MEDICAL IMAGING RESEARCH IN MALAYSIA

BY

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ABSTRACT

The concept of evidence based practice is to enable medical imaging practitioners (radiographers and academicians) to deliver optimal health care services. Research is an important tool to enhance the growth of the discipline. This study explored the state of medical imaging research in Malaysia. To achieve the aim, the global trend of research was examined using Web of Science (WoS) and Scopus online databases. The bibliometric and thematic analysis explored the theme and sub-themes of research in medical imaging, as well as the collaboration activities in research and contributions of Malaysia based researchers in medical imaging research. The findings found that the major theme and sub-theme of the global trend of research in medical imaging was clinical-modality comparison. The professional background for the authors are mostly from university-based researchers. The collaboration activities in research was encouraging and the contribution of Malaysia based researchers was not satisfactory. A questionnaire study was done among medical imaging practitioners that explored the research state among medical imaging practitioners. It examined among others the research obstacles and preferences among. There was significant difference in terms of knowledge, attitude and practice among medical imaging practitioners in research. The main research obstacles outlined by medical imaging practitioners was insufficient time. Their research preferences in medical imaging was the safety aspect; radiation safety, modality safety, cross infection. Based on the findings, a conceptual framework to enhance the state of research in medical imaging was proposed. There is the need of alignment in research among medical imaging practitioners in order to enhance the state of research in medical imaging Malaysia. This can be achieved through the setting up of a research centre. Among others the research centre is expected to centralize the research activities among medical imaging researchers and to align the research activities within the needs of Malaysian population and aspiration of government. More researches that are relevant to local practices and needs are needed especially from Malaysian researchers. For future research involvement, it suggested that more collaboration between academicians and service providers in research in medical imaging is needed to strengthen the contribution of research to meet the needs of patients. This finding can be very helpful for future researchers to find out the most needed topic to conduct a research that could benefit the medical imaging services. This can help to strengthen the medical imaging practice as well as to increase home-grown research.

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خلاصة البحث

إن الممارسة القائمة على الأدلة تساعد ممارسي التصوير الطبي (المصورين الشعاعيين والأكاديميين) على تقديم أفضل الخدمات للرعاية الصحية، وتعتبر الأبحاث في هذا المجال مهمة لتعزيز نمو هذا التخصص. استكشف هذا البحث الوضع الحالي لأبحاث التصوير الطبي في ماليزيا، ولتحقيق هذا الهدف تم فحص الاتجاه العالمي للأبحاث باستخدام قواعد بيانات شبكة العلوم (Web of Science, WoS) وسكوبوس (Scopus) على الإنترنت. أظهرت التحليلات الببليومترية والموضوعية المواضيع الأساسية والفرعية للأبحاث في مجال التصوير الطبي، وكذلك أنشطة التعاون في الأبحاث ومساهمات الباحثين في ماليزيا في أبحاث التصوير الطبي. أظهرت النتائج أن المواضيع الرئيسية والمواضيع الفرعية للاتجاه العالمي للبحث في التصوير الطبي كانت مقارنة سريرية وكيفية، وكانت الخلفية المهنية للمؤلفين غالبا من الباحثين في الجامعات. كانت أنشطة التعاون في مجال البحث مشجعة ولكن مساهمات الباحثين في ماليزيا لم تكن مرضية. تم إجراء دراسة استبيانية بين ممارسي التصوير الطبي والتي حققت في الأوضاع البحثية بين ممارسي التصوير الطبي، وبحثت من بين أمور أخرى العقبات البحثية وتفضيلات الباحثين. كان هناك اختلاف كبير من حيث المعلومات والسلوكيات والممارسات بين ممارسي التصوير الطبي في مجال البحوث. عدم الوقت الكافي هو كانت العقبة الرئيسية في الأبحاث التي حددها ممارسو التصوير الطبي. تضمنت التفضيلات البحثية في التصوير الطبي كلا من: ناحية السلامة، والسلامة الإشعاعية، والسلامة الكيفية، والعدوى المنتشرة. بناءً على النتائج تم اقتراح إطار عمل مفاهيمي لتعزيز حالة البحث في التصوير الطبي، حيث كانت هناك حاجة إلى التوافق في القيام بالأبحاث بين ممارسي التصوير الطبي من أجل تعزيز الوضع البحثي في مجال التصوير الطبي في ماليزيا، وبالإمكان تحقيق ذلك من خلال إنشاء مركز للأبحاث. من بين أمور أخرى فإنه من المتوقع أن يركز مركز الأبحاث هذا على الأنشطة البحثية بين باحثي التصوير الطبي وأن يوفق بين الأنشطة البحثية واحتياجات المواطنين الماليزيين وطموحات الحكومة. هناك حاجة إلى مزيد من البحوث المتعلقة بالممارسات والاحتياجات المحلية، خاصة من الباحثين الماليزيين. من أجل البحوث المستقبلية فإنه يقترح وجود المزيد من التعاون بين الأكاديميين ومقدمي الخدمات في مجال أبحاث التصوير الطبي لتعزيز المساهمات البحثية لتلبية احتياجات المرضى. بإمكان أن تكون هذه النتائج مفيدة جدا للباحثين في المستقبل لمعرفة الموضوع الأكثر حاجة لإجراء بحث عليه والذي قد يفيد خدمات التصوير الطبي، والذي يمكن أن يساعد في تحسين ممارسات التصوير الطبي وكذلك زيادة البحوث المحلية.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Health Sciences (Medical imaging)

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DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Research is a systematic investigation of materials and sources to establish facts and reach new conclusions. Research discovers new or collate old facts by the scientific study or critical investigation. Research is needed to provide the evidence for its practices as research is a means by which a profession defines its own knowledge base and successfully differentiates itself from others (Reeves, 2008).

Research is needed to provide the evidence for its practices as research is a means by which a profession defines its own knowledge base and successfully differentiates itself from others. Research is an important tool to enhance the growth of the discipline. Malamateniou (2009) reported that research in radiography is required as a part of role extension and as a necessary tool to improve the development of medical imaging field.

Recent developments in medical imaging underline the significance of research in professions as research provides the necessary evidences to fulfill the concept of evidence based practice. The concept of evidence based practice is to enable the medical imaging practitioners in delivering optimal health care services. Research in radiography is required as a part of role extension and as a necessary tool to improve the development of medical imaging field. By that, the recent advancements in medical imaging will be kept up-to-date. Research in radiography is as important as in other medical fields and the increase in the quality and quantity of the research output in medical imaging is encouraging. Systematic efforts should be refined and focused

to maintain high research standard and ascertain full integration of research culture into the medical imaging practice (Malamateniou, 2009). Thus, it is undeniable that research is one of the important elements to enhance a betterment of the services in the medical imaging field..

1.2 STATEMENT OF THE PROBLEM

Various authors have highlighted several findings that relate to medical imaging researches. Reeves (2008) stated that the evidence base practice of all allied health professions is lacking. This is due to the research level is found to be generally low. The author also states that the radiography profession must be able to provide evidence for its practices to have an influence over government policy. Snaith (2012) is of the opinion that collaboration between the clinical practitioners and academicians is important to develop radiography research activity and a progressive research culture. Hogg et al. (2011) stated the major contribution of the research came from the academicians. Available data pertinent to the level of research activities among the service providers is limited. This suggests little involvement from service providers in the research area. This presents a limited contribution of research production and knowledge sharing in medical imaging profession.

Zainul and Halimatussa'diah (2013) reported the presence of 132 of active journals in Scopus that were related to medical imaging. An increasing trend over the years in the number of articles suggests that research in medical imaging is actively being undertaken. This was supported by Lim et al (2012) who studied the research characteristics and trends in radiology research. The study showed a major positive trend toward research in terms of increase in number of published research.

The prioritization of research areas and categories provides a useful list of future researches that can enable researches to decide whether their research ideas area are of high priority (Egestad and Halkett, 2016). The study presented that prioritisation helps to map the opportunities for research and would facilitate for improvement in research skills in the prioritised area. Meanwhile, Ooi, Lee and Soh (2012) highlighted that most service providers are interested to involve with research if more structured training courses introducing concepts of research protocols are provided.

The above findings is now seen within the Malaysian context. Little is known about the state of research in medical imaging in Malaysia. The direction of research in medical imaging could be scattered and may not align with the aspirations of the nation. There is a need to examine similar aspects of the studies quoted above with respect to medical imaging scenario in Malaysia. This is due to the research conducted in Malaysia need to address genetics, body sizes, culture, different technological specification and different practices of Malaysian population. The research findings done elsewhere may not be applicable to the Malaysian scenario. The aspects to be covered are research trends, research priorities, research collaboration and research involvement among medical imaging practitioners in Malaysia. The research trend can inform the essential source of information regarding research in medical imaging field. The research preferences functioned as a guideline to a future researchers in Malaysia to direct their research in medical imaging. The research trend and preferences are crucial in medical imaging research.

Exploring the state of research make it possible to analyse the aspects needed to enhance the research participation among medical imaging practitioners in Malaysia. Research collaboration among radiographers and academicians in medical

imaging can improve the research output and quality. The research collaboration among medical imaging practitioners tend to address the needs of Malaysian population in terms of better health care services. The research publication represent the research involvement and successful research activities among medical imaging practitioners. Thus, the medical imaging practitioners need to have encouragement to publish their research findings.

Thus, the above paragraphs justifies the need for a study to be done to the state of research among medical imaging practitioners in Malaysia. The analysis will provide the overview of medical imaging research and open up a room for improvement to enhance research specifically in medical imaging in Malaysia.

1.3 SIGNIFICANCE OF STUDY

This study aimed to determine the state of research in medical imaging in Malaysia. Extra focus was given to the research contributed by Malaysia based researcher. The state of research among medical imaging practitioners was assessed in terms of the knowledge, attitude, practice, research obstacles and research preferences. The study is expected to synergise the role of academicians and experiences of services providers in conducting the researches in medical imaging field. The research trend and priorities can help in directing and managing medical imaging research interest and priorities through optimisation of professional interests in both academics and service sectors. It will be very helpful for future researchers to find out the most needed topic to conduct a research that may benefit others in the services. This could maximise benefit of the researches to the society and the Malaysian health care services.

This study will outline the important undertaking to determine whether the current status of locally grown knowledge and practices are in line with the aspirations of the nation and the expectation of the overall medical imaging field in Malaysia. The outcome of the study can contribute to the enhancement of the quality in medical imaging research education in the country. This is seen to fulfill the National Key Result Area (NKRA) in Government Transformation Program (2010) that states that quality in education and health care are two essential aspects. Efforts will be intensified to formulate a framework for research in medical imaging field in Malaysia.

1.4 RESEARCH OBJECTIVE

The general objective was to address aspects of research in medical imaging in Malaysia. This objective was supported by three specific objectives: The first was to investigate the current themes and trends of the research in medical imaging as evidence in online database (Web of Science and Scopus). Special emphasis was given to researches affiliated to Malaysian researchers. This is followed by the study on the knowledge, attitude, practice, research obstacles and research preferences among medical imaging practitioners. Finally, based on the findings, a conceptual framework was to be proposed to enhance medical imaging research in Malaysia.

1.5 RESEARCH QUESTIONS

The questions that guides this research are:

1- What are the research trends in medical imaging as evidence in Web of Science (WoS) and Scopus?

2- What is the state of research among medical imaging practitioners in Malaysia in terms of knowledge, attitude, practice, research obstacles and research preferences?

3- What needs to be done to enhance research in medical imaging in Malaysia?

1.6 ORGANISATION OF THE THESIS

The thesis consist of six chapters. The first chapter is the introduction. In this chapter, the study background, problem statement, significance of study, research questions and research objectives were outlined. The function of Chapter 1 of the study was to give the initial description of overall content of the thesis.

Chapter 2 outlined the literature review of the thesis. The literature review provided the theoretical background for the study. It gave an overview of the ideas and significant literature currently published that are related to this study.

Chapter 3 of the thesis explained the study conducted to explore the global trend of research in medical imaging as evidence in Web of Science (WoS) and Scopus. The findings of this study presented the global trend of research in 2006-2016 in medical imaging. The themes of research are outlined to figure out the types of research in medical imaging globally. The research collaboration and contribution of Malaysia based researchers in medical imaging as evident in online databases were analysed to point out the performance of medical imaging practitioners in research. This chapter has its own introduction, literature review, methodology and result and discussion sections. In this chapter, the methodologies used were bibliometric and thematic analysis. The outcomes from the study outlined the themes and sub-themes of research in medical imaging, the collaboration efforts and contribution of Malaysia based researcher in medical imaging.

The study of research state among medical imaging practitioners in Malaysia is discussed in Chapter 4 of the thesis. This study explored the state of medical imaging practitioners in Malaysia in term of their knowledge, attitude, practice, research obstacles and research preferences. These aspects explained the state of research and room for improvement to enhance their research preferences. This chapter consist of introduction, literature review, methodology and result and discussion for the specific study. In this chapter, descriptive quantitative study using survey was the study design. The study used questionnaire to explore the state of research in medical imaging in Malaysia in term of knowledge, attitude, practice, research obstacles and research preferences. The study found significant differences in terms of knowledge, attitude and practices among radiographers and academicians in Malaysia. The outcome from this study also pointed out the research obstacles and research preferences of medical imaging practitioners in Malaysia.

From the gathered information, a conceptual framework was proposed to enhance research in medical imaging in Malaysia. This proposed framework is discussed in Chapter 5 of the thesis. Suggestions were focused on several aspects that were in need of improvement. The proposed framework was expected to rule out future steps to be taken to enhance research in medical imaging in Malaysia.

Chapter 6 represents the conclusion of the thesis. This chapter summarizes all the findings from the studies conducted and conclude the overall research findings. This final chapter also outlined the study limitations and future recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter focuses on the literatures that addressed the overview of research in medical imaging. This serves to present the understanding towards the research topic. The review involves searching for the relevant literatures involving the use of "Google Search" and entering keywords, such as "state of research in medical imaging", "state of research", "preferences of research", "medical imaging research in Malaysia" and "medical imaging". There is no specific papers that discussed the current state of medical imaging research in Malaysia. This is the trigger factor to indicate the need to further investigate the global trends of research in medical imaging and current states of research in medical imaging in Malaysia among medical imaging practitioners. The study of research in medical imaging was found in other countries such as Nigeria and Iran.

Using the Pubmed search engine and limiting the keywords to "medical imaging" and "research" in the titles, the search came up with 42 articles. The scope of the majority of the articles discussed the advancement in technology in medical imaging. The technology advancement include the software, data storage and development technology. Other remaining titles discussed the aspect of clinical radiography. Some discussed the ethics of research and one article discussed the future trend of research in medical imaging technology.

The term "medical imaging" was then replaced with "radiography", the search came out with 37 articles. The output of the search is almost the same with the

previous search. The most common titles discussed are mostly related to technological aspect of medical imaging. There are some recent researches that discussed the state of research in education such as a title on a Delphi technique in radiography education research conducted in 2017.

When the term “ultrasound”, “magnetic resonance imaging”, “mammography”, “nuclear medicine”, “computed tomography” and “fluoroscopy” replaced the term of “radiography”, the search came up with 179, 141, 59, 54 and 4 articles for each respective term. These titles are related to medical imaging modalities and clinical radiography. Some titles discussed the technology and advancement of those modalities.

This literature reviews start with the historical perspective followed by a brief overview of medical imaging. This highlights the discovery of X-rays, the evolution of medical imaging modalities and the purpose of X-ray examinations. Following this, the historical perspective of research in medical imaging underlines the origin of research activity in medical imaging discipline. The role of research in medical imaging is included in the literature review to detail out the benefit of research in medical imaging. Other sections included are evidence base practice and evidence based medicine to emphasise the importance of research to the discipline. The next section discussed on role of research in medical imaging. This section expanded the discussion of research focused on medical imaging discipline. Subsequently there is a section that discussed research in relation to the Malaysian government policy. This section highlights the government concern in terms of research specifically in Malaysia.

2.2 OVERVIEW OF MEDICAL IMAGING

Braley (2008) mentioned that medical imaging history began in November 1895 with Wilhelm Conrad Roentgen's discovery of the X-ray. Roentgen noticed that invisible rays were able to penetrate human flesh better than bone and metal as he was working with an early cathode ray tube called a Crooke's tube. For his efforts he was awarded the first Nobel Prize in 1901. Aside from Roentgen, the development of X-ray was contributed also by other researchers such as Joseph John Tomson, Philip Lenard, Heinrich Rudolf Hertz and many more.

The procedure to assist diagnosis concerning a given patient's medical situation was previously known as "radiography". The term defined the simple fact that radiation was extensively used to produce the images. Advancement in knowledge and technology lead to the development and use of other methods to image the anatomy of human body. These methods include the application of sound waves in ultrasound and the utilisation of the behavior of certain atoms in the body in magnetic fields and radio waves as in Magnetic Resonance Imaging (MRI). Due to that, the term "medical imaging" has been adopted to substitute "radiography" to denote all procedures and methods that involves imaging of the human anatomy (Zainul, 2014).

The discovery of X-ray over time led to the introduction of radiological modalities in medical field. Whalen (1993) presented the changes in imaging that had occurred in less than ten years. The changes included Magnetic Resonance Imaging (MRI) and Magnetic Resonance fast-scanning techniques, spiral CT with three dimensional color acquisition, Doppler sonography videoscopic surgical techniques and interventional techniques.

Medical imaging has since grown from a state of infancy to a high level of maturity since last the 50 years. This clearly showed that medical imaging has become

established as having a significant role in patient management and especially radiologic diagnosis (Doi, 2006). The advent of the computers has enabled the capacity of imaging to increase significantly. Laal (2013) and Zainul (2014) collectively identified the development of medical imaging technologies between 1950s and 2000 that introduced the other types of imaging equipment. The modalities are ultrasound (1960s), mammography (1970s), Computed Tomography (1973), Digital Radiography (1978), Magnetic Resonance Imaging (1980), Radionuclide Imaging (1985), Spiral CT System (1989) and Echo Planar Imaging and Open MRI System (1993). These modalities are recognized as major contributors in the medical imaging field. These led to more accurate diagnosis which finally provides the guidance to treatment possibilities (Patizzi, Lee & Crean, 2012).

These developments are also seen within the context of overcoming the limitations of previous imaging technologies. For example, conventional radiography depicts 2 dimensional image from a 3 dimensional object. The image shows all the structures present in the particular region of interest. However, the structures of the organs are superimposed on each other. This make it difficult to localize the exact location of lesion. Based on the limitation of the conventional radiography, a Computerized Tomography (CT) scan can generate a cross-sectional images of the body that result from multiple projection by using ionising radiation. The CT scan enables differentiation of soft tissues in human body as compared to conventional radiography. Besides, it also allows image reconstruction and manipulation to alter the image in order to improve the visualization of the anatomy. This is due to the multiple projections that are used to create the images. However, this is associated with higher radiation dose. Later, further development of technology produces non-ionising