based didactic courses and virtual classrooms, followed by the clinical training at the hospitals or clinical affiliation sites where the students are able to interact with a variety of real cases. The hospitals and clinical settings located locally or distant away from the didactic program (Austin et al., 2005).

In terms of prolonging duration of study, where majority of the participants proposed to qualify perfusionists in two years' time, with one year theoretical followed by one-year clinical placement. This is because cardiovascular perfusion curriculum not only involves a robust knowledge base in short period of time but also developing psychomotor skill and decision-making ability in critical situations essential for comprehensive clinical competency (Palmer, 2007). Nevertheless, it is argued that the quality of the experience that matters instead of the clinical placement hours (Jone et al., 2008). This is because a long period of placement in clinical settings with insufficient support mechanisms such as supporting staff will not provide a conducive quality learning experience (Jone et al., 2008). However, this is not supposed to happen in all settings. Thus, increase duration of time to cover medical science and perfusion theoretical and clinical

placement are needed to accommodate better understanding and competency, as supported by one of the participants saying that current program structure is not well organized with short study period. As revealed in prior study conducted in Saudi, where the training period was reported to be the main barrier to achieve the programme objectives, particularly the hospital rotation period, at 84% (Al-Khatami, 2012).

Most of the participants agreed to benchmark the existing curriculum with other countries such as the American Board of Cardiovascular Perfusion (ABCP), Australian and New Zealand Cardiovascular Perfusion (ANZCP), and from India University which provide degree in Perfusion. This can be done before creating our own bachelor's degree course, assimilated with local components. Benchmarking is necessary to ensure the curriculum meets the standards for professional knowledge, skills and attitudes as required (Thomas & Peng, n.d). Also, to safeguard the quality improvement in assuring the stakeholders that standards are being met. There are many ways that perfusion faculties can be benchmarked. In one way, the faculty can determine the areas to benchmark, and relate these areas to the missions and areas of interest. If all perfusion institutions were benchmarked on the same qualities, there can be a curriculum evolution which initiate better performance in those specific areas. This is desirable outcome if all of perfusion institutions agreed on the competencies that all required to accomplish and value. However, this may lead to curriculum convergence and the absent of diversity and innovation. The other way in benchmarking is each perfusion institution benchmark on its own attributes and values. The example of benchmarking components in terms of social accountability and research skills of graduates. Current study is also supported by previous study conducted in Iranian medical school revealed that the weakness of medical institution includes the curriculum is not comparable to several countries (Mohebbi et al., 2011).

Furthermore, some of the participants suggested to have simulation-based training, where this can be done by providing advance equipment set up so that the trainee can be trained outside of operation theatre in a regular manner. For instance, the "mock run" (assessment and learning through simulation) system where it is synchronized with the theory and practical. Simulation-based training is a developing discipline that consists of clinical situations for teaching and learning purposes created using mannequins, part-task trainers, simulated patients, or computer-generated simulations to provide safe and effective learning environments for trainee (Weller et al., 2012). Simulation-based training is effective in displaying the importance of teamwork, inter-professional knowledge and respect, and communication during the training.

1.6 Input

Input evaluation provides information about the strengths and weaknesses of alternative strategies which might be chosen and structured for the achievement of given objectives. The strengths identified was there are loads of cardiac cases available at the hospital. This is a good practice environment for the trainees to perform procedures. IJN is the national institute where many cardiac cases were referred from all over the states and neighboring countries to be handled.

Therefore, this may lead to competency of perfusionists and other staff. One of the weaknesses is non comprehensive syllabus. As mentioned by the participants, the paucity was noted in perfusion area, in addition to a compulsory to learn general basic medical knowledge. This is in aligned with perfusion education in South Africa where it has deficient standardized training curriculum, study and exit-level outcomes, and competencies required of a cardiovascular perfusionist (Ali-Musa et al., 2018). As emphasized by the American Academy of Cardiovascular Perfusion, one of the qualities for an effective Perfusion Education Program is the requirement of institution and syllabus to be structured and certified and provide skilled instructors to continue education in improving knowledge and skill. The importance of having similar and comprehensive syllabus is also supported by previous study conducted in Indonesia among nurses revealed that there were disparity of nurses passing rate at 56.5% due to unstandardized syllabus (Siswadi et al., 2019). These can be due to the variety of learning and in the education standard for every nursing programme.

The next weakness is lack of clinical experience among trainee and the education is not at par with the international standard. One of the reasons might be due to inadequacy of the trainers in terms of teaching skills. The current education system is inadequate where the teacher that trained the trainee should make regular adjustment to fit with expanding circumstance such as in pandemic. In addition to the foundational skills that most trainers should be acquainted with such as direct observation, establishing a positive learning environment, and providing useful feedback, they need to master other essential skills such as curriculum development, leadership, and establishing programs of assessment (Survey et al., 2020). As clinical trainers are advanced in medical knowledge and skills, however not much in teaching aspect. Physician or any healthcare trainers become more challenging in the perspective of expanding clinical responsibilities and shrinking time for teaching due to their business in clinical practice (Prideaux et al. 2000). Sometimes, clinicians are unaware of educational obligations from licensing and accreditation bodies as well as medical institutions and this may affect the trainee. Hence, necessary orientation and training for their clinical trainers are needed (Ramani & Leinster, 2006).

1.7 Process

Process evaluation provides information about the strengths and weaknesses of a chosen strategy under conditions of actual implementation, so that either the strategy or its implementation might be strengthened. With regards to upgrading diploma level into bachelor's degree, the syllabus should be specific to perfusion and not too general. Some of the respondents suggested to have perfusion training being taught in comprehensive and deeply covering topics of perfusion. This is because generally, in cardiac surgery, it involves a team consists of anesthetists, surgeons, nurses, and perfusionists. Each sub team has its own specific knowledge along the surgery, there is a constant exchange of information within each team. This knowledge exchange depends on the adequacy and proper utilization of that knowledge. The current findings also in congruent by previous study conducted among Saudi clinician, where Diploma degree was not the priority for the Saudi physicians. It is suggested that a higher degree such as a degree bestowed by a medical board was favored by the Saudis. In addition to

that, the respondents appeared to be an apprehension and anxiety of being unable to have the right to continue their postgraduate study after a Diploma graduation. This is an important issue to be discussed with the policy maker (Al-Khatami, 2012).

With regards to the statement of “single exit exam”, according to literatures, a professional body is required to oversee the training process and to ensure a minimum level of clinical competency for cardiovascular perfusionists (Merkle, 2006). An exit exam is defined as a high-stake exam to be passed before moving forward in a professional education program or to advance in professional service. The example of exit exam set by the American Board of Cardiovascular Perfusion are basic science and clinical science exams as many employers and some state licensure applications requirement (Riley et al., 2006). This is also supported by previous study conducted among nurses in Indonesian nursing institutions where the quality of a nursing education program is evidenced by the performance of its graduates on the licensure examination, hence exit exam is needed (Siswadi, 2019). Therefore, the exit exam is crucial to determine students’ progress from didactic to the clinical phase and every student must pass the competency exit exam to obtain entry to the clinical employment (Riley et al., 2006).

Moreover, perfusionists also need to undergo competency-based training, which can be divided into professional and social competence. Professional competence such as being able to perform cardiopulmonary bypass independently for adult, pediatric and neonatal patients. Also, manage cardiac assist devices and cardiac replacement without help. This applies to the setup of the devices, implantation, and postoperative patient management.

1.8 Product

Product evaluation provides information for determining whether objectives are being achieved and whether the change procedure which has been employed to achieve them should be continued, modified, or terminated. Most of the participants revealed that perfusionists have a wide area of demand with greater responsibility, which cover non-cardiac surgery procedures such as apheresis, cancer therapy, blood management, and respiratory management. The other example is the evolving of cardiac cases, especially in covid-19 pandemic, the staff need to integrate the internal medicine into cardiac ECMO management. This circumstance is in consistent with previous situation happened in 2010 when H1N1 flu struck in England, where several cardiac centres had the requirement to carry out a minimum of 20 cases per year to remain certified. However, due to the pandemic, one of the cardiac centres conducted almost 100 ECMO cases, which shown intensive care staff have been exposed to equipment which they never been familiar before. Hence, perfusionists experienced widen responsibility as educational roles, teaching both nurses and medical staff on the ECMO equipment and being an integral part of the multidisciplinary team retrieving patients from tertiary centres (Gooby, 2017).

Limitation and Conclusion

There are some limitations in the present study. Firstly, in terms of validity and reliability, the present study adopted member checking. To further improve the validity and reliability, an audit trail can be included. Secondly, there were only 10 stakeholders being interviewed. Future studies can include broader population such as perfusionists who work overseas to cater for broader perspectives and generalizing the findings beyond the present study's parameters. Future studies can include perspectives from the other policy makers such as higher education providers. Lastly, document review can be applied as part of the methodology. In the present study, document review was gathered from Malaysian Perfusionist Society (MAPS) such as the constitution, pre-liminary survey which was conducted through convenient sampling among perfusionists in Selangor, and some meeting minutes. However, as to avoid biases, the documents from the Higher Education Providers (HEP) namely IJN College (IJNC) and *Institut Latihan Kementerian Kesihatan* (ILKKM) should also be reviewed.

In conclusion, under context evaluation, perfusion programme can be improved by integrating competency acquisition, proper accreditation, and certification, having longer duration of study, to benchmark the curriculum, and integrate simulation-based training. In terms of input evaluation, the strengths of their institutions were having sufficient cardiac cases and certificate recognition. However, few weaknesses have been identified, namely the programme is not par with international standard, lack of clinical experience among trainees due to time constraint, and non-comprehensive syllabus. For process evaluation, some modifications to improve perfusion educations include to upgrade existing diploma to degree level, to encourage critical thinking through evidence-based practice, reduce knowledge and practice gap and to have single exit exam which serve as standard assessment. As for the product evaluation, current perfusionist trainees were less competent and the scope of perfusion need to be widened to cater for the advancement of perfusion field.

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