

Development of an Interprofessional ECMO Education Curriculum for Registered Nurse
and Respiratory Therapist Maintained ECMO at Providence Healthcare

by

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BSN, University of Victoria, 1997

A Project Submitted in Partial Fulfillment of the
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Supervisory Committee

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Dr. Joan MacNeil RN, MSN, PhD, Associate Professor, School of Nursing
Supervisor

Dr. Rosalie Starzomski RN, BN, MN, PhD, Professor, School of Nursing, Associate
Director for Research and Scholarship
Project Committee Member

Abstract

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As a result of the national and international shortage of cardiovascular perfusionists, members of the critical care program at Providence Healthcare want to pursue the implementation of an interprofessional extracorporeal membrane oxygenation (ECMO) education program for registered nurses (RNs) and respiratory therapists (RTs). My original intent in this project was to develop the curriculum for the in-house interprofessional ECMO program for RNs and RTs based upon the vision of the stakeholders. However, due to findings in the curriculum development process, my aim changed to that of developing a curriculum with another facility that currently conducts interprofessional ECMO education. The goal for the curriculum remained unchanged—for RNs and RTs to participate in and successfully complete the ECMO education so that they could develop the cognitive, affective, and psychomotor skills needed to collaboratively, safely, and competently maintain ECMO on adult patients in the intensive care unit (ICU). Achieving this goal would lessen the effects of the perfusionist shortage, meet the desire for interprofessional education in the ICU, strengthen collaboration, and possibly create the capacity to expand services provided to patients including bridging to transplantation. In this paper, I outline the process I followed in developing the curriculum. I clearly identify the problem, perform a general and targeted needs assessment, establish goals and objectives, identify philosophical and theoretical

underpinnings, and develop a plan for implementation. Unfortunately, due to significant unresolved social and political issues, at this time, implementation of the curriculum is not feasible.

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Dedication

To:

my husband Chad

my three children Conlin, Carver, Caitlin

and my parents Larry and Brigitte Hunt

*You were my strength when I was weak
You were my voice when I couldn't speak
You were my eyes when I couldn't see
You saw the best there was in me
Lifted me up when I couldn't reach
You gave me faith 'coz you believed
I'm everything I am
Because you loved me*

~ An excerpt from Céline Dion's song "Because You Loved Me" (Warren, 1996)

Many people recognize that it takes a great deal of time, effort, and sacrifice on the part of an individual to complete a master's program – which is true. However, what many people do not readily see is the amount of sacrifice families of graduate students undergo as well. Over the past 2 years you have all made sacrifices to make this possible for me, and I want to take this opportunity to say THANK YOU! I could not have accomplished this without your love, support, and encouragement.

Development of an Interprofessional ECMO Education Curriculum for Registered Nurse
and Respiratory Therapist maintained ECMO at Providence Healthcare

Extracorporeal membrane oxygenation (ECMO) is a treatment that uses devices and technology outside the patient's body to provide cardiac and respiratory support to critically ill patients whose heart, lungs, or both have been severely damaged due to disease or cannot currently serve their function optimally due to trauma. (For a more detailed explanation of ECMO, including types of ECMO and indications for ECMO please see Appendix A.) At Providence Health Care (PHC), the set-up, monitoring, maintenance, and discontinuation of ECMO are exclusively performed by cardiovascular perfusionists. Perfusionists are specialized healthcare professionals who have undergone extensive and specialized education and training related to conducting cardiopulmonary bypass and other forms of life support using technology such as heart-lung bypass machines (including ECMO), ventricular assist devices, and intra-aortic balloon pumps. The challenge, however, is that there is an international and national shortage of perfusionists, which results in treatment delays for critically ill patients. To help ease this shortage, some healthcare organizations in Europe, the United States, and Canada have provided other health care providers, such as registered nurses (RNs) or respiratory therapists (RTs), with limited specialized education and training related only to ECMO. Members of the critical care program at PHC have expressed great interest in pursuing the education and training of RNs and RTs to maintain ECMO.

As a clinical nurse educator and former intensive care unit (ICU) nurse (and hopefully a future critical care clinical nurse specialist), I took great interest in the idea of an RN- and RT-maintained ECMO education program. As a graduate student, I

suggested to the ICU physicians and Regional Director of the Cardiac Program that I develop the ECMO curriculum. Although I have no experience in curriculum development, the physicians and administrators permitted me to pursue this project. Hence my intent for this project was to develop, as per the stakeholders' vision, an intentional prescriptive and descriptive educational curriculum for an in-house RN- and RT-maintained ECMO program. The goal of the program being for RNs and RTs to participate in and successfully complete the ECMO education so that they develop the cognitive, affective, and psychomotor skills needed to collaboratively, safely, and competently maintain ECMO on adult patients in the ICU. However, after I had carried out the assessment portions of the curriculum development process, it was clear to me that an in-house ECMO education program would not be advisable. Although I found this disappointing, this was not the end of the curriculum project.

In the following pages, I provide some background about the local, international, and national perfusion shortage, as well as information about PHC. I then outline the curriculum development process I undertook for this project, and lastly, I reveal the RN and RT education program curriculum I was able to develop for PHC, including the philosophical and theoretical underpinnings of the curriculum.

Statement of Problem – The Perfusionist Shortage

As previously mentioned, at PHC, the Department of Perfusion provides the services to initiate, maintain, monitor, and discontinue ECMO. This requires a perfusionist to always be in attendance at the patient's bedside for the duration of ECMO therapy, a second perfusionist must be in-house (i.e., at the hospital) to provide relief or back up, and a third perfusionist must be on-call (i.e., at home) in case of emergencies.

In 2011, the PHC Department of Perfusion oversaw 33 cases of ECMO. As dedicated and hardworking as the perfusionists are, there exists a shortage of qualified staff. As a result, initiation of ECMO treatment at PHC can be delayed or the open-heart surgery program is placed on diversion resulting in delays in treatment for that patient population.

According to the Canadian Society of Clinical Perfusion's (2012) list of certified perfusionists, Canada currently has only 264 certified perfusionists, 38 of whom are employed in five perfusion departments throughout British Columbia (BC), with nine perfusionists at PHC. These may seem like adequate numbers, yet when one takes into consideration that one single case of ECMO requires three perfusionists around the clock for what could be days or weeks, it becomes evident that a critical shortage exists, and it is in fact predicted to get worse. The Provincial Health Service Authority, a branch of the BC Ministry of Health, reported in 2008 that the caseload in BC would continue to increase with an estimated caseload of over 4,500 in the year 2015, further indicating a need for more perfusionists (Edgell, 2008). What caused this shortage? The local, national, and international perfusion shortage is an ongoing problem that has been attributed to limited education and training programs, as well as recruitment and retention challenges (Bandali, 2008; Bui, Hodge, Schakelford, & Acsell, 2010; Hutton & Coolican, 2010; Merkle, 2006; Plunkett, 1993; Sistino, 2003; Stanton, 1992; Toomasian, Searles, & Kurusz, 2003).

Limited Perfusion Education and Training Programs

Within Canada, there are only three perfusion education or training programs (British Columbia Institute of Technology, Michener Institute, and the Université de Montréal), one of which is only accessible to French-speaking residents of Québec. To

compound this problem further, each program only offers limited seats in each program on a reduced frequency—on average, 12 students every 2 years. The limited number of training programs is not just restricted to Canada; as Bandali (2008) pointed out, in the United States (US), “perfusion schools decreased in the US by 50%” (p. 3) by the late 1990s. This decrease in the number of schools in the US will result in only a total capacity of 166 students per year, with only 124 graduates for 2008 (Edgell, 2008).

Recruitment and Retention Challenges

Recruitment and retention challenges are primarily related to heavy workloads, increased caseloads, excessive job demands; excessive amounts of overtime (over 300 hours per year); on-call duties; and decreased quality of life or poor work-life balance (Bui et al., 2010).

Bandali (2008) also states that increased career opportunities and wages within the professions of nursing and respiratory therapy have contributed to the reduced recruitment of RNs and RTs to the perfusion profession.

To lessen the effects of the perfusionist shortage, such as decreased availability of care to patients, the ICU and administration at PHC are extremely interested in the implementation of an RN- and RT-maintained ECMO program. Such programs have been successfully implemented and sustained for decades in Europe, the US, and Canada in neonatal and pediatric critical care patient populations. There has also been success over the last decade in Europe and the US with RN- and RT-maintained ECMO in the adult critical care population. In fact, Freeman, Nault, Mowry, and Baldrige (2012) examined the results of a 2007 survey of ECMO facilities and found most ECMO team

are comprised of RNs (84%) and RTs (71%), while perfusionists only accounted for only 32% of the team.

One often-voiced concern about implementing RN- and RT-maintained ECMO is the risk of increased rates of adverse events such as increased infection rates and treatment complications. Evidence does not support this argument. For example, Freeman et al. (2012) recently published an account of a successful implementation of an RN-maintained ECMO program in an adult patient population in the Cardiovascular ICU at the University of Michigan Health Care System. Freeman et al. reported a total of 24 patients were managed for 154 days with no sentinel, adverse events, or ECMO complications. Thirteen patients survived to discharge, which is unchanged from pre-RN ECMO measures at the facility (Freeman et al., 2012). Freeman et al. noted that not only were there no increased rates of adverse events, but the RN-maintained ECMO model also allowed for expanded services to be provided to patients including bridging to transplantation. Significantly, the RN-maintained ECMO program not only met patient demand while maintaining quality and safety, it also helped to provide further capacity for patient care. The RN- and RT-maintained ECMO model is innovative and would certainly help PHC meet patients' needs. This care model would also foster interprofessional education, collaboration, research, and may possibly allow for expansion of services and treatment options that PHC could provide to patients—all of which are foci of the PHC mission, vision, values, and strategic directions (Providence Health Care, 2012a, 2012d). In the following section, I provide background information on PHC.

Providence Healthcare – A Bit of Background

The beginnings of PHC stretch back more than a century to 1890 when the Sisters of Providence opened St. Paul’s Hospital, which at the time was a 25-bed infirmary in a house in English Bay, Vancouver, BC (Providence Health Care, 2012c). Since that time, PHC has undergone many changes and much growth. At present, PHC is comprised of 16 sites around Vancouver and there are 1,000 physicians and over 6,000 employed staff (Providence Health Care, 2012e), making it one of the largest faith-based health care organizations in Canada. PHC provides care and health services to patients and residents both from the Lower Mainland and the rest of BC in partnership with Vancouver Coastal Health, the Provincial Health Services Authority, and the University of British Columbia. PHC is the centre of excellence for people with heart disease, lung disease, kidney disease, mental health illnesses, HIV/AIDS, and drug- and alcohol-related issues (Providence Health Care, 2012b). PHC also provides specialized care to critically ill pregnant women and prenatal and maternal care for high-risk cardiac patients including post heart transplant.

The mission, vision, and values of PHC (2012a) foster a culture of compassion, social justice, exceptional care, and innovation, which are clearly identifiable within the aims of the five organizational strategic directions and three foundation strategies (Providence Health Care, 2012d). For example, under the strategic direction for innovation PHC (2012d) stated, “We will transform the health of the populations we serve through the generation, implementation, and spread of new ideas and solutions that add value” (Overview section, para. 5), and under the strategic direction for people PHC stated, “We will foster communities where people thrive” (Overview section, para. 6).

The entire PHC mission, vision, and values statements as well as the organizational strategic directions and foundation strategies are available for review in Appendix B (see also Providence Health Care, 2012a, 2012d).

Alongside PHC's (2012d) strategic directions, which focus on exceptional care, compassion, and innovation, are the foundational directions that focus on interprofessional education and collaboration. Although collaborative practices have been evident for many years in PHC's critical care areas (e.g., interdisciplinary rounds, effective teamwork, and open communication), there are few opportunities for interprofessional education, yet there is a desire for it. In my conversations with ICU administrators, leaders, physicians, RNs, and RTs, all expressed a keen interest in and support for interprofessional education. The development of an interprofessional ECMO education curriculum for an RN- and RT-maintained ECMO would certainly provide an opportunity to integrate interprofessional education within the ICU.

Aim of the Project

Although there is great interest and support for an RN- and RT-maintained ECMO at PHC, there is currently no educational program. Hence my aim in this project, as mentioned previously, was to develop an intentional prescriptive and descriptive educational curriculum for an in-house RN- and RT-maintained ECMO based upon the vision of the stakeholders. The goal for the curriculum is for RNs and RTs to participate in and successfully complete the ECMO education so that they can develop the cognitive, affective, and psychomotor skills needed to collaboratively, safely, and competently maintain ECMO on adult patients in the ICU. Achieving this goal would lessen the effects of the perfusionist shortage, meet the desire for interprofessional education in the

ICU, strengthen collaboration, and possibly create the capacity to expand services provided to patients including bridging to transplantation.

In the following sections, I present the process I undertook in developing the curriculum, identify the philosophical and theoretical underpinnings for the curriculum, and then finally divulge the PHC RN- and RT-maintained education curriculum I developed.

Curriculum Development

Curriculum development is the creative, nonlinear, iterative process of developing and introducing a unified and meaningful curriculum that provides learners with the opportunities to develop knowledge and skill so that they are capable of functioning within society, the “real world,” a particular environment, or a chosen profession. The process of curriculum development includes the following tasks:

- determine the need for the curriculum;
- identify the stakeholders and gain their support;
- organize for curriculum development by securing resources, including faculty development;
- gather data about internal and external contextual factors that may influence the curriculum (i.e., professional standards, organizational mission, technology, politics, etc.);
- identify the philosophical approach;
- establish the purpose, goals, and outcomes of the curriculum;
- ensure the philosophical approach matches desired learning experience, context, and content;

- design the curriculum;
- plan implementation;
- determine the evaluation process and methods;
- implement the curriculum;
- evaluate the curriculum;
- refine the curriculum as needed; and
- reevaluate the curriculum on an ongoing basis (Iwasiw, Goldenberg, & Andrusyszyn, 2009; Kern, Thomas, & Hughes, 2009).

The Six-Step Approach to Curriculum Development

There are many models that can be employed for curriculum development, but I chose to use Kern et al.'s (2009) six-step approach to curriculum development for medical education. Developed over 21 years ago at Johns Hopkins University, this model has been used extensively by health care educators and faculty throughout the world, including North America, Europe, China, and Japan. The intent of the model is to “provide a practical, theoretically sound approach” (Kern et al., 2009, p. 1) to curriculum development. Although developed for medical education, this model can and has been applied successfully to other programs and disciplines (Kern et al., 2009). Besides being flexible and adaptable to numerous audiences, this model is very simple in design. I was attracted to Kern et al.'s approach because of their simple format of six steps, which include problem identification and general needs assessment; targeted needs assessment; goals and objectives; educational strategies; implementation, and evaluation and feedback. To me, these six steps are reminiscent of the nursing process of assessment,

data and/or diagnosis, plan, implementation, and evaluation, which I am familiar with and proficient at using.

Developing a curriculum is much like developing a care plan for a patient. First, one seeks to clearly identify the problem through asking questions and reviewing data. Then one can formulate a plan that clearly defines the goals to be achieved and outlines the means by which the goals are to be achieved. Next, one can implement the plan and evaluate whether the plan was effective and the goals were achieved. Below I describe the process of building the PHC ECMO curriculum for an RN- and RT-maintained ECMO.

The Process of Building of the PHC ECMO Curriculum

As the process of curriculum development progressed, I found that I continuously had to remind myself of the direction, goals, and objective of the curriculum. To help me stay on track I developed a mind map, which can be viewed in Appendix C.

Step 1: Problem Identification and General Needs Assessment

This first step of the process is to clearly identify and define a problem that needs to be addressed in the clinical practice setting. As stated earlier, my intent for this project was to develop a curriculum, in consultation with the PHC stakeholders, to provide the RNs and RTs with the cognitive, affective, and psychomotor skills needed to collaboratively, safely, and competently maintain ECMO on adults patients in the ICU, thereby lessening the impact of the perfusionist shortage.

As I was not experienced in curriculum development, nor was I familiar with ECMO, the first action I took was to thoroughly review these subjects. To accomplish this, I attended workshops on curriculum development, engaged in curriculum

development discussions with the Practice Lead of the Education Department at PHC, attended an ECMO conference and 2-day education event, watched videos of ECMO, spoke with healthcare providers who perform ECMO, and read extensively on both the subjects of ECMO and curriculum development.

Once comfortable with these two subjects, I then set out to clearly identify the problem and perform a general needs assessment. In undertaking this, I spent several weeks engaging in conversation with stakeholders, including ICU physicians, the ICU Director, the ICU Operations Leader, one of the five ICU Clinical Nurse Leaders, the ICU Clinical Nurse Educator, the Regional Director of the Cardiac Program, the Clinical Practice Lead for Respiratory Services, and several ICU RNs and RTs, discussing ECMO, interprofessional education, and an RN and RT education program for ECMO at PHC. Prior to each conversation with these stakeholders I prepared a list of questions that I would use as prompts during the discussions. Please see Appendix D for the list of the questions I asked stakeholders in regards to an interprofessional ECMO education program at PHC.

Stakeholders clearly identified that the shortage of perfusionists impacted services available to patients being cared for at PHC. I was able to further support this with routinely gathered hospital statistics, such as number of ECMO cases per year, number of ventricular assist devices per year, number of balloon pumps per year, number of open heart surgeries per year, and amount of overtime for the Department of Perfusion per year. Further to this, ICU physicians and administrators, both ICU and organizational, expressed great interest in pursuing the development of an in-house interprofessional education program that would provide the necessary education and training for RNs and

RTs to be able to maintain ECMO. The majority of the stakeholders were supportive of an RN and RT ECMO education program, expressing that interprofessional education was very much wanted. Some stakeholders voiced some concern about implementing an RN and RT ECMO program and affirmed that all the necessary standards, protocols, guidelines and education needed to be completed well in advance of any RN or RT maintaining ECMO in the ICU. This concern was based upon a recent event where Novalung Interventional Lung Assist device, an external membrane ventilator driven by a patient's own heart function that allows for oxygen and carbon dioxide exchange to occur by simple diffusion, was initiated on a patient without staff being consulted or receiving education, and without any standards, protocols, and policies in place. Stakeholders also expressed concern over an increased rate of moral distress amongst staff maintaining ECMO. During the conversations, I was able to ease some of the concern by sharing that the physician group had already developed ECMO standards, policies, and protocols that were based upon the Extracorporeal Life Support Organization's (2010) guidelines.

At this point in the process I was unable to hold discussions with one major stakeholder group—the perfusionists. This was not an oversight on my part, as I believe strongly in the need for their input and participation. However, administrators instructed me, at this point, not to interact with the perfusionists due to the many social and political issues that needed to be addressed and resolved at a higher administrative level. Once the social and political issues are resolved, the administration will then bring all the stakeholders together. I found not engaging with the perfusionists to be very challenging, as I had many unanswered questions about ECMO at PHC (including choice of equipment), and I wanted to understand their perspectives, learn what their vision of an

RN- and RT- maintained ECMO program might look like, and determine their level of commitment for the RN and RT curriculum. Nonetheless, I proceeded as best as possible with the information that I had gathered.

Step 2: Targeted Needs Assessment

This step involves examining all the internal and external forces, circumstances and situations that must be taken into consideration when planning a curriculum. In performing this step, I was astounded by the amount of time it took to accomplish a needs assessment, and I was astonished by the sheer volume of information I had collected. I had spent weeks gathering information in regards to the internal and external factors, which are depicted in Figure 1.

Internal	External
<ul style="list-style-type: none"> • The PHC's mission, vision, values, strategic directions, • ICU's and organization's physical infrastructure • Human resources: number of RNs, RTs, and perfusionists employed at PHC, hourly income of each, etc. • Financial resources needed and available • Physical resources and equipment needed and available • Resources available to support teaching and learning • Faculty development that would be needed • Social and political considerations 	<ul style="list-style-type: none"> • Needs of the community • Requirements of governing bodies, legislation, associations, etc.: educational and training requirements for each profession/discipline; scope of practice profession/discipline; standards of practice for each profession/discipline • Resources available to support teaching and learning

Figure 1. Internal and external factors gathered when conducting the needs assessment for developing RN and RT ECMO curriculum.

As a result of conducting the general and targeted needs assessment, it became evident that there were too many barriers or obstacles impeding the development and implementation of an in-house ECMO education program, including a lack of physical space to conduct the education, lack of dedicated equipment, limited faculty expertise to

facilitate ECMO education and interprofessional education, limited financial resources, and significant unresolved social and political issues.

Despite this disappointing conclusion, all was not lost in the pursuit of an RN and RT ECMO curriculum. Through the general and targeted needs assessment, I had also investigated what other ECMO education programs currently exist in BC. I learned that BC Children's Hospital (BCCH) has an Extracorporeal Life Support Organization accredited interprofessional ECMO education program. As I wanted to learn more about the program, I met with the BCCH's ECMO program director. Through our discussion I learned that BCCH has dedicated equipment, classroom space, and an ECMO simulation lab; I also learned that developing a collaborative education relationship would be possible, as BCCH routinely collaborates with other facilities in Canada and the US to provide ECMO education and training.

Therefore, based on all my findings in the general and targeted needs assessment, the direction of the curriculum development could be altered from being an in-house program to being a collaborative program with BCCH. When I presented my findings to the ICU physicians and administrators, they were initially disappointed that PHC would not be able to develop its own in-house ECMO education program; however, they were enthusiastic about and supportive of pursuing a collaborative education relationship with BCCH. This leads to the next step of setting goals and objectives.

Step 3: Goals and Objectives

The title of this step is a bit misleading in that it would seem to infer that it is a simple matter of identifying what it is one is working toward, but there is so much more that is part of this step than just setting the end goals and objectives. This step includes

identifying the philosophical and theoretical underpinnings of the curriculum, as well as determining the core competencies of the curriculum, and formulating competency statements. Outlined below are the philosophical and theoretical underpinnings for the RN- and RT-maintained ECMO curriculum. For the core competencies and competency statements please refer to Appendix E.

Philosophical approach. A philosophical approach to education and curriculum development consists of the answers to the following questions: What is knowledge? How does one come to know? How does an individual learn? What is the role of the teacher and the learner in learning? What is the purpose of the educational program, courses, and material? What teaching strategies are to be used? These questions were derived from the following academic works: Airasian and Walsh (1997), Iwasiw et al. (2009), Ornstein (1990), and Young and Paterson (2007). Idealism, realism, essentialism, constructionism, and constructivism are a few examples of philosophical approaches that one can use as philosophical underpinnings for a curriculum.

The stakeholders' vision for the ECMO education program was for an interprofessional experience in which all professions are learning together in or as close to the clinical setting as possible to acquire the skills and knowledge to collaboratively, safely, and competently maintain ECMO. However, a simulated clinical setting would be acceptable as an alternative. To achieve this end, I believe that the philosophical approach of social constructivism would be most appropriate, as learning and working together in teams is a highly social, active, and interactive process in which thoughts, ideas, expertise, and knowledge are shared to gain understanding, further thinking, and

foster personal and professional development, while adhering to social rules of acceptable conduct for that particular environment or context.

Social constructivism is a branch of the larger philosophy of constructivism.

Within the constructivist point of view, learners actively construct, not just acquire, new knowledge as they interact with their environments. Everything one experiences in the world (reads, sees, hears, feels, and touches) is tested against prior knowledge. When the learner is able to make sense of and understand these experiences (in whole or in part) new knowledge is acquired. Knowledge is also not fixed; with new experiences, learners adapt and reconstruct their knowledge. The process of learning is very much internal and individually centred (Airasian & Walsh, 1997; Hruby, 2001; Iwasiw et al., 2009; Richardson, 2003; Young & Paterson, 2007).

Within the social constructivist view, learning is not only an individual process, it is also a social process. A good deal of an individual's experiences in the world involves interactions with others through use of language and cultural artifacts, such as technology. As such, learners are not only trying to internally understand these experiences through their senses, but they are also trying to understand these experiences in the world through their interactions with others by using language and other cultural artifacts. Through this social process, learners also discover how to be a part of that culture or society (Brooks, 2002; Wertsch, 1991). According to researchers and theorists (Brooks, 2002; Iwasiw et al., 2009; Vygotsky, 1978; Wertsch, 1991; Young & Paterson, 2007), the social constructivist view encompasses the following key principles of learning:

1. Learning is an active process by which the learner attempts to understand and make sense of the world around them—in its entirety and in its parts. This is accomplished through observation, active involvement with others, experimentation, processing, interpretation, reflection, and integration and assimilation.
2. Learning is an individual and a social process.
3. Learning occurs at a different rate for each learner due to internal (e.g., cognitive and psychological abilities) and external factors (e.g., the environment).
4. The purpose of learning is for learners to develop beliefs about the world they live in, not to prove things about the world they live in (i.e., viability versus validity).
5. Construction of meaning relies on learner interpretation.
6. Emphasis is placed on the value of others in the learning process. When acting independently, learners are only capable of learning so much at a given time, but through interaction with others or with assistance from others, the individual learner is able to learn considerably more.
7. Language, communication, and cultural artifacts (e.g., media) play an essential role in learning.
8. Motivation is key to learning. The motivation, desire, or need learners have greatly impacts on their ability to learn, to make meaning of, and to understand the world.

9. Learning takes place in context. Learners do not separate their experience in the world from their previous knowledge, beliefs, values, and assumptions.
10. The more learners know, the more they are able to learn. It is not possible to assimilate or integrate new knowledge without having a foundation developed from previous knowledge to build on. (This is also known as scaffolding.)
11. Learning takes time. Experiences must be thought about, new ideas and concepts must be experimented with, and beliefs and assumptions must be reflected upon.

Theoretical lens. Although the philosophical approach provides the foundation upon which a curriculum is developed, guiding rules and principles are required to help provide the framing structure of the curriculum. These guiding rules and principles come from theory. As the curriculum for the RN and RT ECMO education is complex, I believed that it was insufficient to employ only one set of guiding rules and principles. I, therefore, used several theories to frame the structure of the RN and RT ECMO curriculum, including Vygotsky's (1978) social development theory, Knowles's (as cited in Harper & Ross, 2011) adult learning theory (i.e., andragogy), and the principles of interprofessional education (Centre for the Advancement of Interprofessional Education, 2013). I chose these theories because I believed they best met the vision of the stakeholders and they promoted the active, interactive, and social nature of learning, as understood and valued in social constructivism. Social constructivism includes the following values and assumptions:

1. Learning is not the transmission and memorization of knowledge; it is meaning making and knowledge development.

2. Learners require respect.
3. Learning and knowledge development depend on social interaction.
4. Teachers must facilitate the development of a safe and supportive learning environment.
5. Learning is an active process that must be focussed on process, not on content.
6. The teacher–learner relationship must be collaborative and reciprocal.

(Airasian & Walsh, 1997; Brooks, 2002; Fer, 2009; Jaramillo, 1996; Lave & Wenger, 1991; Iwasiw et al., 2009; Richardson, V. 2003; Vygotsky, 1978; Wertsch, 1991; Young & Paterson, 2007)

Vygotsky's social development theory. Lev Vygotsky is viewed as a significant contributor to social constructivism, as he was one of the first psychologists to suggest the mechanism by which culture becomes part of an individual's learning (Brooks, 2002;). Through his social development theory, Vygotsky emphasized the socially transmitted nature of knowledge and the active engagement of the learner in the learning process. Vygotsky's theory contests traditional teaching methods such as memorization, and recitation. According to researchers and theorists (Airasian & Walsh, 1997; Brooks, 2002; Fer, 2009; Jaramillo, 1996; Lave & Wenger, 1991; Vygotsky, 1978; Wertsch, 1991), the social development theory of learning is based upon the following three major themes:

1. Learning is a developmental process, not a product; this process is dependent on social interaction and social learning for the progression of a learner's development. Vygotsky's (1978) view that social learning precedes development is in direct contrast to that of Piaget (Airasian & Walsh, 1997;

Brooks, 2002; Wertsch, 1991), a cognitive constructivist who argued that development precedes learning. Vygotsky (as cited in Wertsch, 1991) asserted, “Every function in the child’s cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)” (p. 57). As learning is dependent on social interaction, language and environment (context) play a central role in a learner’s development.

2. An individual is able to learn and develop significantly more through social interaction and social learning than he or she can acquire independently. The difference between what an individual is able to accomplish independently versus what he or she is able to achieve with social interaction is known as the zone of proximal development. According to Vygotsky, it is in this space of difference that learning occurs.
3. Learning and development occur as a result of social interactions and social learning with a more knowledgeable other (MKO). The MKO is anyone who is more knowledgeable (has a better understanding) or skilled (high level of ability) than the learner, with respect to a particular subject, skill, process, or concept. The MKO can be a teacher, coach, peer, younger person, or even a technology (e.g., computers).

Researchers and theorists, such as Airasian and Walsh (1997), Brooks (2002), Jaramillo (1996), Vygotsky (1978), and Wertsch (1991), also discussed the following principles of social development theory:

1. The teacher and the learner must enter into a collaborative, reciprocal relationship.
2. Learning occurs for both the teacher and the learner.
3. The physical space in which the education takes place is suited to social interaction and social learning. For example, desks are arranged in groups for group work or discussions.
4. Participants in the class become part of a community of learning.
5. Scaffolding and reciprocal teaching are utilized as strategies to access the zone of proximal development.
6. Scaffolding, or building off of previous knowledge, requires the teacher to provide the learner with opportunities to extend his or her knowledge and skills.
7. The teachers must facilitate a safe learning environment and provide guidance, encouragement, and support to all learners.
8. Reciprocal teaching encourages dialogue and discussion (beyond simply the answering of scripted questions) amongst learners and between teachers and learners.

In short, Vygotsky's social development theory promotes learning contexts or environments that are safe and in which students play an active role in learning; teachers collaborate with learners and provide learning opportunities or experiences for learners in order to facilitate meaning and knowledge construction; and learning is a reciprocal experience for the teacher and the learner.

Knowles's learning theory (andragogy). Malcolm Knowles's adult learning theory (or andragogy) is widely used to explain the process of helping adults learn. According to researchers and theorists (Blondy, 2007; Harper & Ross, 2011; Kern et al., 2009; Renner, 2005; Young & Paterson, 2007), Knowles's theory is built upon the following assumptions:

1. Adults are internally motivated and self-directed.
2. Adults bring life experience and knowledge to the learning experiences that help to form the foundation of new knowledge.
3. Adults are goal-oriented.
4. Adults are practical.
5. Adult learners want to be respected.
6. Adults want to know the rationale for the learning.
7. Adults must be involved in the learning process (including planning and evaluation).
8. Learning needs to be relevant and applicable.
9. Adult learning is problem centred.

Knowles's theory of andragogy emphasizes the value of the process of learning and it also stresses the importance of a more equal, collaborative, and reciprocal relationship between teacher and learner. Knowles advised teachers to employ the following seven-step process in order to implement his theory:

1. Create a safe and cooperative learning environment.
2. Plan course goals and objectives with the learners.
3. Determine learner needs, interests, and wants.

4. Assist learners in identifying and constructing their personal learning goals and objectives based on their needs and interests.
5. Design learning activities or provide learning opportunities in an order that supports achievement of goals and objectives.
6. Follow through with the selected learning activities and opportunities.
7. Evaluate the learning experience and need for learners to participate in continuing education and learning.

Although Knowles did not explicitly link his theory to a philosophical approach or foundation, I believe that there is a strong social constructivist presence or influence.

Like Vygotsky, Knowles asserted that learning must

- focus on the process (not on the content),
- be learner centred,
- require the active participation of the learner,
- be an active process,
- place teachers in roles of facilitation that support and encourage learners to maximize their knowledge and abilities,
- build off of learners prior knowledge and experience,
- be a continuous process, and
- require a safe and respectful environment.

Interprofessional education. The Centre for Advancement of Interprofessional Education (CAIPE) is a worldwide leader in interprofessional education development and training. In 2002, CAIPE (as cited in Centre for the Advancement of Interprofessional Education, 2013) outlined that “interprofessional education occurs when two or more

professions learn with, from and about each other to improve collaboration and the quality of care” (The Definition section, para. 1). This definition has been adopted internationally and nationally by organizations such as by The World Health Organization (WHO), the Interprofessional Education Collaborative Patient-Centered Practice (IECPCP), and the Canadian Interprofessional Collaborative (CIHC). Locally, PHC has also adopted the CAIPE definition of interprofessional education.

According to researchers (Anderson, Cox, & Thorpe, 2009; Clark, 2006; Cooper, Braye, & Geyer, 2004; Freeman, Wright, & Lindqvist, 2010; Freeth, Hammick, Reeves, Koppel, Barr, 2005; Hean, Craddock, & Hammick, 2012; Olenick, Allen, & Smego, 2010; Sargent, 2009; Scarvell & Stone, 2010), interprofessional education is founded upon the following underlying tenets:

1. Knowledge is largely created through the interactions (group work, discussions, case studies, etc.) of the learners and teachers.
2. The focus is equally on the learning process as it is on the content, which includes knowledge, skills, and attitude.
3. Mutual understanding and respect for all participants’ professions and disciplines is required.
4. Learning requires the development or enhancement of collaborative practice competencies, such as effective communication, problem solving, and conflict management and resolution.
5. All teaching and learning is based upon available best practice evidence.

In review, PHC would like to create an ECMO curriculum in which:

- the learning is relevant, practical, and applicable;

- RNs and RTs are actively engaged in the learning process;
- the learning takes place in a safe environment;
- every learner feels supported and respected;
- thoughts, ideas, and solutions can be freely discussed and tested;
- learners are provided with opportunities to build off of their previous knowledge and further expand their knowledge and develop new skills;
- knowledge is acquired through interactions with all participants in the program (facilitators, learners, and mentors);
- the RNs and RTs are learning with and from each other;
- the perfusionists and physicians are participating in the education and learning with and from the RNs and RTs as well as from each other; and
- all ECMO team members come together to form a common language, belief, and value system in order to provide exceptional evidence-informed care to patients.

The philosophical and theoretical approaches of social constructivism, Vygotsky's social development theory, Knowles's learning theory (andragogy), and interprofessional education provide a good foundation and support for these curricular goals. With the goals and objectives set, a plan of action must be devised to meet these goals and objectives, which leads to Step 4 of curriculum development process.

Step 4: Educational Strategies

As indicated, this step involves developing the education strategies by which the goals and objectives from Step 3 are to be achieved. Educational strategies involve both

choosing curricular content and teaching or educational methods. Educational strategies must

- be congruent with the philosophical approach of the curriculum, as well as the learning goals and objectives;
- take into consideration that every learner has a specific learning style and, therefore, multiple educational methods should be used; and
- be realistic and feasible based upon resources available, including time, human, resources, money, and space and infrastructure.

Based on the content of the curriculum, the philosophical and theoretical underpinnings of the curriculum, the resources available (time, space, expertise, etc.), and the goals, objectives, and core competencies of the curriculum, I chose the educational strategies of problem-based learning, experiential learning, competency-based learning, and evidence-based learning. Figure 2 depicts how these strategies would be enacted.

Problem-Based Learning	Experiential Learning	Competency-Based Learning	Evidence-Based Learning
<ul style="list-style-type: none"> • Case studies • Discussion • Debate • Puzzles • Team-building exercises • Online communities of learning • Online community of practice 	<ul style="list-style-type: none"> • Simulations • Mentored clinical shifts and experiences • Team-building exercises 	<ul style="list-style-type: none"> • Competency checklist • Skills assessment • Knowledge assessments or exams • Self-directed learning • Online communities of learning • Online community of practice • Self-evaluation and reflection • Peer evaluation • Teacher/facilitator/mentor evaluation • Didactic lectures 	<ul style="list-style-type: none"> • Discussion • Debate • Case studies • Didactic lectures

Figure 2. Methods of enacting educational strategies.

Using a multitude of educational strategies in the ECMO curriculum increases the likelihood of maintaining learner engagement and interest, thereby promoting knowledge development, retention of knowledge, and knowledge translation. The curriculum is designed to appeal to various learning styles, thereby maintaining learner-centredness and again increasing learner engagement and interest. The curriculum also targets all areas of development: cognitive, affective, and psychomotor. With the goals and objectives set and the educational strategies identified it is time to move on to Step 5 – Implementation.

Step 5: (Planning and) Implementation

I disagree with Kern et al.'s (2009) titling of this step. The original title implies that one can progress directly from creating goals and objectives, and identifying teaching strategies, directly to implementing the curriculum, which is not the case. Much planning needs to occur prior to implementation. I, therefore, titled this step Planning and Implementation to make it clear that planning is an essential and necessary component of this process. The following steps are part of the planning and implementation phase:

1. Secure and protect resources (money, time, infrastructure, human resources, etc.).
2. Create a timeline for implementation.
3. Establish roles and responsibilities for the implementation phase.
4. Communicate of the implementation plan to all stakeholders.
5. Develop alternate plans that address potential problems or issues that may arise or that have arisen.

6. Construct a plan for sustainment and determine who will be responsible of overseeing the maintenance of the curriculum, address questions about the curriculum post implementation, be responsible for ongoing communication in regards to the curriculum, and review and disseminate evaluation results.

I have developed a detailed plan of implementation for the RN and RT ECMO curriculum, which is available for review in Appendix F. Unfortunately, at the time of writing this paper there continue to be significant unresolved social and political issues that prevent the curriculum from being implemented, including liaising with BCCH. ICU physicians, administrators, and I hope that the issues will be resolved early in 2013 so that the implementation of the curriculum can proceed later in the year.

Until input, support, and participation can be secured from the Department of Perfusion the implementation of the ECMO curriculum is on hold, which also means that the next step of the curriculum development process, evaluation and feedback, will be delayed. I will, however, share what this step entails.

Step 6: Evaluation and Feedback

Kern et al. (2009) defined evaluation as “the identification, clarification, and application of criteria to determine the merit or worth of what is being evaluated” (p. 101). Assessments of learners’ achievements (knowledge, skills, attitudes) must be conducted to identify if the curriculum is accomplishing its purpose, goals, and objectives. As a result, people and processes need to be evaluated, including teachers, learners, curriculum content, curriculum resources, learning experiences, and teaching methods. The evaluation of the ECMO curriculum would not only include the effectiveness of curriculum in providing the education be assessed, it would also include

the RNs' and RTs' ability to safely, competently, and collaboratively maintain ECMO. Effectiveness and successfulness of the curriculum itself could be identified through a review of test scores, pass and fail rates, and learner, facilitator, and mentor surveys. The RNs' and RTs' abilities could be evaluated through test scores, self-evaluation, mentor evaluation, measurement and review of patient outcomes including adverse events rates, and rates of complications. The specifics of how the ECMO curriculum and the RNs and RTs would be evaluated, how that information would be disseminated, and to whom the evaluation findings would be disseminated all need to be established. These will occur after all obstacles and barriers to implementation are resolved.

Conclusion

ECMO requires the collaboration of several healthcare providers (physicians, RNs, RTs, perfusionists) to provide optimal patient care. For effective collaboration to occur, each healthcare provider must understand the roles of the other team members, respect the other health care providers, be able to communicate clearly and effectively with the other health care providers, resolve conflict effectively, and develop common goals. This is often challenging to accomplish, as RNs, RTs, physicians, and perfusionists are educated in distinctive silos with values, beliefs, customs, and languages that are unique to each discipline. These distinctive silos reduce the ability of healthcare providers to communicate, collaborate, and provide safe optimal care to patients (Sargeant, 2009). In order to develop the skills needed to collaborate effectively, health care providers must be given the opportunities for shared learning experiences. Through these shared learning experiences, members of the individual disciplines can learn with and from each other about their values, beliefs, assumptions, roles, responsibilities, and

language. Health care professionals will learn how to be with and work with each other, as well as how to collaborate through the use of effective communication and multidisciplinary problem solving. It is also prudent that this learning take place in the same social and contextual environment in which these individuals practice so that the knowledge they have developed can be readily applied in their practice.

Developing the ECMO curriculum based upon the philosophical and theoretical underpinnings described in this paper PHC will provide RNs, RTs, doctors, and perfusionists with the opportunities to share their unique professional knowledge, individual experiential knowledge, and specialized skills. The shared knowledge and skills can enable others to learn from and with each other and improve RNs' and RTs' cognitive, affective, and psychomotor skills to provide ECMO to patients, thereby by reducing the effects of the perfusionist shortage.

The chosen teaching strategies in the ECMO curriculum will enable learners to interact with each other during class, through simulations, and in the community of learning forum to share and reflect on their experiences and to help others (including teachers) develop and learn. For example, RTs are extremely proficient in performing respiratory assessments, interpreting arterial blood gases, and mechanical ventilation. These skills can be shared with RNs during case studies and simulations to enable RNs to improve their skills in those areas, develop a better understanding of the RTs' beliefs, values, language, and role in the provision of optimal care. Developing a better understanding of other team member's beliefs, values, and roles increases collaboration, improves communication, and reduces conflict, which ultimately leads to improved and safer care to patients.

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Appendix A: Extracorporeal Membrane Oxygenation

Extracorporeal Membrane Oxygenation (ECMO) is a treatment that uses devices and technology outside the patient's body to provide cardiac and/or respiratory support to critically ill patients whose heart and/or lungs have been severely damaged due to disease(s) or cannot currently serve their function optimally due to trauma. ECMO treatment entails special cannula being placed by a surgeon, often at the bedside, into specific large vessels in the patient. Then the patient's blood is being circulated outside the body, using a mechanical pump, and directed through an oxygenator or "artificial lung" where carbon dioxide is removed from the blood, and supplemental oxygen is introduced into the blood. The blood is then returned to the patient. The purpose of ECMO is to allow for intrinsic recovery of the heart and lungs.

There are two forms of ECMO: veno-venous (VV) and veno-arterial (VA). Veno-arterial ECMO, often called heart-lung bypass, provides both cardiac and respiratory support, and is predominantly used for short periods of time such as during and immediately following open-heart surgery. Veno-venous ECMO provides only respiratory support, and is capable of providing support for longer periods of time (days to weeks) such as in incidences of severe cases of H1N1.

Indications for ECMO therapy include any of the conditions listed below that are believed by the team to be potentially reversible, and are at the time of assessment unresponsive to conventional management such as high frequency oscillating ventilation:

- Hypoxemic respiratory failure
- Hypercapnic respiratory failure with arterial pH less than 7.20
- Refractory cardiogenic shock
- Cardiac arrest
- Failure to wean from cardiopulmonary bypass after cardiac surgery
- Bridge to heart or lung transplantation or placement of a ventricular assist device
- Severe pneumonia
- Sepsis
- Pulmonary embolism
- Severe air leak problems
- Severe or persistent pulmonary hypertension
- Aspiration pneumonia
- Pulmonary embolism
- Respiratory distress syndrome
- Cardiomyopathy/myocarditis
- Trauma such as car accidents or gunshot wounds

Note. The information in this appendix was derived from the following sources:

Annich, G., Lynch, W., MacLaren, G., Wilson, J., & Bartlett, R. (Eds.). (2012). *ECMO: Extracorporeal cardiopulmonary support in critical care* (4th ed.). Ann Arbor, MI: Extracorporeal Life Support Organization.

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Appendix B: Providence Healthcare Mission, Vision, Values, Organizational Strategic Directions and Foundational Strategies

- Mission:

Providence Health care is a Catholic health care community that respects the sacredness of all aspects of life.

Inspired by the healing ministry of Jesus Christ, our staff, physicians, and volunteers are dedicated to service and to the support of one another.

In this environment of service, support, and respect, we meet the physical, emotional, social and spiritual needs of those served through compassionate care, teaching and research.

- Vision:

Driven by compassion and social justice, we are at the forefront of exceptional care and innovation.

- Values:

Spirituality: We nurture the God-given creativity, love, and compassion that dwells within us all

Integrity: We build our relationships on honesty, justice and fairness

Stewardship: We share responsibility for the well-being of our community

Trust: We behave in ways that promotes safety, inclusion and support

Excellence: We achieve excellence through learning and continuous improvement

Respect: We respect the diversity, dignity & interdependence of all persons

(Providence Health Care, 2012a)

Organizational Strategic Directions:

Care experience: We will have person and family centered care as an approach to the planning, delivery, and evaluation of health care that is grounded in mutually beneficial partnerships among healthcare providers, the people we serve and their families

Means that:

- a. Patients, residents, families will experience culturally safe, socially just person-and-family centered care across PHC

Infrastructure: We will renew or replace physical infrastructures at all our sites and implement a clinical information system that aligns with PHC's care needs.

Means that:

- a. We redevelop St. Paul's Hospital
- b. We redevelop Mount St. Joseph's Hospital
- c. We renew the residential and hospice facilities
- d. We implement a clinical information system

Innovation: We will transform the health of the populations we serve through the generation, implementation, and spread of new ideas and solutions that add value

Means that:

- a. We create a culture that engages, excites and motivates creativity and innovation
- b. We accelerate the pace and impact of knowledge translation
- c. We develop a structure and processes to manage the organization's priorities

People: We will foster communities where people thrive.

Means that:

- a. We create a workplace where all people are highly engaged in contributing to PHC's success
- b. Our leaders are exceptional and create environments where people do their best
- c. Our teams produce amazing results

Quality & Safety: We will continuously improve the safety and quality of care provide so that patients and residents achieve the best possible health outcomes.

Means that:

- a. We provide the right care to the right patient and resident every time
- b. We ensure that our patients and residents experience no needless harm (Providence Healthcare, 2012)

Foundational Strategies:

Mission/Values Ethical Framework Foundational

Means that:

- a. We advance a culture that reflects PHC's mission, values and identity
- b. We foster a culture of ethical behavior and decision making
- c. We focus on the integration of spirituality and health.

Research & Learning Foundational

Means that:

- a. We improve care through increased participation of health professionals in research and in interprofessional learning
- b. We improve care through the integration of research with care for each population of emphasis
- c. We improve care through increased knowledge translation and evidence-based care

Fiscal Sustainability

Means that:

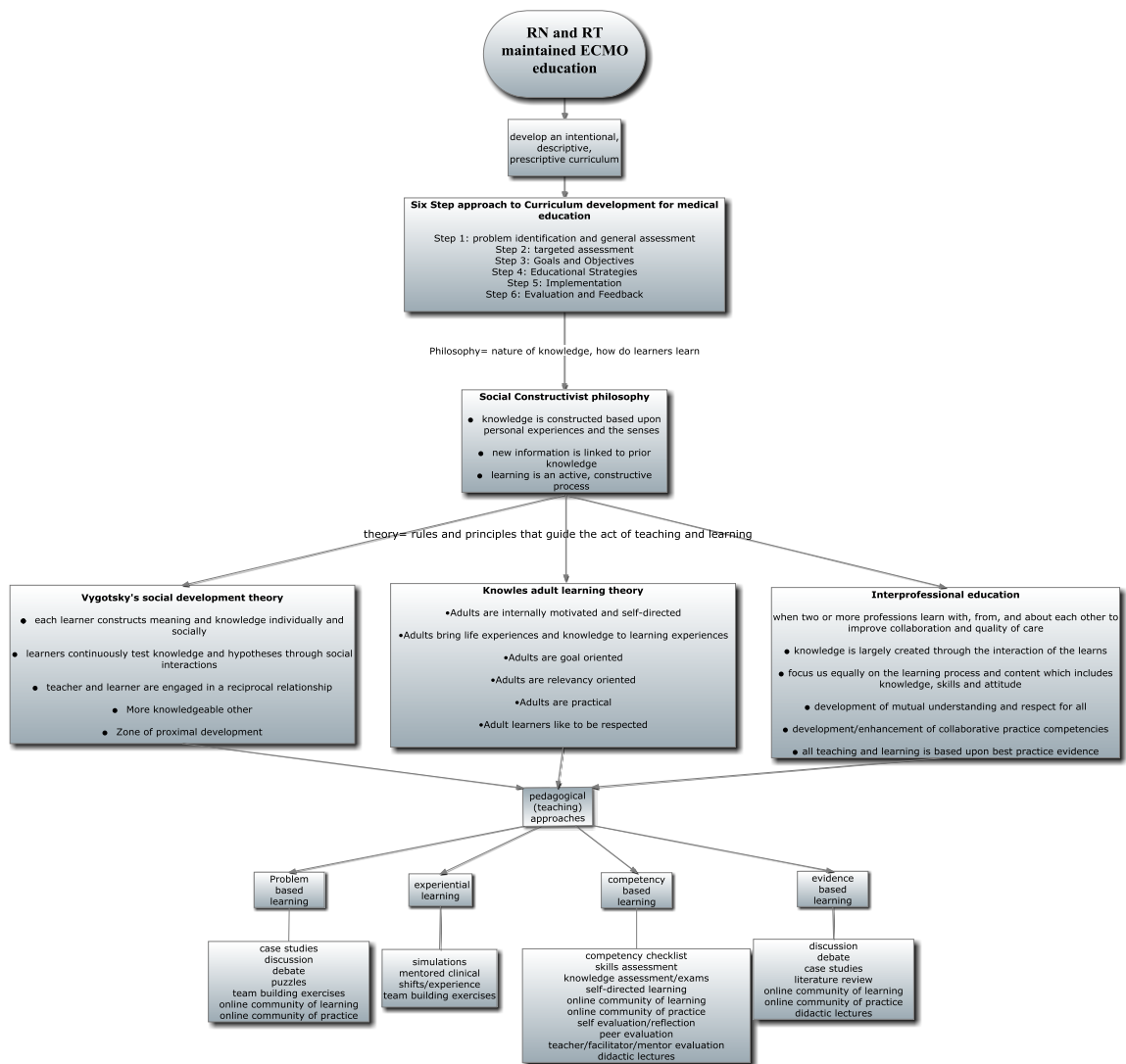
- a. We always meet or exceed our budget and financial targets
(Providence Health Care, 2012)

Note: The information in this appendix is from the following Providence Health Care sources:

Providence Health Care. (2009). *PHC strategic directions 2009–2012: Innovations, solutions & exceptional care for British Columbians*. Retrieved from <http://www.providencehealthcare.org/sites/default/files/PHC-Strategic-Directions-Summary.pdf>

Providence Health Care. (2012). *Providence Health Care strategic directions 2012–2015*. Retrieved from http://www.providencehealthcare.org/sites/default/files/PHC-Strategic-Directions_0.pdf

Appendix C: Mind Map of RN- and RT-Maintained ECMO Curriculum Project



Appendix D: Questions for Stakeholders

Leadership: Regional Director Cardiac Services, Director of Critical Care Services, ICU Operations Leader, ICU Physician Directors (Administrative and Clinical), Respiratory Clinical Practice Lead, and ICU Clinical Nurse Leader

1. As a leader in the ICU do you believe that it is appropriate for RNs and RTs to be educated in and participate actively in providing ECMO to patients in the PHC ICU?
2. What would your vision be for an ECMO education/training program? (Who would participate, where would it be held, what would be the underlying philosophy?)
3. What do you think the benefits would be to such a program?
4. What do you think would be the barriers to such a program? How would you plan to overcome these barriers?
5. What would be some acceptable alternatives to your ideal ECMO program?
6. As a leader in the ICU would you support interprofessional education? Why or why not? And how?
7. Do you think interprofessional education is appropriate for the ICU at PHC? Please explain why or why not.
8. What do you believe would be the barriers/obstacles to interprofessional education in the SPH ICU?
9. Do you believe that these barriers can be overcome or worked around? How would you suggest overcoming or working around these barriers?
10. Would you as a leader in the ICU support RN and RT maintained ECMO education and practice? In what manner/means would you provide this support? What resources would you be willing to contribute/commit?
11. If the PHC ICU were to develop an RN and RT ECMO program what skills/knowledge/ experience/characteristics would you think a candidate for the education/training should have?
12. What screening process would you like to see candidates undergo?

Clinical Nurse Educator

1. As the Educator in the ICU do you believe that it is appropriate for RNs and RTs to be educated in and participate actively in providing ECMO to patients in the PHC ICU? Why or why not.

2. What would your vision be for an ECMO education/training program? (Who would participate, where would it be held, what would be the underlying philosophy?)
3. What do you think the benefits would be to such a program?
4. What do believe would be the barriers to such a program? How would you plan to overcome these barriers?
5. What would be some acceptable alternatives to your ideal ECMO program?
6. As the Educator in the ICU would you support interprofessional education? Why or why not? And how?
7. Do you think interprofessional education is appropriate for the ICU at PHC? Please explain why or why not.
8. What do you believe would be the barriers/obstacles to interprofessional education in the SPH ICU?
9. Do you believe that these barriers can be overcome or worked around? How would you suggest overcoming or working around these barriers?
10. Would you as the Educator in the ICU support RN and RT maintained ECMO education and practice? In what manner/means would you provide this support? What resources would you be willing to contribute/commit?
11. As the Educator in the ICU do you think you have the knowledge/skills/competencies to provide interprofessional education? If not, what supports/resources/education and training would you require?
12. As the Educator in the ICU do you believe you have the knowledge/skills/competencies to provide ECMO training/education? If not, what supports/resources/education and training would you require?
13. As the Educator in the ICU do you believe you have the knowledge/skills/competencies to create, and perform simulation labs including effective, structured debriefing? If not, what supports/resources/education and training would you require?
14. If the PHC ICU were to develop an RN and RT ECMO program what skills/knowledge/ experience/characteristics would you think a candidate for the education/training should have?
15. What screening process would you like to see candidates undergo?

Registered Nurses (RN) and Respiratory Therapists (RTs)

1. Do you believe that an RN/RT maintained program is needed in this ICU?
2. Do you believe that it is appropriate for RNs and RTs to be educated in and participate actively in providing ECMO to patients in the PHC ICU?
3. Would you be willing to undergo the education and training if it were offered to you?
4. What would your vision be for an ECMO education/training program? (Who would participate, where would it be held, what would be the underlying philosophy?)
5. What do you think the benefits would be to such a program?
6. What do believe would be the barriers to such a program? How do you believe that these barriers could be overcome?
7. What would be some acceptable alternatives to your ideal ECMO program?
8. As an RN/RT in the ICU do you support interprofessional education? Why or why not? And how?
9. Do you believe interprofessional education is appropriate for the ICU at PHC? Please explain why or why not.
10. What do you believe would be the barriers/obstacles to interprofessional education in the SPH ICU?
11. Do you believe that these barriers can be overcome or worked around? How would you suggest overcoming or working around these barriers?
12. Would you as an RN/RT in the ICU support RN and RT maintained ECMO education and practice? In what manner/means would you provide this support?
13. If the PHC ICU were to develop an RN and RT ECMO program what skills/knowledge/experience/characteristics would you think a candidate for the education/training should have?
14. What screening process would you like to see candidates undergo?

Appendix E: Step 3: Goals, Objectives and Competencies

“A goal or objective is defined as an end toward which an effort is directed.” (Kern et al., 2009, p. 43). Establishing the goals and objectives of the curriculum helps to:

1) direct the choice of curriculum content; 2) selection of teaching methods/strategies; 3) determine assessment/evaluation methods and tools; 4) foster the clear communication of expected outcomes to stakeholders, including teachers, learners, administration, leadership, etc.

The goal for the curriculum is for RNs and RTs to participate in and successfully complete the ECMO education so that they can develop the cognitive, affective, and psychomotor skills needed to collaboratively, safely, and competently maintain ECMO on adult patients in the ICU. With RNs and RTs safely and competently maintaining ECMO this will lessen the effects of the Perfusionists shortage and increase the availability of needed care/services to patients.

Listed below are the goals, objective and competencies for RNs and RTs participating in the ECMO education program:

ECMO Knowledge			
Acquires and demonstrates understanding of the knowledge in the following areas in relations to ECMO			
TASK/TOPIC	Competencies	Competency met (Date & Initials)	Learning Contract (Date & Initials)
<ul style="list-style-type: none"> • Pathophysiology of: respiratory and circulatory system including principles of oxygenation • Acid-base balance and ABG interpretation • Physiology of coagulation, including coagulation cascade, activated clotting time, and DIC • ECMO basics including: history, 	<ul style="list-style-type: none"> • Participated in minimum # hours of training/education, including : <ul style="list-style-type: none"> ○ Didactic lectures ○ Simulations ○ Mentored bedside shifts • Completed pre-course self-directed reading package • Achieved a minimum grade of 80% on all quizzes/exams • Actively participates in the discussions in the online community of learning 		

<p>indications for, criteria for, patient selection for, risks and benefits of, types of, physiology of ECMO, roles and responsibilities of ECMO team members, ECMO equipment, and cannulation process</p> <ul style="list-style-type: none">• Disease Physiology including: respiratory failure, pneumonia, pulmonary embolism, sepsis, ARDS, postoperative congenital heart disease, cardiomyopathy, persistent pulmonary hypertension, respiratory distress syndrome, and myocarditis• Medications including priming solutions, electrolytes and anticoagulants			
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Equipment Knowledge and Technical skills			
Appropriately and safely operates equipment; and demonstrates knowledge of appropriate maintenance of equipment			
TASK/TOPIC	Competencies	Competency met (Date & Initials)	Learning Contract (Date & Initials)
Routine use of ECMO pump and related equipment, including: <ul style="list-style-type: none"> • pump, • gas delivery device, • oxygen analyzing device, • temperature control units, • in-line monitoring device, • blood analyzer, • filters, • reservoirs 	<ul style="list-style-type: none"> • Locates equipment and supplies • Identifies purpose, limitations and indications for use of equipment • Assembles and disassembles equipment correctly and proficiently • Demonstrates process to set-up, start, and shut-down equipment, including appropriate use of checklists • Operates equipment safely, appropriately, and according to patient's needs • Performs required monitoring of ECMO and related equipment during patient treatment as per facility policy/procedure • Cleans/disinfects and stores equipment as per manufacturers recommendations and facility policy/procedures • Performs preventative and routine maintenance (calibration, inspection) as per manufacturers recommendations and facility policy/procedure • Identifies resources to 		

	<p>assist in set up, operating, troubleshooting, shutting-down equipment, maintaining and cleaning equipment</p> <ul style="list-style-type: none"> • Accurately documents <ul style="list-style-type: none"> ○ Set-up ○ Monitoring ○ Preventative and routine maintenance ○ Cleaning/disinfection ○ Equipment malfunctions/ failure 		
ECMO circuit	<ul style="list-style-type: none"> • Assembles the circuit as per manufacturers recommendations and facility policy/procedure • Describes the relationship of ECMO blood flow to oxygen supply and demand • Identifies the relationship of sweep gas and carbon dioxide removal • Consistently and appropriately examines the circuit for integrity and safety during set-up and treatment • Accurately identifies and uses appropriate priming solution as per facility guidelines • Administers medications appropriately via the circuit as per facility policy/procedure • Administers blood and blood products via the circuit as per facility policy/procedure • Accurately documents <ul style="list-style-type: none"> ○ ECMO pump and related equipment 		

	<p>monitoring (flow rates, pump speed, removal rates, infusion rates, etc.)</p> <ul style="list-style-type: none"> ○ Administration of medications, and blood and blood products 		
<p>Routine and emergency replacement of ECMO pump and related equipment, including:</p> <ul style="list-style-type: none"> • ECMO pump (roller or centrifugal), • Raceway • Compliance chamber or bladder • Bridge, • Stopcocks, • Transducer lines • Oxygenator, • Oxygen saturation monitor, • In-line blood monitor, • ACT analyzer • Pigtail and connector components • Heater • Gas line • Pressure monitor 	<ul style="list-style-type: none"> • Responds to alarms in a timely manner • Troubleshoots pump and related equipment alarms in an organized and timely manner • Initiates appropriate and timely interventions based upon alarm data and pump/equipment assessment, including taking patient off ECMO • Demonstrates procedures for routine replacement of ECMO pump and related equipment as per facility policy/procedure • Demonstrates procedures for emergency replacement of ECMO pump and related equipment as per facility policy/procedure • Identifies process to document equipment failure • Identifies process to have equipment repaired • Demonstrates technique for handcranking 		
<p>Equipment Emergencies</p>	<ul style="list-style-type: none"> • Responds to equipment emergencies in a timely manner • Troubleshoots equipment emergencies in an organized and timely manner 		

	<ul style="list-style-type: none"> • Intervenes in equipment emergencies in an appropriate and timely manner • Demonstrates appropriate interventions/procedures for managing or resolving equipment emergencies as per facility policy/procedure, including: <ul style="list-style-type: none"> ○ System or component malfunction/failure ○ Circuit disruption ○ Cannula problems ○ Air embolism ○ Clots ○ Tubing rupture • Accurately documents equipment emergency events, interventions undertaken, and patient response to emergency event and interventions 		
Patient Care			
Appropriately and safely provides routine and emergency care to an ECMO patient			
TASK/TOPIC	Competencies	Competency met (Date & Initials)	Learning Contract (Date & Initials)
Patient assessment	<ul style="list-style-type: none"> • Performs accurate and thorough patient assessments • Appropriately interprets assessment/clinical findings • Collects and analyses data from several sources to support assessment findings and interventions • Correctly interprets patient arterial blood 		

	<p>gases, laboratory results</p> <ul style="list-style-type: none"> • Strictly monitors 24 hour intake and output • Accurately documents: <ul style="list-style-type: none"> ○ Assessments ○ Interventions/treatments ○ Hourly intake and output ○ Laboratory results 		
<p>Routine Patient Care including weaning, and decannulation</p>	<ul style="list-style-type: none"> • Provides culturally sensitive patient and family care • Adapts/adjusts ECMO treatment to meet patient needs based upon assessment/clinical finding, laboratory results, blood gas results, and evidence. • Establishes and maintains a respectful, partnering relationship with patients and families • Participates in interprofessional/interdisciplinary discussion of patient care; including goals of care, decision making around patient care, etc. • Demonstrates appropriate interventions/procedures for weaning • Demonstrates appropriate interventions/procedures for decannulation • Accurately documents weaning interventions/procedures and patient response to weaning • Accurately documents 		

	<p>decannulation interventions/procedures and patient response to decannulation</p> <ul style="list-style-type: none"> • Responds appropriately to complications related to weaning • Responds appropriately to complications related to decannulation 		
Emergency Patient Care	<ul style="list-style-type: none"> • Responds to patient emergencies in a timely manner • Troubleshoots patient emergencies in an organized and timely manner • Intervenes in patient emergencies in an appropriate and timely manner • Demonstrates appropriate interventions/procedures for managing or resolving patient emergencies as per facility policy/procedure, including: <ul style="list-style-type: none"> ○ Hemorrhage ○ Accidental decannulation ○ Hypotension ○ Hypovolemia ○ Severe coagulopathy ○ Seizures ○ Hemothorax/hemopericardium ○ Pneumothorax/pneumopericardium ○ Cardiac arrest • Accurately documents patient emergency events, interventions undertaken, and patient 		

	response to emergency event and interventions		
Complex Patient Care	<ul style="list-style-type: none"> • Demonstrates appropriate interventions/procedures for managing or resolving complex patient care situation as per facility policy/procedure, including: <ul style="list-style-type: none"> ○ Surgery on ECMO patient ○ Intra- and inter hospital transport 		
Clinical Practice Demonstrates the skills and knowledge necessary to practice as an effective member of the interprofessional ECMO team			
TASK/TOPIC	Competencies	Competency met (Date & Initials)	Learning Contract (Date & Initials)
Roles and responsibility	<ul style="list-style-type: none"> • Clearly describes their own role and responsibilities as a professional and as a member of the interprofessional ECMO team • Clearly identifies the roles and responsibilities of other professionals and other ECMO team members • Recognizes and adheres to limitations/restrictions of own role, responsibilities, and level of competence • Recognizes and respects the limitations/restrictions of others' roles, responsibilities, and level of competence • Engages other 		

	<p>healthcare professions and ECMO team members in discussing and/or developing strategies to meet the need of the patient, patient population, or community.</p> <ul style="list-style-type: none"> • Consistently demonstrates effective critical thinking and problem solving skills • Engages in reflection of their own practice as well as the practice of the ECMO team 		
Teamwork	<ul style="list-style-type: none"> • Consistently demonstrates the ability and willingness to work together with other professions and ECMO team members • Collaborates effectively with other professions and team members to: <ul style="list-style-type: none"> ○ Assess, plan, provide, and evaluate evidence-informed, and clinically competent care for individual patients, patient populations, and the community ○ Manage/resolve conflict using effective conflict management/resolution strategies, as well as analyzing the causes of conflict and working to eliminate them ○ Verbalizes how to effect change utilizing the Providence 		

	<p>Healthcare model of change and Change Initiative resources</p> <ul style="list-style-type: none"> • Demonstrates and supports mutual respect between professions and ECMO team members • Demonstrates and supports willingness to collaborate with other professions and other ECMO team members • Demonstrates and encourages sharing of knowledge and skills between health professions and ECMO team members • Encourages the engagement of all health professions and ECMO team members • Integrates the knowledge and skills of all health professionals and ECMO team members in the discussion, planning and provision of care 		
Communication	<ul style="list-style-type: none"> • Reports abnormal assessment/clinical signs, laboratory results, concerns or issues utilizing SBAR format to appropriate team members in a timely fashion • Uses communication and information technology effectively and as per facility policy • Employs effective communication techniques to facilitate discussion and interactions amongst 		

	<p>professionals and ECMO team members</p> <ul style="list-style-type: none"> • Demonstrates and encourages open and honest communication between members of all professions and between all ECMO team members • Openly shares information that is organized, clear and understandable with other health professions, ECMO team members, and patients and families in a respectful manner • Expresses their knowledge and opinions to other health professions and ECMO team members openly with confidence, respect and clarity • Actively listens • Provides feedback to other team members in a timely, sensitive and constructive manner • Responds respectfully to others who are providing them with feedback 		
Ethics	<ul style="list-style-type: none"> • Places the interests, needs, wants of the patient at the center of care planning and delivery • Consistently respects the dignity and privacy of patients • Maintains patient confidentiality • Advocates for: <ul style="list-style-type: none"> ○ Self ○ Other professions and team members 		

	<ul style="list-style-type: none"> ○ Patients ○ Families ● Respects the unique culture, values, beliefs, roles, responsibilities, and expertise of other professions and ECMO team members ● Respects the unique culture, values, and beliefs of the patient and family ● Provides care in partnership with the patient in family as outlined in the Providence Healthcare Partnership in Care Agreement ● Identifies the process by which ethical concerns/dilemmas can be brought forth, discussed, and resolved ● Confirms that research conducted on individual patients has been approved by the ethics board, and has been consented to by the patient and/or patient representative. 		
Safety and Quality Adheres to safety and quality policies, standards, procedures as established by ELSO, legislation, and the organization			
TASK/TOPIC	Competencies	Competency met (Date & Initials)	Learning Contract (Date & Initials)
	<ul style="list-style-type: none"> ● Participated in minimum # hours of training/education, including : <ul style="list-style-type: none"> ○ Didactic lectures ○ Simulations 		

	<ul style="list-style-type: none"> ○ Mentored bedside shifts ● Achieved a minimum grade of 80% on all quizzes/exams ● Maintains a safe and organized work environment ● Follows established facility and unit based protocols, policies, and procedures ● Demonstrates appropriate use of aseptic technique ● Demonstrates the appropriate donning and doffing of personal protective equipment ● Handles blood, body fluids, biohazardous material, and sharps as per facility policy/procedure ● Reports and documents (or is able to verbalize the process to report and document) unsafe conditions ● Reports and documents (or is able to verbalize the process to report and document) unsafe behavior/conduct ● Reports and documents (or is able to verbalize the process to report and document) adverse events ● Contributes to ongoing safety and quality improvement initiatives within the facility as well as within ELSO ● Participates in the collection of safety and 		
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	quality indicators <ul style="list-style-type: none"> • Participates in the collection of patient outcomes data • Engages in reflection on their own practice as well as practice of the ECMO team 		
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Note. The information in this table is based on the following works: Centre for the Advancement of Interprofessional Education (2002); Canadian Interprofessional Health Collaborative (2007, 2012); Canadian Society of Clinical Perfusion (2009), College of Health Disciplines (2008), Extracorporeal Life Support Organization (2010a), Extracorporeal Life Support Organization (2010b), Interprofessional Education Collaborative (2011), and Sargent (2009).

Appendix F: Step 5: Implementation Timeline

Phase 1: Selection of Candidates (Spring/Summer of 2013)

The process for the selection of candidates for the ECMO education will begin with a notice being posted in the unit and on the ICU intranet website of the opportunity to undergo the ECMO education, as well as an email sent to all staff via their work email. Individuals with a minimum of 2 years of critical care experience who are interested in participating must submit a written letter of interest. Individual staff can also be approached by the ICU Operations leader, Clinical Nurse Educator, Clinical Nurse Leader, and /or Respiratory Practice Lead and encouraged to submit a letter of interest. Review of the letters and short-listing of candidates will be performed by the ICU Operations Leader, Clinical Nurse Educator, Clinical Nurse Leader, Respiratory Practice Lead, and ECMO Coordinator.

Short listed candidates will then undergo a panel interview. The panel will consist of the ICU Operations Leader, Clinical Nurse Educator, Clinical Nurse Leader, Respiratory Practice Lead, ECMO Coordinator and an ICU Physician. The interview will include a discussion regarding the individual's understanding of the level of commitment required to undergo the education and subsequently join the "ECMO team", answering questions about their competencies and characteristics, as well as completing case scenarios that exhibit their problem solving/decision making skills, leadership skills, and level of knowledge. All candidates will be scored using a standard interview-scoring tool used by Providence Healthcare. The selection of the successful candidates will be performed by the panel.

Selection of the candidates will be based upon:

- Years of experience – minimum 2 years of ICU experience
- Competencies: current level C CPR and ACLS, Code Team member, Prisma, charge, sick ICU patients
- Characteristics: leadership skills, teamwork, good communication skills, consistent effective problem-solving/decision-making, mentoring nature, organized, thorough/detail oriented, motivated
- Level of knowledge: ABG interpretation, principles of oxygenation, pathophysiology, decision-making/problem-solving

All candidates will be contacted as to the results of the interviews and provided with constructive feedforward about their performance and provided with information on resources that are available to them should they like to apply again in the future.

Phase 2: Pre-Course Self-Directed Reading and Online Community of Learning (August 2013)

One month prior to attending the in-person/classroom portion of the ECMO education all learners will receive a self-directed reading package, the two required textbooks, as well as their login information for the online ECMO community of learning. The required textbooks are: the most current editions of *ECMO Specialist Training Manual* (ELSO),

and *ECMO Extracorporeal Cardiopulmonary Support in Critical Care* (ELSO), also known as the Red Book.

Learners must have completed the pre course self-directed reading package in its entirety upon arrival to the in-person portion of the ECMO education. The pre-course self-directed reading package contains the following material:

- Review of pathophysiology – respiratory, circulatory
- Review of principles of oxygenation (content, supply and demand) and ventilation
- Review of acid base balance, ABG interpretation
- Review of physiology of coagulation including:
 - Coagulation cascade
 - Activated clotting times and lab tests
 - Disseminated intravascular coagulation
 - Blood/ blood products
 - Heparin pharmacology
- Introduction to ECMO, including:
 - Brief history
 - Current status
 - Types of ECMO
 - Indications for
 - Risks and benefits
 - Physiology of ECMO
 - Membrane gas exchange physics and physiology
 - Shunt physiology
 - Research
 - Future applications
- Physiology of diseases treated with ECMO, including:
 - Sepsis/pneumonia
 - ARDS
 - Aspiration pneumonia
 - Pulmonary embolism
 - Persistent pulmonary hypertension
 - Respiratory distress syndrome
 - Post-operative congenital heart disease/heart transplantation
 - Cardiomyopathy/myocarditis

Note: Each section of the pre-course reading package contains a pre-test and post-test so that learners may track their progress.

- Glossary of terms
- Instructions on how to access online community of learning

Participation in the online community of learning is voluntary but highly recommended to learners. Learners are encouraged to participate by posting their questions about topics within the reading package. The activities on the community of learning are to be monitored and facilitated by the ECMO coordinator and Clinical Nurse Educator.

Phase 3: In-Person/Classroom Sessions (September 2013)

The in-person/classroom portion of the education will involve didactic lectures, demonstrations, small group discussions, case studies and simulation. The online community of learning continues to be available for learners to pose questions and ongoing discussion. Each day of class will begin with a short team building exercise.

- The in-person/classroom portion of the ECMO education will include:
 - Identification of roles and responsibilities of all the ECMO team members
 - Pre ECMO procedures, including:
 - Selection criteria
 - Patient selection process including Pre-ECMO evaluation
 - Notification of ECMO team members
 - Cannulation procedures
 - ECMO equipment, including:
 - Circuit components (cannula, pump, venous return monitor, in-line saturation monitor, pressure monitor, heater, hemofilter, bubble detector)
 - Circuit design
 - Oxygenator function and blood gas control
 - Circuit priming
 - Daily patient and circuit management, including:
 - Patient:
 - Neurological status, level of sedation and pain control
 - Cardiac output and function
 - Oxygenation and ventilation
 - Fluid and electrolyte management
 - Hematologic status and coagulation
 - Nutrition and elimination
 - Infection control
 - Activity
 - Hygiene and skin care
 - Psychosocial and spirituality
 - Safety
 - Circuit:
 - Circuit check
 - Pressure monitoring
 - Pump/gas flow
 - Circuit infusions
 - Anticoagulation management

- Blood and blood product infusion
- Hemofiltration set-up
- Maintenance of aseptic technique
- Alarms and troubleshooting
- Documentation
- ECMO emergencies and complications – Patient and Machine:
 - Patient:
 - Hypotension
 - Hypovolemia
 - Severe coagulopathy
 - Seizures
 - Hemothorax/hemopericardium
 - Hemorrhage – intracranial and other
 - Pneumothorax/pneumopericardium
 - Accidental decannulation
 - Cardiac arrest
 - Machine:
 - System or component malfunction or failure
 - Circuit disruption
 - Raceway rupture
 - Air embolus
 - Clots
- Management of complex ECMO cases:
 - Surgery on ECMO-post-operative bleeding
 - Intra- and inter hospital transport
- ECMO Weaning techniques
 - Clinical indications for weaning (pulmonary/cardiac recovery)
 - Pump/gas flow technique
 - Activated Clotting Time (ACT) changes during weaning
 - Ventilatory changes during weaning
 - Trial off/decannulation from low flow
- ECMO weaning complications
 - Inadequate oxygenation/ventilation
 - Respiratory distress
 - Hemodynamic instability
- Decannulation procedures:
 - Roles and responsibilities of ECMO team members
 - Decannulation procedure
 - Medications required
 - Potential complications
 - Vessel ligation
 - Vessel reconstruction
 - Percutaneous approach

- Post ECMO complications:
 - Platelet and electrolyte alterations
- Short- and long-term developmental outcome of ECMO patients:
 - Institutional follow-up protocol
 - Literature review
- Ethical and social issues:
 - Consent process
 - Parental and family support
 - Withdrawal of ECMO

Several examinations will be administered to learners during the course of the in-person/classroom sessions. A minimum grade of 85% on each exam must be achieved to successfully pass the in-person/classroom portion of the ECMO education.

Skills, knowledge, attitude and behavior during simulations will be evaluated through:

- Learner self-evaluation;
- Peer evaluation; and
- Teacher/facilitator evaluation

Upon successful completion of the in-person/classroom portion of the education, the learners then progress on to completing mentored clinical shifts

Detailed in Class Timetable

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Morning 0730-1000	Morning 0730-1000	Morning 0730-1000	Morning 0730-1000	Morning 0730-1000	Morning 0730-1000
<ul style="list-style-type: none"> ●Welcome, introduce, and round table ●Overview of education including learner and facilitator expectations ●Ice breaker/ team building exercise ●Review and Q&A of self –directed learning material <ul style="list-style-type: none"> ○Respiratory and circulatory pathophysiology ○Principles of oxygenation ○Acid base balance ○Coagulation Physiology 	<ul style="list-style-type: none"> ●Review and Q&A <ul style="list-style-type: none"> ○Patient selection and pre-ECMO evaluation ○Roles and responsibilities of ECMO team members ○Notification of team ○Cannulation procedure ○ECMO equipment ○ECMO circuit ●Exam – 1 hour <ul style="list-style-type: none"> ○ matching ○ multiple choice ○ short answer ○ diagram labeling 	<ul style="list-style-type: none"> ●Review and Q&A <ul style="list-style-type: none"> ○Daily Management of the patient on ECMO ○Daily management of ECMO circuit ●Exam – 1 hour <ul style="list-style-type: none"> ○ matching ○ multiple choice ○ short answer ○ diagram labeling ●Ice breaker/ team-building exercise 	<ul style="list-style-type: none"> ●Review and Q&A <ul style="list-style-type: none"> ○ECMO Complications and Emergencies ●Exam – 1 hour <ul style="list-style-type: none"> ○ matching ○ multiple choice ○ short answer ○ diagram labeling ●Ice breaker/ team-building exercise 	<ul style="list-style-type: none"> ●Review and Q&A <ul style="list-style-type: none"> ○Complex ECMO ○Legal and Ethical issues ○Weaning Techniques ○Decannulation ○Exam – 1 hour ○ matching ○ multiple choice ○ short answer ○ diagram labeling ●Ice breaker/ team-building exercise 	<ul style="list-style-type: none"> ●Simulations replicating clinical scenarios supervised by experienced practitioners.

scenarios supervised by experienced practitioners.	scenarios supervised by experienced practitioners.	scenarios supervised by experienced practitioners.	scenarios supervised by experienced practitioners.	scenarios supervised by experienced practitioners.	scenarios supervised by experienced practitioners.
<ul style="list-style-type: none"> •Introduction to simulation; including ground rules •Roles and responsibilities of ECMO team members •Notification of team •Cannulation procedure 	<ul style="list-style-type: none"> •Cannulation •Daily management of ECMO circuit <ul style="list-style-type: none"> ○Circuit check ○Pressure monitoring ○Pump/gas flow ○Medication administration ○Circuit infusions ○Blood administration ○Anticoagulation management (including blood surface interactions) ○Hemofiltration set-up ○Maintenance of aseptic technique ○Alarms and troubleshooting ○documentation 	<ul style="list-style-type: none"> •ECMO Complications and Emergencies <ul style="list-style-type: none"> <u>Patient</u> <ul style="list-style-type: none"> ○Bleeding ○Pneumothorax/ ○Pneumopericardium ○Hypotension/ ○Hypovolemia ○Severe coagulopathy ○Seizures <u>Equipment</u> <ul style="list-style-type: none"> ○Circuit disruption ○Raceway rupture ○System/ ○component rupture ○Air embolus ○Inadvertent decannulation ○clots 	<ul style="list-style-type: none"> •Complex ECMO •Weaning techniques •Decannulation 	<ul style="list-style-type: none"> •Simulations replicating clinical scenarios supervised by experienced practitioners. 	<ul style="list-style-type: none"> •Simulations replicating clinical scenarios supervised by experienced practitioners.
Break 1415-1430	Break 1415-1430	Break 1415-1430	Break 1415-1430	Break 1415-1430	Break 1415-1430
<ul style="list-style-type: none"> • Introduction to ECMO equipment • Introduction to ECMO circuit and components: (cannula, pump, venous return monitor, in-line saturation monitor, pressure monitor, heater, hemofilter, bubble detector) • Priming of ECMO circuit • Initiation of bypass 	Continue with: <ul style="list-style-type: none"> • Cannulation • Daily management of ECMO circuit 	Continue with: <ul style="list-style-type: none"> • ECMO Complications and Emergencies 	Continue with: <ul style="list-style-type: none"> • Complex ECMO • Weaning techniques • Decannulation 	Continue with: <ul style="list-style-type: none"> • simulations 	Continue with: <ul style="list-style-type: none"> • simulations
<p>ELSO minimum education and training: 24-36 hours didactic lectures; 24-40 hours simulation, labs, and/or drills PHC education: over 24 hours didactic lectures plus self-directed learning material and participation in online community of practice; 28 hours of simulation and 72 hours of mentored bedside shifts.</p>					

Phase 4: Mentored Clinical Shifts (September – October 2013)

The learner will complete a minimum of 72 hours of mentored clinical shifts. During the mentored clinical shifts learners and mentors will record the clinical experiences and competencies that have been experienced/performed/met utilizing a clinical experience checklist and a competency checklist. Prior to beginning the mentored clinical shifts learners will be provided with a clinical hand guide. The hand guide contains:

- Clinical experience checklist
- Competency checklist
- Glossary of terms
- Policies, procedures, standards for initiating, maintaining, and discontinuing ECMO
- Patient assessment guidelines
- Documentation guidelines
- Roles and responsibilities
- Contact list
- Tips and tricks for troubleshooting ECMO circuit, alarms, etc.

As in the simulations skills, knowledge, attitude and behavior during mentored clinical shifts will be evaluated through:

- Learner self-evaluation;
- Peer/team member evaluation; and
- mentor evaluation

Upon successful completion of all three components of the ECMO education of the learner then receives their ECMO certification.

Phase 5: Ongoing Competency and Development (September 2013 and onward)

- Case Review team meetings:
 - Effectiveness of the team
 - Individual performance
 - Equipment function
 - Systems function
 - Problem identification

Note: Attendance is recorded and monitored. ECMO team members must attend and actively participate in a minimum of 3 meetings per year.

- Formal Team meetings
 - Review of ECMO literature
 - Review of policies, procedures, standards, order sets, etc.

- Review of unit statistics – # of cases, pump hours, etc.
- Quality improvement – infection rates, adverse events, etc.

Note: Attendance is recorded and monitored. ECMO team members must attend and actively participate in a minimum of 3 team meetings per year.

- Simulations/water drills
 - Minimum 12 hours every six months, preferably every 4 months
- Annual re-examination
 - Knowledge, skills and attitude
- Minimum # of pump hours or re-training
 - Minimum of 8 pump hours every ten weeks or must undergo re-training (Extracorporeal Life Support Organization, 2010).

Sources:

Annich, G., Lynch, W., MacLaren, G., Wilson, J., & Bartlett, R. (Eds.) (2012) *ECMO: Extracorporeal cardiopulmonary support in critical care* (4th ed.) Ann Arbor, MI: Extracorporeal Life Support Organization.

Short, B., & Williams, L. (Eds.) *ECMO specialist training manual* (3rd ed.) Ann Arbor, MI: Extracorporeal Life Support Organizations.

Extracorporeal Life Support Organization. (2010, February). *ELSO guidelines for ECMO centers* (Version 1.7). Retrieved from <http://www.elsonet.org/downloads/resources/guidelines/also%20guidelines%20for%20ecmo%20centers.pdf>