

**KNOWLEDGE AND ATTITUDES LEVEL OF STEM
CELL AMONG REGISTERED NURSES AND
UNDERGRADUATE NURSING STUDENTS IN
UNIVERSITI SAINS MALAYSIA**

by

LYE JEE LENG

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LIST OF ABBREVIATIONS

ASC	-	Adult Stem Cell
ESC	-	Embryonic Stem Cell
UCBSC	-	Umbilical Cord Blood Stem Cell
USM		Universiti Sains Malaysia
RN	-	Registered Nurse
HUSM	-	Hospital Universiti Sains Malaysia

KNOWLEDGE AND ATTITUDES LEVEL OF STEM CELL AMONG REGISTERED NURSES AND UNDERGRADUATE NURSING STUDENTS IN UNIVERSITI SAINS MALAYSIA (USM)

ABSTRACT

Stem cell research holds great promise for treatments in many devastating disease of mankind. Study suggests that stem cell research is an important scientific breakthrough to intervene in medicine and bringing hope in terms of quality of life. Registered nurses and nursing students need to understand stem cell research so they can translate information on this issue. The aim of this study was to investigate the knowledge of stem cells, attitudes toward the application in medical setting among Neonatal Intensive Care Units (NICUs) and Obstetrics and Gynecology Wards registered nurses in Hospital Universiti Sains Malaysia (HUSM) and undergraduate nursing students in Universiti Sains Malaysia (USM). A cross-sectional study was conducted on registered nurses (RNs) and undergraduate nursing students in the Health campus, USM after ethics approval was obtained. Simple random sampling was used to select the sample. Ninety-seven (RNs) and 88 undergraduate nursing students were involved in this study. Data were collected using self-administered questionnaire developed by the researcher according to the literature. The questionnaire included demographic characteristics of respondents and 20 knowledge questions and 10 attitude statements on stem cell application in medical setting. Data was analyzed using the Statistical Package Social Science (SPSS) software version 20.0. The results showed that most respondents had moderate knowledge on stem cell, nevertheless, Independent T-test revealed that registered nurses were more knowledgeable regarding stem cells, with a mean score of 32.6, compared to the undergraduate nursing students, with mean scores of 31.7 ($p < 0.05$). There was no significant difference in attitude among the registered nurses and undergraduate nursing students ($p > 0.05$). Most of the respondents are worried about

stem cell treatments, nevertheless they see the future of stem cell treatment and agree that more exposure should be given to them. Using the correlation coefficient, it was shown that there was a fair relationship ($r=0.26$) between the employment years and knowledge of stem cells for RNs. On the other hand, there seem to show poor relationship ($r=0.02$) between the educational years and knowledge of stem cells for the undergraduate nursing students. In conclusion, this study suggests that both groups of participant, whether RNs or undergraduate nursing students (future nurses) lack stem cell knowledge that is essential for daily practices. This moderate knowledge affects their attitude in delivering stem cell issues and information. Therefore, review of curriculum and continuous nursing education on stem cells information is suggested.

TAHAP PENGETAHUAN DAN SIKAP TERHADAP SEL STEM ANTARA JURURAWAT BERLESEN DAN PELAJAR KEJURURAWATAN BERIJAZAH MUDA DI UNIVERSITI SAINS MALAYSIA (USM)

ABSTRAK

Penyelidikan sel stem mempunyai potensi rawatan untuk pelbagai penyakit yang membinasakan manusia. Kajian mencadangkan penyelidikan sel stem adalah suatu penemuan saintifik yang penting untuk mencelah dalam bidang perubatan dan membawa peningkatan kualiti hidup. Jururawat berdaftar dan pelajar kejururawatan harus memahami penyelidikan sel stem supaya mereka mampu menterjemahkan maklumat-maklumat tentang isu ini. Tujuan kajian ini adalah untuk menyiasat pengetahuan sel stem, sikap terhadap aplikasi pada jururawat berdaftar di persekitaran perubatan seperti Unit Penjagaan Rapi Neonatal (NICUs) dan wad Obstetrik dan Ginekologi di Hospital Universiti Sains Malaysia (HUSM) dan pelajar kejururawatan sarjana muda di Universiti Sains Malaysia (USM). Kajian keratan rentas telah dijalankan ke atas jururawat berdaftar dan pelajar kejururawatan sarjana muda di kampus kesihatan, USM selepas memperolehi etika kelulusan daripada hospital dan etika jawatankuasa USM.

Persampelan rawak ringkas telah digunakan untuk memilih sampel. Sembilan puluh tujuh (jururawat berdaftar) dan 88 pelajar kejururawatan sarjana muda terlibat dalam kajian ini. Data telah dikumpulkan dengan menggunakan soal-selidik yang ditadbir sendiri yang dicipta oleh penyelidik berdasarkan bahan kesusasteraan. Soal-selidik merangkumi ciri-ciri demographic, 20 soalan tentang sel stem dan 10 soalan sikap tentang aplikasi sel stem di persekitaran perubatan. Data dianalisis dengan menggunakan perisian "Statistical Package Social Science" (SPSS) versi 20.0. Kajian berbentuk deskriptif telah digunakan untuk membentangkan data demografi. Keputusan

menunjukkan kebanyakan responden mempunyai pengetahuan yang sederhana tentang sel stem, namun begitu, ujian-T mendedahkan bahawa jururawat berdaftar mempunyai pengetahuan tentang sel stem yang lebih, dengan skor min sebanyak 32.6, berbanding dengan pelajar kejururawatan sarjana muda, dengan skor min sebanyak 31.7 ($p < 0.05$). Ini menunjukkan bahawa tiada perbezaan yang ketara dalam sikap di kalangan jururawat berdaftar dan pelajar kejururawatan sarjana muda. Kebanyakan responden risau bahawa rawatan sel stem mungkin akan membunuh nyawa, namun, mereka juga tahu tentang masa depan rawatan sel stem dan setuju bahawa lebih pendedahan harus diberikan kepada mereka.

Dengan menggunakan pekali korelasi, ia menunjukkan bahawa terdapat hubungan yang wajar ($r=0.26$) di antara tahun pekerjaan dan pengetahuan sel stem. Akan tetapi, antara tahap pendidikan dan pengetahuan sel stem untuk pelajar kejururawatan sarjana muda, ia menunjukkan hubungan yang lemah ($r=0.02$). Kesimpulannya, kajian ini mencadangkan kedua-dua responden, tidak kira jururawat berdaftar ataupun pelajar kejururawatan sarjana muda (jururawat pada masa depan) mempunyai pengetahuan sel stem yang kekurangan yang penting untuk amalan harian di wad. Pengetahuan yang sederhana akan menjejaskan sikap penyampaian isu dan maklumat tentang sel stem. Oleh itu, penyelidik mencadangkan supaya kurikulum dan pendidikan kejururawatan dikaji dengan berterusan.

DECLARATION

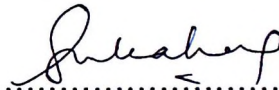
I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.



.....
Lye Jee Leng
Student of Degree of Bachelor Health Sciences (Nursing),
School of Health Science,
Health Campus,
Universiti Sains Malaysia,
16150 Kubang Kerian,
Kelantan
Date: 26 / 6 / 2013

CERTIFICATE

This is to certify that the dissertation entitles “Knowledge and Attitudes Level of Stem Cell among Registered Nurses and Undergraduate Nursing Students in Universiti Sains Malaysia (USM)” is the bonafide record of research work done by undergraduate nursing student Lye Jee Leng [Matrick No: 106513] during the period of 1st September 2012 to 30th April 2013 under our supervision. This thesis submitted in fulfillment for the degree of Bachelor of Health Sciences (Nursing). Every research work and collection of data belongs to Universiti Sains Malaysia.



Supervisor

Co-Supervisor

Dr. Tan Suat Cheng
Lecturer
School of Health Sciences
Health Campus
Universiti Sains Malaysia
16150 Kubang Kerian, Kelantan

Dr Soon Lean Keng
Senior Lecturer
School of Health Sciences
Health Campus
Universiti Sains Malaysia
16150 Kubang Kerian, Kelantan

Date: 25/6/2013

Date: 26/6/2013

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DEFINITION OF KEY TERMS

- Adult stem cells (ASCs) - ASCs are undifferentiated cells found in differentiated tissue or organs, and they have potential to renew themselves or to differentiate into major specialized cell types. The role of ASCs in the body is to maintain and repair the tissue in which they are found (Ministry of Health Malaysia, 2009).
- Attitude - Attitude is defined as a learned, enduring, and affective evaluation of an object that exerts a directive impact on social behaviour. The object can be a person, entity or an idea (Perloff, 2002).
- Bone marrow stem cells (BMSCs) - BMSCs originated from bone marrow. The bone marrow consists of two main stem cell types, mesenchymal and haematopoietic and it show a strong tendency for proliferation and multi-lineage differentiation (Tuli, Tuli, Nandi, Wang, Alexander, Haleem-Smith, Hozack, Manner, Danielson and Tuan, 2003).
- Embryonic stem cells (ESCs) - ESCs are derived from the inner cell mass of the blastocyst, which forms in the early stages of embryonic development, before implantation in the uterine wall. These cells can self-renew and are pluripotent (Kirschstein and Skirboll, 2001), meaning they have the ability to proliferate and can differentiate into a broad range of cell types (Shamblott, Axelman, Littlefield, Blumenthal, Huggins, Cui, Cheng and Gearhart, 2001).
- Knowledge - Knowledge is literally defined as facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject (Oxford, 2012). Knowledge is operationally defined as the level or degree of information acquired in a particular field. Knowledge is important because it is the basis on which positive changes in behaviour occur, bringing awareness which leads into action (Ndikom and Onibokun, 2007).
- Nursing student - According to Florence Nightingale, nursing is the art of utilizing the environment of the patient to assist him in his recovery while a nurse's responsibility is act as a caregiver, communicate with the client to identify the problem and help them to make modification in their

behavior and increase their quality of life (Berman, Synder, Kozier and Erb, 2007). Student on the other hand mean a person who is studying at a university or other place of higher education (Oxford, 2012). Thus student nurse can be defines as one who is studying at a university or other place of higher education leading to assist a patient in his or her recovery.

Registered Nurse
(RN)

A RN is defined as a person who has undergone a formal course of nursing education, whether degree or diploma and registered with the Malaysian Nursing Board. Nurses in Malaysia are divided into different grades, such as U29, U31 and U41. Grade U29 are held by diploma nurses. Grade U31 nurses are nurses who are trained in profession and are able to manage patient care holistically. Grade U41 on the other hand are degree holders. The RN's nursing practice includes respect and to provide good standard of nursing care towards patient (Rameela, 2004).

Stem cell

- It is a cell that can become established in an appropriate growing environment, has the ability to multiply, can produce cell types that continue to differentiate and renew itself or ensure the continuation of its own population and can regenerate tissue with functional damage (Dinc and Sahin, 2009).

Umbilical cord
blood stem cells
(UCBSCs)

- UCBSCs are derived from the umbilical cord blood and placenta. UCBSCs have properties similar with ESCs and hematopoietic cells, including low immunogenicity and differentiation capability (Yong, Wang and Theodore, 2006).

CHAPTER 1: INTRODUCTION

Recent developments in stem cell biology have explained a significant differentiation plasticity of both embryonic stem cells (ESCs) and adult stem cells (ASCs) in human tissue (Sadri, Mazhari, Sadri, Konjedi & Shah, 2011). Scientists are excited about the knowledge that could come from studying human stem cells. Most of them believe that these cells offer a precious opportunity to learn more about cytopathology, including how diseases develop and how they might be prevented or treated on the cellular level. Based on the extensive stem cell research findings, many scientists have claimed that the research could generate cures and treatment for everything from cardiovascular disease to cancer (Dresser, 2010), igniting hopes of achieving cell-based replacement therapy.

Due to the bright potential of stem cell-based treatment, the Ministry of Health in Malaysia recognizes that it is crucial for local scientists and clinicians to be involved in stem cell research provided that these conform to ethical guidelines. Thus, it is vital for health care provider to keep abreast of current advances in stem cell science, especially when there is an enormous potential of revolutionizing therapy in the form of cell replacement therapy (Ministry of Health Malaysia, 2009). It is proven when the health ministry is locating RM32 million to further develop and strengthen stem cell and blood bank activities (MCA, 2008). According to the Malaysia Ministry of Health, Yang Berhormat Dato Sri Liow Tiong Lai in his opening speech at the 1st National Stem Cell Congress 2012, the vision of the Malaysian Government to propel Malaysia to be in the forefront of regenerative medicine is wanting and there is a need to provide the necessary scientific evidence prior a cell product is introduced to patients in Malaysia. Therefore, as health care professional, must have

the knowledge about stem cells to provide the right information about stem cells to allow people to form their attitudes based on factual knowledge. This study investigates the knowledge and attitudes level of stem cells among Neonatal Intensive Care Units (NICUs) nurses and undergraduate nursing students in Universiti Sains Malaysia (USM).

1.1 Background of the Study

Stem cells are repair units of the body that serve a central function in the maintenance and regeneration of organs and tissues throughout an organism's lifetime. In the early 20th century, European researchers realized that the various type of blood cells included white blood cells, red blood cells and platelets, all came from a particular same progenitor/ancestor cell found in the adult bone marrow. This progenitor was later recognized as a 'hematopoietic stem cell' (Mazzarello, 1999). This stem cell is a type of adult stem cells (ASCs). ASCs derived mostly from umbilical cord blood and bone marrow, they have been used in research since the 1960s. ASCs also were found in other organs such as neural stem cells from the brain (Gritti, Vescovi and Galli, 2002), cardiac stem cells from the heart (Martinez and Kofidis, 2011) and mammary stem cells from mammary gland (Joshi, Di Grappa and Khokha, 2012). The main functions of these ASCs are to replenish dying cells and regenerate damaged tissues specific to the organ where they are found (Wagers and Weissman, 2004).

Continuous development in cell biology since the advent of microscope and biotechnology in the 1980's and 1990's had advanced doors to not only the ASC but also to many other human stem cell researches. For example, in 1998, James Thomas, a scientist from University of Wisconsin in Madison established the first

human embryonic stem cells (ESCs) research (Thomson, Itskovitz-Eldor, Shapiro, Waknits, Swiergirl, Marshall and Jones, 1998). ESCs are different from ASCs in which they are undifferentiated (Pera, Reubinoff and Trouson, 2000), meaning that they aren't programmed to be specific to the brain, the heart, the myoepithelial cell in mammary gland, or other bodily tissues, as the ASCs did. Therefore ESCs is considered by many scientists to be fundamental in developing diverse supply of tissues in treatment of a variety of disease such as acquired immunodeficiency syndrome (AIDS), diabetes, Parkinson's, Alzheimer's, spinal cord injuries and cardiovascular disease (Johnson, 2001), making this important scientific breakthrough a potential improve of the quality and length of life (De Back, 2001).

Nonetheless, ESCs research has been an issue of ethical, legal, and social controversy since the first isolation of human ESCs in the laboratory in 1998 (Nisbet, 2004; Robertson, 2010). The controversy has slowed the pace of stem cell science and shaped many aspects of its subsequent development. The oppositions believe that a human embryo is equivalent to a human life and that embryos deserve the same protections as human beings, thus destroying embryos would therefore be morally wrong, making them equivalent to murdering. Due to such issue, it would not be surprising to find that ESC research might be morally problematic for many respondents. In a research done by Matthew C. Nisbet during July 2001, 54% of respondents agreed that ESCs research was morally wrong, but among those same respondents an ambivalent majority said that although the research may be morally wrong, it might also still be necessary. By May 2002, the percentage regarding ESCs research as morally wrong decreased to 39% and later in May 2003, the percentage again decrease to 38% (Nisbet, 2004). In a recent study performed by National

Center for Science and Engineering Statistics (NCSES), 70% of the respondents favor the use of ESCs order to pursue a treatment for conditions such as Parkinson's Disease or a spinal cord injury (National Center for Science and Engineering Statistics, 2012).

Despite the opposition of ESC research is decreasing in accordance with the increase of understanding toward ESC research, there is a general afraid of using ESC in human research. This had led to the demand of alternative sources of stem cell which does not involve killing of embryo. Then in 1988, umbilical cord blood stem cell (UCBSC) was discovered. A child with Fanconi's anemia was successful treated using UCB transplant, even after 12 years, the patient was doing well (Gluckman, Broxmeyer, Auerbach, Friedman, Douglas, Devergie, Esperou, Thierry, Socie, Lehn, Cooper, English, Kurtzberg, Bard and Boyse, 2010). Since then, knowledge of the biologic characteristics of UCBSC has increased and simultaneously UCB banks have been established, with more than 30,000 units currently available and more than 1,500 UCB transplant being performed on those with malignant and non-malignant diseases (Rubinstein, Carrier, Scaradavou, Kurtzberg, Adamson, Migliaccio, Berkowitz, Cabbad, Dobrila, Taylor, Rosenfield and Steven, 1998). Unlike ESCs, UCBSCs is very much desirable due to the high proliferative potential, increased ability for self-renewal, decreased ability for antigen presentation and most importantly the safety and ethical free characteristics. Besides, UCBSCs are advantageous because they do not present these antigens that mark them as foreign and trigger an immune response, rejecting them (Ikuta, 2008). Even then, there is currently no public service in Malaysia that provides cord blood banking.

Even though there were many potential of stem cells application in medical field and also the social controversies arise from stem cell research, the media only started giving significant attention to this issue in America during the summer of 2001. Even then, only 20% of Americans reported following the issue either “very closely” or “fairly closely” related to them (Nisbet, Brossard and Kroepsch, 2003). Public knowledge on stem cell is pathetically poor (Hart, 2004), there is a public expectation that front line health care providers are expected to be competent not only in their skills but also in their knowledge. Early studies indicated that public with little or no information regarding disease or treatment generally rely on their health care provider (Siegrist and Cvetkovich, 2000; Siegrist, Cvetkovich and Roth, 2000) to provide information and decision for their treatment. Thus, stem cell knowledge and its association with medical application among nurses are important and could affect the decision in providing appropriate treatments to many diseases and cancers. However, little attention has been paid to describe the staff nurses and nursing students’ knowledge and attitude on stem cell and its medical application.

1.2 Problem Statement

Nurses are charged with a spectrum of duty, of which one of it is as an advocator by providing information to ensure patient gets the best option and treatment. For example, in 2008, the American College of Obstetricians and Gynecologists agreed that obstetricians have an ethical obligation to explain not only the pros but also the cons of a particular treatment option, and are obligated to suggest alternative treatment options, if available, to their patients (Fox, Chervenak and McCullough, 2008). Information given to patient must be balanced and accurate, so that decision can be made with facts and unbiased answers.

Nurses are a trusted source of information for most patients. A study done on improving health care providers' knowledge, attitudes and practice found that nurses who have higher level of knowledge and attitudes led to improved trust, better monitoring and better adherence to health guidelines (Himelfarb, 2004). Lack of stem cell knowledge among nurses poses a more difficult challenge to them to appropriately advocate stem cell-based treatment to their patients. Thus, nurses and nursing students should explore appropriate options for patients and also equipped themselves with expert knowledge of stem cell so that they are able to educate their patients about stem cell and its therapeutic potential (Abdullah, 2011). In addition, nurses need to equip themselves with accurate information based on the International Council of Nursing Code of Ethics for Nurses and their own ethical decision-making process, so that they are able to become important sources of information to help patients understand stem cell treatment (De Back, 2001; Yildirim and Sahin, 2007).

According, in the last few years, some studies have focused on this social behaviour in some North American, European and Asian countries investigating knowledge and attitudes about stem cells and cord blood banking among pregnant women and among parents (Screnci, Murgi, Pirre, Valente, Gesuiti, Corona and Girelli, 2012). It was noted during the literature review that no current papers from Malaysia was found for inclusion in the review, suggesting a need for more local research to determine the knowledge and attitude of Malaysian nurses and nursing students.

In order to contribute to the body of knowledge on this issue and help to address the gap in Malaysian research, the researcher has conducted a study among Hospital Universiti Sains Malaysia (HUSM) nurses and undergraduate nursing students in

Universiti Sains Malaysia (USM). Therefore the outcome of this study can help to address the issue of advocating nurses and also future nurses in providing the necessary information about stem cell in medical settings and also meeting the challenges associated with providing health education and advice to patients. The result of this study might able to serve as a basis to facilitate continuous education regarding stem cell and improve nursing practice as a whole in Malaysia.

To inform this research, the appropriate theory used is the theoretical concept: 'concept of knowledge and confidence level' by Michel Foucault which wrote that knowledge can be gained from power, and this will reach into the individual and insert into their actions and attitudes (Foucault, 1980).

1.3 Research Objective

The aim of this study was to investigate the knowledge and attitudes toward the application of stem cells in the medical setting among HUSM nurses and nursing students at USM.

1.3.1 Specific Objectives

- a. To determine the mean difference of knowledge scores related to the application of stem cells in medical setting among HUSM nurses and nursing students in USM.
- b. To determine the mean difference of attitude scores related to the application of stem cells in medical setting among HUSM nurses and nursing students in USM.
- c. To determine the correlation between knowledge scores of HUSM nurses and nursing students in USM with their education year(s)/employment years.

1.4 Research Questions

- a. What is the level of knowledge about stem cells among HUSM nurses?
- b. What is the level of knowledge about stem cells among nursing students in USM?
- c. What is the comparative knowledge about stem cells between HUSM nurses and nursing students in USM?
- d. What is the attitude towards the application of stem cells in the medical field among HUSM nurses?
- e. What is the attitude towards the application of stem cells in the medical field among nursing students?
- f. What is the comparative attitude of nurses and nursing students towards the use of stem cells in the medical field?
- g. What are the correlation between stem cell knowledge scores of nurses and their employment year(s).
- h. What are the correlation between stem cell knowledge scores of nursing students and their education year(s).

1.5 Research Hypothesis

- i. Ho: There is no significant mean difference of stem cell knowledge score between nurses and nursing students.
H_A: There is a significant mean difference of stem cell knowledge score between nurses and nursing students. ($H_0 \neq H_A$)
- ii. Ho: There is no significant mean difference of stem cell attitude score between nurses and nursing students.
H_A: There is a significant mean difference of stem cell attitude score between nurses and nursing students. ($H_0 \neq H_A$)

iii. Ho: There is no significant relation of stem cell knowledge score based on educational and employment years between nurse and nursing students.

H_A: There is a significant relation of stem cell knowledge score based on educational and employment years between nurses and nursing students. (H₀≠H_A)

1.6 Significance of the Study

The incidence of number of admission for in-patient in HUSM is increasing rampantly, recording from 35,954 patients in 2009 to 36,622 in 2010 (Hospital Universiti Sains Malaysia, 2009). The ratio of patient who came for follow up and new patient in 2009 was 11.6 while in 2010, it increased to 12.1 (Hospital Universiti Sains Malaysia, 2009). Even with the increase in patients and diseases, many current treatment methods for many diseases are ineffective and inadequate, thus driving the growing interest in stem cell-based therapy (Janowski, Bulte and Walczak, 2012). Even though allogeneic stem cell transplantation is now routinely and successfully practiced and worldwide applied for the treatment of haematological malignancies, there are still many nurses who know very little about the treatment, benefits and disadvantages of stem cell.

In Malaysia, nurses contribute a large population of the health care provider. Thus it is important for nurses and nursing students who are future nurses to be knowledgeable and competent to provide the highest quality of care in terms of treatment (Kirk, Cramm, Price, Penny, Jarvie and Power, 2009). To be confident in providing the appropriate advices and information to patient, it is imperative that nurses and nursing students to have the accurate knowledge of stem cells and its

application in medical field. Furthermore, it is important that the nurses are knowledgeable, as they are role models for their patients.

Since there is a public perception that nurses are expected to be competent in their skills, knowledge and be confident in providing professional health care services to patients, thus, knowledge on stem cells is needed. Therefore it is important for nurses to grasp fully regarding stem cell treatment and keep abreast on its latest updates when stem cell treatment is being fully introduced in Malaysia.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Review of literatures regarding a topic are necessary before conducting a research as it enables the researcher in reviewing and assessing the depth and breadth of available knowledge concerning the research problem (Haber and Wood, 1998). By doing literature review, this will enable the researcher to have a comprehensive understanding of the topic. Hence, making them aware of what is known and what yet to be known (Gorard, Roberts and Taylor, 2004). Thus, reaching the ultimate goal of research which is to develop, refine, and expand a body of knowledge in the particular topic of interest (Polit and Beck, 2004). The purpose of this literature review is to explore the research literature on the knowledge and attitude of stem cell knowledge among nurses and nursing students towards medical setting. This can be done by first exploring the types of stem cell and the importance of stem cell in medical setting.

2.2 Stem Cell

Stem cell is a population of primitive cell characterized by its remarkable and unique ability to self-renew and to differentiate into many cell types. These cells are able to self-propagate in a quiescent, undifferentiated state *in vivo* and this property is preserved throughout the lifetime of an organism (Henningson, Stanislaus and Gewirtz, 2003; Rajaraman, Guernsey, Rajaraman and Rajaraman, 2006). In addition, stem cell is a formative cell, whose daughter cells may give rise to other cell types (Mosby, 2009). It is characterized by its potency (potential to differentiate into different cell types) as either a totipotent, a pluripotent, or a multipotent cell. During human embryogenesis, a totipotent (from the Latin word *totens*, meaning having total

power) zygote is formed when a sperm fertilizes an egg. After several cell divisions, totipotent stem cell develops into three embryonic germ layers, namely endoderm, mesoderm and ectoderm which will later develop into all cell types found in adult body. After reaching the 16 cell stage, the totipotent cell will differentiate into either the blastocysts's outer trophoblasts or the inner cell mass. Outer trophoblasts will develop into placenta; whereas the inner cell mass will become the source of pluripotent (from the Latin word pluris, meaning several or many) stem cells. Pluripotent stem cells have limited differentiation potential compared to totipotent stem cells because these cells can give rise to all adult cell type except the placenta. An example of pluripotent stem cells is embryonic stem cells (ESCs). These pluripotent ESCs can give rise to multipotent stem cells.

Multipotent stem cells have the potential to give rise to multiple cell types, but their potency are tissue restricted. These cells exist within specialized tissue and are restricted to give rise to only cell types belonging to that tissue (Henningson *et al.*, 2003). An example of multipotent stem cell is hematopoietic stem cell (blood stem cell) that can develop into several types of blood cells, but can't develop into cells in other lineage, example: neuron, cardiomyocytes, adipocytes. At the end of multipotent stem cell division, the cells are terminally differentiated. The cells now are considered to be permanently committed to specific function. For example: erythrocyte (red blood cell) is to transport oxygen via cardiovascular system, lymphocyte (a type of white blood cells) play an important role in immune system while a cardiomyocytes is to contract to pump blood in or out from a heart.

Stem cell research have been going on for many years and according to Dresser, stem cell research is aimed at understanding and treating chronic disease of aging, such as heart disease and neurologic diseases (Dresser, 2010). In addition, stem cell hold great promises in curing many incurable diseases (Henningson *et al.*, 2003). Figure 2.1 illustrates the hierarchy of different types of stem cells based on their differentiation potential, starting from a totipotent stem cell (zygote) to various fully differentiated adult cells found in human body.

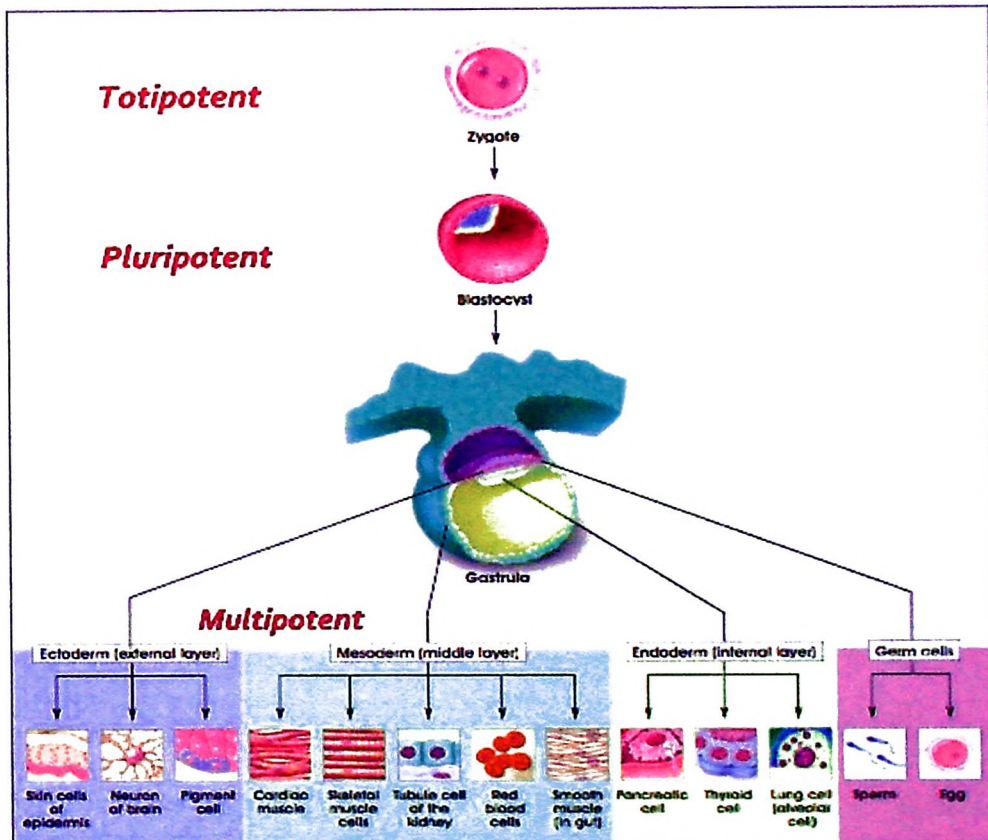


Figure 2.1: Stem cell hierarchy (Resource: Winslow and Duckwall, 2001)

2.2.1 Embryonic Stem Cell

ESCs are derived from the inner cell mass of the blastocyst, which forms in the early stage of embryonic development, approximately 4 – 5 days after fertilization and before implantation in the uterine wall. ESCs are pluripotent cells in which they are capable to self-renew or differentiate into cell types except placenta (Henningson *et*

al., 2003). Thus, this discovery has caused ESCs to be widely investigated for their potential to cure diseases by repairing or replacing damaged adult cells and tissues. One of the biggest advantages is that ESCs can be maintained for long period *in vitro* and it can be directed to differentiate into a broad type of important cell types including neuron (Joannides *et al.*, 2007), Purkinje cells (Muguruma, Nishiyama, Ono, Miyawaki, Mizuhara, Hori, Kakizuka, Obata, Yanagawa, Hirano and Sasai, 2010) and cardiomyocytes (McDevitt, Laflamme and Murry, 2005). In addition, studies in animal models have shown that transplantation of ESCs successfully treated many chronic diseases, such as Parkinson disease (Kim, Anuerbach, Rodriguez-Gomez, Velasco, Gavin, Lumelsky, Lee, Nguyen, Sanchez-Pernaute, Banklewlcz and McKay, 2002), diabetes (Guo and Hebrok, 2009), injury of the spinal cord (Zahra, Muzavir, Zafar, Khan and Ahmad, 2012), Purkinje cell degeneration, Duchenne muscular dystrophy (Meng, Muntoni and Morgan, 2011), liver or heart failure (Kobayashi, Miyazaki, Fukaya, Inoue, Sakaguchi, Uemura, Noguchi, Kondo, Tanaka and Namba, 2000) and osteogenesis imperfecta (Horwitz, Prockop, Fitzpatrick, Koo, Marx, Pyeeritz and Brenner, 1999).

Due to its potential to generate any cell type in the body, ESC is extremely attractive for studies in tissue repair. Nonetheless, recent study also indicates that this very same potential can also be problematic because a transplant with the presence of undifferentiated cells could result in the formation of teratomas (Yoshida and Yamanaka, 2010). Teratomas are composed of somatic differentiated tissues (Oosterhuis and Looijenga, 2005), which can make them either benign or malignant. Nussbaun *et al* (2007) discovered that transplantation of ESC into mouse heart triggered the formation of cardiac teratoma rather than new myocardium (Nussbaum,

Minami, Laflamme, Virag, Ware, Masino, Muskheli, Pabon, Reinecke and Murry, 2007).

In addition, despite of the great therapeutic potential of ESCs, many considered this research to be immoral, illegal and unnecessary (Young, 2000) because ESCs can only be obtained via the destruction of an embryo derived 3 – 5 days after implantation (Giacomini, Baylis and Robert, 2007). Many of the opposition of ESC research are firm religious and conservative elites whom beliefs that a human embryo is equivalent to a human life and that embryo are deserving of the same protections as other human beings. Thus, to destroy embryos would be morally wrong, essentially equivalent to murder (National Bioethics Advisory Committee, 1999). Due to the ethical issue, development of ESC research is greatly limited.

2.2.2 Adult Stem Cell

ACS is defined as an undifferentiated cell found among differentiated cells in a tissue or organ; it can renew itself and differentiate to yield the major specialized cell types of the tissue or organ (European Association for Bioindustries, 2003). ASCs, also known as somatic stem cells are generated from ESCs. During the development of the embryo, ASCs proliferate and their progeny undergo a process of progressive lineage restriction to finally generate the terminally differentiated cells that will form mature tissues. This differentiation process make them multipotent (Gritti, Vescovi and Galli, 2002), or tissue restricted. ASCs are often relatively slow proliferating cells compared to ESCs but they have the ability to resume proliferation activity to replace dead and/or injured cells (Fang, Alison, Wright and Poulson, 2004).

ASCs are localized in specific niches that are essential for them to develop and maintain their attributes, particularly the ability to self-renew. Some niches are clearly defined within their respective tissues and the stem cells residing there can be identified quite precisely by their morphology and spatial localization within the niche. For example, hepatocytes in the liver or neurocytes in the brain (Gritti *et al.*, 2002). Nevertheless, recent studies show that ASCs also have pluripotent properties. For example, ASCs derived from bone marrow, apart from differentiating into blood and immune cells, have been shown to be capable to transdifferentiate, or differentiating into cells of non-hematopoietic lineage, such as skeletal muscles, microglia and astroglia in the brain, and hepatocytes of the liver (Kirschstein and Skirboll, 2001).

2.2.3 Umbilical Cord Blood Stem Cell

UCBSC has been used recently as a source of stem cells to replicate the hematopoietic system and other organs (Bonde *et al.*, 2004; Ballen, 2005). In umbilical cord blood, there are two different stem cells, which are hematopoietic stem cells and mesenchymal stem cells. The majority of hematopoietic stem cells are found in the fetal circulation, therefore it is found in the placenta and umbilical cord. UCBSCs remain in the umbilical cord and placenta during post-delivery and an average of 120ml of blood can be collected (Rogers, 2004). UCBSCs have been a very potential therapeutic tool due to their abundant with global birth rate more than 200 millions per year (Mcguckin, Forraz, Baradez, Basford, Dickinson, Navran and Hartgerink, 2006). Besides that, the procedure to collect UCBSC is non-invasive and has no side effects on either mother or child (Watt and Conteras, 2005; Mcguckin *et al.*, 2006; Ballen *et al.*, 2008). Due to the UCBSCs is at the intermediate age stage

between ESCs and ASCs, this leads UCBSCs to a higher proliferating potential compared to ASCs (Slatter and Gennery, 2006). In addition, UCBSCs are more tolerant to human leukocyte antigen mismatches for lowering the graft-versus-host disease (Welte, Foeken, Gluckman and Navarrete, 2010), thus making UCBSCs expanding in the medical field, providing treatment for hematological malignancies such as leukemia, lymphomas (Wang, Zhan, Ouyang, Chen, Zhou and Yang, 2010) and neurological diseases and injuries (Mcguckin and Forraz, 2008). Therefore, due to the many advantages in UCBSCs, UCBSCs is favored compared to bone marrow stem cells. In addition, there are around 600,000 of umbilical cord blood have been banked and close to 20,000 of allogenic UCB transplants from related and unrelated donors have been done worldwide (Wagner and Gluckman, 2010). From these, we realize that UCBSC is getting more common in society nowadays due to the advantages thus it is a field that must not be neglected and knowledge about stem cells must be introduced in the medical setting.

2.3 Public Opinion about Stem Cell

Public are often assumed to be ignorant of the complexities of scientific research, they are also often assumed to be unaware of the science product commercialization process (Millstone and van Zwanenberg, 2000; van Gend, 2002). For an example, in February 2002, a survey was done by Nisbet (2004) tested on the understanding of the American public's knowledge regarding stem cell and it was reported that only 27% of respondent came across or heard about stem cell. However, in September 2002, 46% of respondent responded that they have heard little or nothing at all about stem cell (Nisbet, 2004). In addition, according to a report released by the University of Michigan C. S. Mott Children's Hospital National Poll on Children's health which

was done in August 2008, only 11 % know a lot about stem cell research (Hopson, 2008).

Patients, which also represent the public, have very little reliable data on which to assess stem cell interventions when it comes to medical application, an example will be whether a mother should keep their children's UCBSC for future use. This constraint forcing patients to turn to media coverage, patient self-reports and other information sources which are not well-suited for this task (Levine, 2010). Some of the patients might turn to their health care provider such as the nurses who are trusted source of information (Abdullah, 2011), yet nurses' view of these interventions are not well understood neither (Levine, 2010).

2.4 Importance of Stem Cell Understanding among Nurses

Understanding stem cell is important for efforts that are designed to alleviate the risk it poses to both individual patients and the broader research field. Recent studies show that both patients and health provider know little about the cells transplanted during stem cell treatments and the possibility exists that some providers are not using stem cells at all but using multiple cell from sheep, shark or rabbit cells (Lau, Ogbogu, Taylor, Stafinski, Menon and Caulfield, 2008). Darren Lau *et al* (2008), Alan Regenberg *et al* (2009) and Siegrist *et al* (2000) have consistently found evidence that an uninformed public do in fact generalize their trust towards scientific institutions (Siegrist, 2000; Siegrist and Cvetkovich, 2000; Siegrist *et al.*, 2000; Lau *et al.*, 2008). Their research suggests that support for new technologies is strongly associated with "the willingness to rely on those who have the responsibility for making decisions and taking actions relate to the management of technology, the

environment, medicine, or other realms of public health and safety” (Siegrist *et al.*, 2000). Furthermore Siegrist’s research has consistently found that if an individual trusts the organizations associated with a particular technology, they will be more likely to believe that the perceived outcomes of the technology will be beneficial rather than detrimental, and in turn, report increasing support (Siegrist, 2000; Siegrist and Cvetkovich, 2000; Siegrist *et al.*, 2000).

From the literature review, studies have found that nurses are trusted for stem cell information. Public is generally poor in knowledge and have to depend on health professionals such as nurses to communicate this knowledge to them. Not only that, nurses are frontline health care workers and are also the people who will spend more time and are the first contact person with the patients. In addition, nurses are the caregiver, communicator, teacher, counselor and patient advocates (Berman *et al.*, 2008) in terms of knowledge. Nurses are frontline health care workers who play a vital role in shaping patient’s knowledge and attitudes regarding diseases and also recent advancement of medical treatment. Besides that, nurses’ attitude towards stem cell are crucial in advocating patients regarding stem cell application in medical field. Once nurses are armed with expert knowledge of this subject, they will be equipped to teach patients about stem cells, which include the advantages and disadvantages of different types of stem cell.

Despite nurses are generally trusted to be able to provide information on stem cell, there is still lack of knowledge of stem cell and its medical application among nurses (Bevans, Bruch, Burgunder, Castro, Ford, Miller, Rome, Tierney and Schmit-Pokorny, 2012). In Malaysia, there is no full understanding of knowledge and

attitude of stem cell among registered nurses and student nurses. Therefore in this study, the researcher proposes to initiate a survey regarding the knowledge and attitudes of registered nurses and nursing students in Malaysia, beginning from a tertiary teaching hospital, USM.

2.5 Conceptual Framework: Foucault's Concept of Power-Knowledge

In this research, Michael Foucault's (2006) concept of power-knowledge was used as the conceptual framework. Foucault provided the macro lens, by allowing the researcher to situate the knowledge and attitudes level of nurses and nursing students within the larger considerations of power-knowledge. He claimed that there is no power relation without a correlative filled of neither knowledge, nor any knowledge that does not presuppose and constitute at the same time, power relations (Foucault, 1998).

The conceptual framework of Foucault was chosen in this study because it can help in illuminating and providing further understanding of the research questions in this study, that is 'knowledge and attitudes level' on stem cells and its application in medical setting. In medical application of stem cell such as UCBSC transplantation, each health care provider, especially front line health care professionals such as nurses must have knowledge about stem cells. Michael Foucault believed in the freedom of people. He also realized that as individuals, they react to situations in different ways.

According to Foucault, knowledge confers power, in which power "reaches into the very grain of individuals, touches their bodies and insert itself into their actions and

attitudes, their discourses, learning process and everyday lives” (Foucault, 1980). The conceptual concepts are presented to support the knowledge and attitudes level of the nurses and nursing students relating to application of stem cell in medical setting. In this study, the knowledge and attitudes level are the concepts under investigation. It is in this framework where the research problem under study was evolve. The concepts are presented to support the knowledge and attitudes level of the nurses and nursing students regarding stem cells and its application in medical setting. The French philosopher Michael Foucault (1962 – 1984) argued that society grants power for people who possess specialized; that is knowledge confers power. For Foucault, power and knowledge are synonymous; where power is exercised, knowledge and confidence in communicating accurate information is created. Taking charge of this knowledge reinforces power, securing the continuation of exercising power and confidence, and attitude leading to more knowledge, confidence and so on (Perron, Fluent and Holmes, 2005). Thus, determining the knowledge and attitude level of the nurses and nursing students, the future front line health care professionals is deemed important to see the relationship between concepts relating to stem cells and its application in medical setting.

This conceptual framework of power-knowledge by Michael Foulcault was used by Lai (2011), with the topic ‘Midwives’ and nurses’ knowledge and confidence level in relation to obesity and adiponectin in early pregnancy in HUSM: a comparative study”. It was found that the advantages of this conceptual framework was that it drew attention to the benefits of power and it helped researcher to see the changes in the practices and thereby changing ones approach (Mayo, 2000).

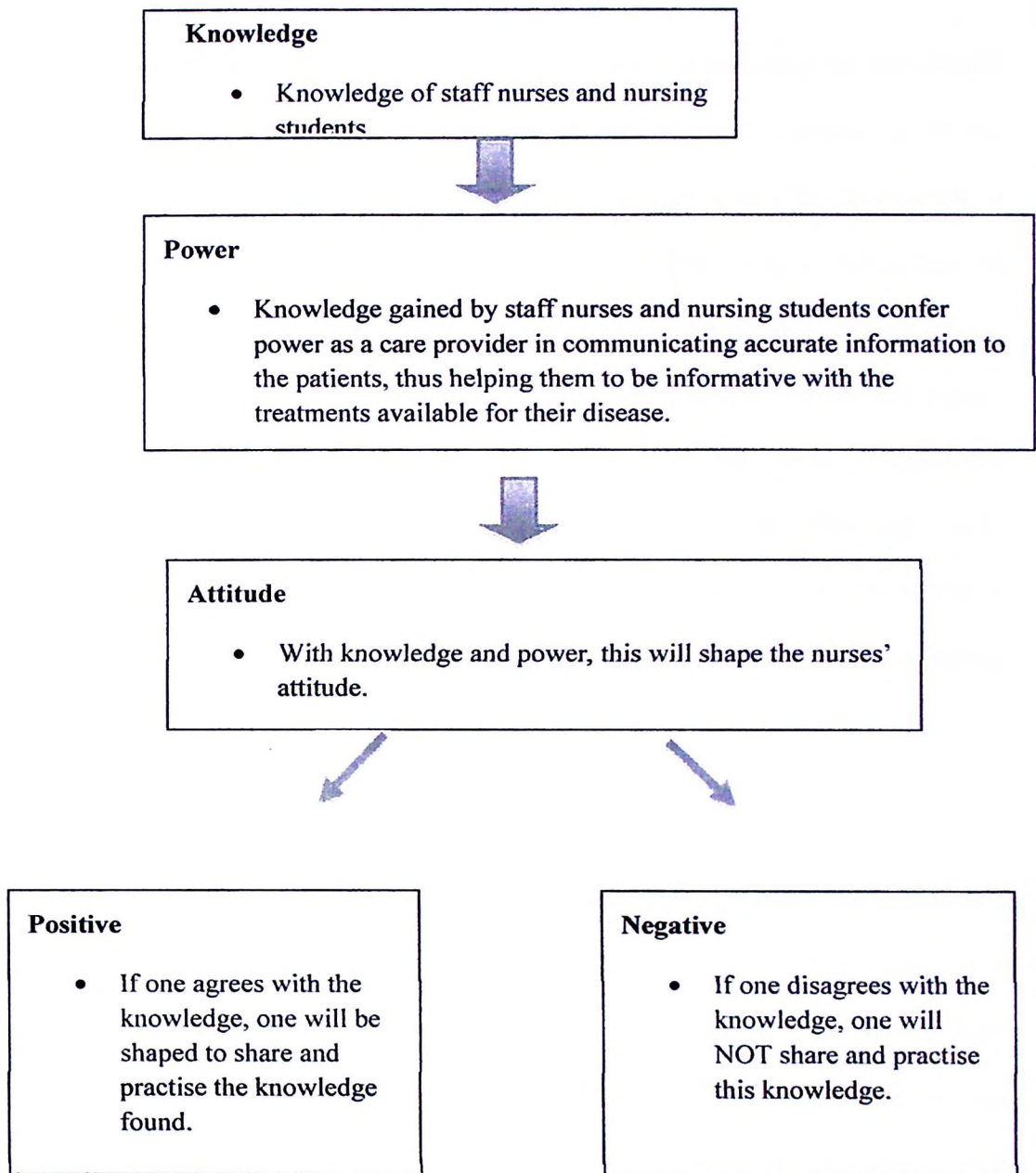


Figure 2.5: Concept of Power-Knowledge by Michael Foucault

CHAPTER 3 METHODOLOGY & METHODS

3.1 Research Design

This was a cross-sectional descriptive study focused on investigating the knowledge and attitude level of nurses in Neonatal Ward and Obstetrics and Gynecology Ward; including undergraduate nursing students in USM towards stem cell application in medical setting. A cross-sectional descriptive study collects detail description of existing variables to investigate and justify current conditions and practices, particularly when little is known about the phenomenon (LoBiodo-Wood and Haber, 2002). The design was relatively quick to carry out as these respondents (undergraduate nursing students in USM or registered nurses in HUSM) used a self-administered structured questionnaire once only. The descriptive research aimed to describe the characteristics of individuals or groups and to identify the relationship among the variables.

3.2 Population and Setting

The aim of this study was to determine the knowledge and attitude of nurses and nursing students towards the application of stem cells in USM. A population is defined as “all the inhabitants of a given country or area considered together” (Young, 2004). The area can be a region within a nation, a local area within a state such as a city, town or a neighbourhood. For the purpose of this study, both undergraduate nursing students in USM and registered nurses working and posted in HUSM clinical units such as Neonatal Ward (Neonatal Intensive Care Unit and Nursery) and Maternity Units (Antenatal ward, Postnatal ward, Labor Room and Obstetrics and Gynecology Clinic) was recruited in this study because their job

requires them to not only have regular and first contact with patients but also offer care and health teaching regarding umbilical cord blood stem cell (UCBSC).

3.3 Sample Plan

The samples in this study were the USM undergraduate nursing students and registered nurses (RNs) working in the Neonatal and Maternity Units, HUSM.

3.3.1 Sample

Certain inclusion and exclusion criteria were being applied when conducting this research:

Inclusion criteria

Participants were eligible for inclusion in the study if they:

- were RN working in the Maternity Unit or Neonatal unit for more than 1 year (Antenatal ward, Postnatal ward, Labor room, Obstetrics and Gynecology Clinic, NICU and 1 Nilam)
- were 2nd, 3rd and 4th year undergraduate student nurse studying in USM.
- gave informed consent to be involved in the study.

Exclusion criteria

Participants were excluded from the study if they:

- were registered nurse (RN) who work in areas other than the Maternity and Neonatal Units, HUSM.
- were 1st year undergraduate student nurse who haven't enter clinical years.