

## EVALUATION OF POINT OF CARE ULTRASOUND TRAINING FOR MIDWIVES

EVALUATION OF POINT OF CARE ULTRASOUND TRAINING FOR MIDWIVES

By Bronte K Johnston, BHSc. (Hons)

A thesis submitted to the Faculty of Health Sciences in Partial Fulfillment of the  
Requirements for the Degree Master of Science in Health Sciences Education

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MASTER OF SCIENCE (2021)  
(Health Sciences Education)

McMaster University,  
Hamilton, ON, CANADA

TITLE:

EVALUATION OF POINT OF CARE  
ULTRASOUND TRAINING FOR MIDWIVES

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NUMBER OF PAGES

xv, 167

## Lay Abstract

The ability to conduct ultrasounds has recently been included in Ontario midwives' scope of practice. This project evaluated a newly developed Point of Care Ultrasound (POCUS) curriculum for practicing midwives to understand how midwives can learn and apply POCUS into their clinical work. Learners completed surveys at four time points from pre-course to one-year post-course to share their experiences of knowledge and skill acquisition and applying this training to their clinical work. Five midwives also participated in an interview to share their perspectives about the course more in-depth. It was found that Ontario midwives were very interested to learn POCUS to improve client care. Unfortunately, they struggled finding time and opportunities to refine their sonography skills such as securing a clinical practicum or the funds to purchase a device. However overall, POCUS in midwifery was well received, this technology and its respective education should continue to be supported in Ontario.

## Abstract

**Introduction:** In 2018, the College of Midwives of Ontario expanded the scope of practice for registered midwives to include performing point of care ultrasound (POCUS) to aid their obstetrical clinical assessments. This project evaluated learner sonography knowledge, skill acquisitions, and integration of this technology following an innovative POCUS curriculum developed for midwives to understand the impacts of this training.

**Methods:** Concurrent triangulation with mixed methods was used in this study through surveys and interviews. First, the surveys were used to collect data across four time points including before and after the intervention. Five- and seven-point Likert scale questions were analyzed through descriptive statistics. Open-ended questions were qualitatively analyzed using thematic analyses. Second, the semi-structured interviews were conducted to better understand participants' attitudes and clinical behaviours. Interviews were coded and analyzed using a combination of Corbin and Strauss as well as Charmaz approaches to grounded theory.

**Results:** The findings demonstrated how there was a positive growth in learner comfort with POCUS and a desire to continue using it during clinical practice. The frequency of POCUS use within antenatal care increased with common applications including fetal presentation and assessment of pregnancy viability. The interviews highlighted five themes: facilitating learning, improving care, refining the role of the midwife, serving

community, and maintaining competency. Access to clinical placements and the cost of a device were identified as barriers to promoting POCUS skill sets. Participants who had access to a device and completed the clinical practicum are continuing to use sonography within their clinics to provide more comprehensive client care.

**Conclusions:** This project demonstrates how POCUS training can positively impact midwives particularly with aiding clinical decision making such as those regarding fetal viability and presentation. However, the challenges with obtaining a clinical practicum to ensure competency and the cost and access to a device, are significant barriers that unless they are addressed, may result in minimal integration within community practices.

## Dedication

*To Mom, Dad, and Makenna  
My Earliest Teachers and Biggest Supporters  
Merci pour tout ce que vous faites*

*“Fight for the things that you care about, but do it in a way that will lead others to  
join you.” -Justice Ruth Bader Ginsburg*

## Acknowledgments

I would like to sincerely thank my supervisor Dr. Beth Murray-Davis for all of her continued support, guidance, and insights throughout my thesis. I am eternally grateful for her continued mentorship in helping me complete this degree and develop my skills as a researcher. I would also like to thank Drs. Elizabeth Darling and Anne Malott for their help in shaping this project and for their ample feedback to make me a better scientist. Thank you also to Ms. Carol Bernacci and Ms. Laura Thomas for all their insights into medical radiation sciences, sonography training, and POCUS curricula throughout this work. Gratitude as well to Dr. Anita Acai for her help with this project and for being the external examiner for my defense.

I would also like to take this opportunity to thank all the members of the McMaster Midwifery Research Centre for all their support, help, and comradery. Many thanks to Dr. Elizabeth Cates, Dr. Stacey Ritz, and Prof. Hartley Jafine from the Bachelor of Health Sciences Program for your continued encouragement and opportunities to engage with the inquiry process. Thank you as well to the Health Sciences Education program, notably Dr. Lawrence Grierson, for all their assistance and support in making it possible for me to pursue graduate studies —I am forever grateful.

Thank you to all the study participants for sharing your stories. It was an honour to hear and see your dedication to midwifery and the excellent care you provide to your clients. I would also like to thank all the babies I have cuddled at McMaster's NICU for



motivating me to pursue perinatal research and a scientific career to make the world a better place. You may have been small, but your strength and might was indescribable.

I would like to thank my friends and family for their love and encouragement for me to pursue my dreams of graduate school. You constantly encourage me to think bigger, take much needed breaks, laughs, and excellent training sessions to challenge my athletic abilities. To my sister Makenna for her love and our inside jokes; I am also blessed to have another 'sister' in my dear friend Juliette (*how did I deserve a best friend like you?*). To my dog Oscar, thank you for being my running partner, my companion in graduate school (*your woofs provided many insights*), and most of all for being my mom's service dog. Thanks to Hudson as well, for bringing lots of puppy energy and your cheeky behaviour in during difficult times. Finally, Mom and Dad, this truly would not be possible without your unwavering love and selflessness, you are the reasons I am here today.

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## Abbreviations

BPP	Biophysical Profile
CAC	Certificate of Added Competency
CBE	Competency Based Education
CHERRIES	Checklist for Reporting Results of Internet E-Surveys
CMO	College of Midwives of Ontario
COVID-19	Coronavirus-19
CPG	Clinical Practical Guidelines
EMCM	Expanded Midwifery Care Model
ECV	External Cephalic Version
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HiREB	Hamilton Integrated Research Ethics Board
MMRC	McMaster Midwifery Research Centre
MOHLTC	Ministry of Health and Long-Term Care
OSCE	Objective Structured Clinical Exam
POCUS	Point of Care Ultrasound

## Declaration of Academic Achievement

The work described in this thesis was performed by Bronte Johnston, who will be referred to as the “primary researcher” moving forward. This project was supervised by Dr. Beth Murray-Davis. Drs. Elizabeth Darling and Anne Malott assisted with the research and writing progress of this thesis as supervisory committee members. Ms. Carol Bernacci and Ms. Laura Thomas helped to develop this point of care ultrasound course and provided their insight and feedback throughout this research process. The external examiner of this thesis defence was Dr. Anita Acai.



## Gendered Language Disclaimer

*The majority of available literature surrounding midwifery care and perinatal health use binary gender pronouns. Therefore, binary pronouns are sometimes used throughout this thesis for clarity of writing. However, it is acknowledged that not all pregnant people and parents identify as female.*

## CHAPTER ONE: PROJECT INTRODUCTION

### 1.0 Project Overview:

Midwives are regulated healthcare professionals who provide primary care during pregnancy, birth, and six-weeks postpartum for pregnant people and newborns. In 2018, the College of Midwives of Ontario (CMO), approved a scope expansion that allows midwives to perform ultrasound scans in their clinical practice provided their interest and completion of appropriate sonography training (1). In response to the 2018 scope expansion, McMaster University and Mohawk College partnered together to create and launch a Point of Care Ultrasound (POCUS) course for primary maternity care providers in 2019: *The McMaster-Mohawk Point of Care Ultrasound for Primary Maternity Care*. The purpose of this thesis was to evaluate this educational initiative to understand how maternity care providers learn and clinically apply POCUS.

### 1.1 Background on Midwifery in Ontario:

The Canadian midwifery model of care is based on three major tenants of continuity of care, choice of birth place, and informed choice. These principles help to ensure that midwives clients feel supported, have all the information they need to make informed decisions throughout their pregnancy and are able to give birth where they feel most personally comfortable (2). Midwifery is a fast growing perinatal healthcare profession in Canada, with over 1,900 midwives caring for approximately 40,939 low-risk pregnant people or 11% of Canadian births in 2019 (3). The midwifery profession is regulated at

the provincial level through a province or territory's respective College of Midwives (4). Until recently, Prince Edward Island and the Yukon had no practicing midwives in these regions, however this is slowly changing provide midwifery access in these communities. The provincial government of Prince Edward Island is working to include midwifery in their registered health professions act to hopefully offer midwifery services in Fall 2021 (5,6). Midwifery will shortly be available in the Yukon as well, as policy makers are trying to regulate and fund the profession, as well as developing standards of practice to provide excellent perinatal care by midwives throughout the territory (7,8).

In Ontario, midwives are publicly funded through the Ministry of Health and Long-Term Care (MOHLTC). Therefore, Ontarians do not have to pay any additional costs to seek perinatal care from a midwife (9). The midwifery profession in Ontario was first regulated in 1994 through the Midwifery Act (10,11). Ontario midwives are governed by the CMO which outlines a midwife's scope of practice and their clinical care standards (10,11). The CMO also plays a key role in shaping midwives' conduct by outlining the ethical and philosophical underpinnings of the profession, such as the emphasis in midwifery on client-centred care, practitioner self-regulation, and professional integrity (12). Since 1994, the midwifery scope of practice has been revised and to ensure midwives are able to continue to provide the best client-centred care throughout Ontario and the rest of Canada (13–15).

On January 1<sup>st</sup> 2018, a CMO scope expansion occurred which allows midwives to perform ultrasounds to improve antenatal care (1). This expansion resulted in

amendments in the MOHLTC's Controlled Acts Regulation to accurately reflect the professional framework of Ontario midwives (16). Midwives incorporating sonography into their clinical work must demonstrate the required knowledge, skills, and clinical judgement to include POCUS in their care as this additional skillset is optional (1). For Ontario midwives to work to in their fullest scope of practice and to support safe clinical integration of POCUS, education is required.

In Canada, midwifery education is delivered through a specific undergraduate health sciences midwifery degree. The Canadian midwifery education model allows learners to appreciate various midwifery perspectives, such as from anatomy and physiology, microbiology, pharmacology, and social sciences lenses. This divergent education provides learners with broader contexts of the health care system and social determinants of health, while also facilitating extensive clinical learning through placements. Upon degree completion, students are able to complete the Canadian Midwifery Registration Examination for their respective college and upon passing the exam, they may begin practicing as a registered midwife (10). However, midwives must continue with recertification and continuing education courses to maintain their knowledge, skills, and good clinical standing with their college throughout their careers. This rigorous undergraduate and continuing midwifery education provides students and midwives with a variety of resources to acquire, maintain, and further their clinical learning to be excellent practitioners.

## 1.2 Background of Point of Care Ultrasound (POCUS):

According to Sonography Canada, a bedside or point of care ultrasound scan is used to improve patient care by supplementing practitioners' clinical examinations to better inform their clinical judgments (17). POCUS is utilized by many healthcare providers, such as by emergency physicians in cardiac assessments to help determine if further interventions or examinations are required (18,19). Sonography Canada acknowledged in 2018 how POCUS is intended to aid clinical examinations but does not replace any diagnostic tests or imaging (17). Sonography Canada's professional practice guidelines emphasized how technically challenging it is to acquire ultrasound skills. Therefore, there is the need for detailed training particularly for health professions who have no previous sonography training (17).

## 1.3 Midwifery and POCUS:

The midwifery model of care includes highlights how technology is only to be used appropriately to best support client care (1). The CMO is very supportive of expanded midwifery scopes of practice, such as 2018 ultrasound expansion, and provides additional information regarding their regulatory framework, insurance, and funding (1,20). It is understood that technology, such as a POCUS device, has the potential to positively enhance care, but there is also an awareness that it must be cautiously applied. For example, a bedside ultrasound scan may not be clinically necessary in

certain situations or in all prenatal visits, therefore it should not be used without an indication (21,22).

Across Canada, POCUS usage varies between different provincial midwifery regulations. For example, the midwifery college and health policies in British Columbia highlight that practicing midwives are able to apply ultrasound to help with fetal heart monitoring (23,24). Other provinces such as Alberta stated that regulated midwives with advanced authorization may perform ultrasounds for obstetrical purposes with training (24,25). While Alberta's legislature indicated that midwives can use bedside ultrasounds in their work, there were minimal specifics for what clinical scenarios and indications this includes. Provinces such as Manitoba, Quebec, New-Brunswick, and Nova Scotia have no direct references to midwives applying ultrasound within their practice in their regulatory acts (26–29). The variance of how ultrasound may be used demonstrates the differences in midwifery legislation and a midwife's scope of practice across Canada.

While the CMO's 2018 scope expansion was the first legislation to enable midwives to perform ultrasound in Ontario, POCUS is an element of midwifery care and continuing perinatal education in other provinces and throughout the world (23,30,31). POCUS is starting to be incorporated globally into midwifery care, particularly in underserved areas and low-resource countries where ultrasound clinics are not readily accessible (30). POCUS in obstetrics allows practitioners, such as midwives, to have real time sonographic images to guide their clinical evaluations to minimize pregnancy complications and mortality (32). Currently, there are no guidelines with respect to the

minimum training and curricula standards to ensure competency amongst POCUS trainees. Specifically with Ontario midwifery, there is no guidance regarding how ultrasound can be taught and integrated into clinical practice (1,11). Therefore, there is a need to evaluate POCUS training, curricula, and clinical integration.

Currently, ultrasound training is not part of undergraduate midwifery education program in Ontario. Other provinces in Canada have included sonography training as a continuing education course (23,31). For example, in British Columbia, there is an ultrasound course that has online modules and workshops for midwives and physicians to improve remote sonography clinical care (31). In general, POCUS is a recent element of midwifery care and continuing education across the world (30,33). Therefore, sonography education programs are in demand to teach clinicians ultrasound techniques as POCUS technology becomes more readily available.

The McMaster-Mohawk POCUS Primary Maternity Care Course was the first Ontario initiative to educate clinical learners about POCUS in perinatal care. The purpose of this course was to teach midwives the knowledge and scanning techniques for POCUS across the three trimesters of pregnancy. This research project explores how the ultrasound scope expansion influences midwifery practice, how midwives develop sonography skills, and the greater implications of POCUS in Ontario midwifery care.

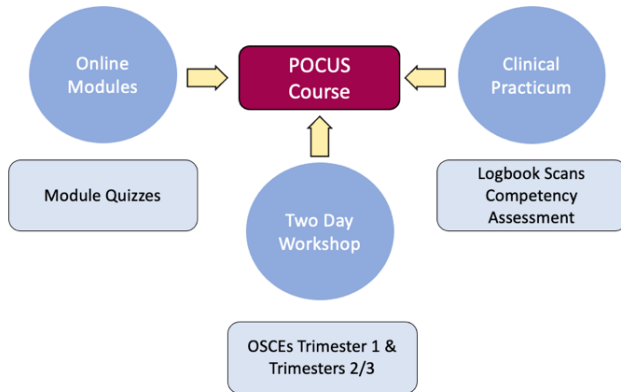
## 1.4 The McMaster-Mohawk POCUS Course for Primary Maternity Care Fall 2019

This POCUS for primary maternity care continuing education course was developed from 2018-2019 and was offered to learners for the first time in October 2019. The course development was a collaborative initiative between the McMaster Midwifery Education Program and the Mohawk-McMaster Collaborative Medical Radiation Sciences Program. A team of faculty from various departments including sonography, midwifery, and obstetrics worked together to develop the course content and structure. This course was designed to encompass various sonographic techniques throughout the three trimesters of pregnancy using a variety of instructional and assessment approaches (Figure 1).

The major areas of study for learners included: an introduction to the use of POCUS, ultrasound physics, sonographic anatomy across all trimesters and ethics. The course content was designed to reflect Sonography Canada's National Competency Profile requirements in obstetrical ultrasound and was informed by a recent needs assessment examining Ontario midwives intentions for how to use ultrasound in practice (17,34).



Figure 1 POCUS Course Components



This course was designed to provide midwifery sonography training in a Canadian context for entry-level POCUS skills and included three components: online modules, a two-day workshop, and a clinical practicum (Appendix A, Figure 1). Based on the different ultrasound learning methods throughout this curriculum, a variety of assessment tools were used to evaluate learner knowledge and skill acquisition with POCUS (Figure 1). Each of the online modules had an online quiz in which learners had to obtain at least 80% in before attending the in-person weekend session. The purpose of the modules and quizzes were to lay the sonography knowledge foundation learners needed to acquire the clinical skills in the workshop and the practicum. The two-day workshop required learners to practice and demonstrate their skills through clinical scans and assessments across all three trimesters. Learners needed to pass these simulated scans to move forward to the clinical practicum; remediation was available if learners did not pass on their first attempt. During the clinical practicum, learners were supported to refine their POCUS skills under direct supervision from a preceptor.

Participants were responsible for organizing this placement with a clinical supervisor and to document their scans for evaluation. The competency requirements of the practicum for each learner were signed off as satisfactory by their preceptor in a logbook. Learners were required to conduct 20 first trimester and 20 second or third trimester scans.

Learners were also required to complete a final objective structured clinical examinations (OSCE) based on Sonography Canada's recommendations to assess their POCUS competencies (17). Once learners had completed their logbook and passed the required course assessments, they received a certificate of course completion. Following completion of the practicum, learners were then able to use and self-regulate POCUS usage within their midwifery practice.

### 1.5 Study Purpose:

Since Ontario midwives have only recently been able to perform ultrasound, there is currently little evidence to support the learning or clinical applications of POCUS for midwives in Ontario. The ways midwives develop their POCUS knowledge and skills, as well as how they apply ultrasound to clinical practice are starting to be uncovered in the global literature; but remains unknown and minimally studied in the Ontario and Canadian contexts respectively. Thus, our aim was to evaluate the McMaster Mohawk POCUS continuing education course by exploring what midwives learned in this curriculum, how this impacted their practice, how they maintained competency in their new ultrasound skills, and areas for course improvements.

## CHAPTER TWO: LITERATURE REVIEW

### 2.0 Overview of the Literature:

In this chapter, the literature that informed this project will be reviewed. This literature was primarily centred around current uses of POCUS with relation to clinical obstetric care, sonography continuing education curriculum design, and POCUS learning assessments. Additional literature that will be discussed in this chapter include determining POCUS competency in learners, sonography learning barriers, and continuing health professions program evaluation with the Kirkpatrick model.

### 2.1. POCUS Use Within Obstetrics:

There is growing evidence in the literature that POCUS has been positively received by healthcare providers to inform their clinical decisions. It is important to note that POCUS does not replace any diagnostic scans performed by a radiologist or an accredited sonographer (19). POCUS supplements practitioners' clinical assessments in real time to better inform their next steps to treat their patients. The standard of care for diagnostic ultrasounds in low-risk pregnancy typically include two scans: a gestational dating scan in the first trimester and a fetal anatomical scan in the second trimester. However, if any abnormalities are found in prenatal screening or the parent is considered high risk pregnancy, additional scans may be requested by a patient's primary perinatal care provider (35,36).

While POCUS is not a diagnostic scan, the easy and timely images from a bedside ultrasound scan help to improve clinical care. Some examples of how POCUS has been used in obstetrics include practitioners using this technology to confirm gestational age and placental location (32,37). The benefits of bedside sonography were shared in Morgan et al.'s (38) work that evaluated the use of POCUS to aid the clinical management of suspected intrauterine pregnancies (IUP) in emergency departments through a multi-centered retrospective randomized control trial (38). This study compared POCUS and full diagnostic ultrasound scans for patients who had vaginal bleeding and abdominal pain to determine the presence of an IUP. In total, 118 patients received POCUS and 106 had a diagnostic ultrasound. The results indicated that the time to diagnoses and length of hospital stay was 87 and 181 minutes for POCUS, and 136 and 201 minutes for diagnostic ultrasounds respectively. While this study population was small and focused IUPs in early pregnancy, the results illustrate the potential for POCUS to aid in clinical efficiency in obstetrical emergencies (38). Similarly, French, Henry, and Williams' (39) study employed a retrospective design where medical records were reviewed based on the presentation of vaginal or abdominal bleeding or syncope in patients during their first trimester. This study was situated in the West Indies, where ultrasound clinics are not readily available because of the minimal operational equipment available in these communities. Participants were stratified based on their ultrasound records based on if they had an IUP or not. An IUP was defined in this study as the presence of a gestational sac with or without both a yolk sac or a fetal pole in the

uterus. Participants without an IUP were further categorized as confirmed ectopic pregnancies, free fluid, a combination of both free fluid and an adnexal mass, or no free fluid to represent what ultrasound images presented (39). The results indicated that bedside scanning was an excellent method to screen which patients required more testing, such as a diagnostic scan (39). It was estimated that 56% of French, Henry, and Williams' study population (total study population size  $n=116$ ,  $56\%= 66/116$ ) would have been sent home with an extrauterine pregnancy untreated if a bedside scan was not performed (39). Therefore, POCUS was able to help ensure a correct diagnosis and safe patient discharge. It is important to note that this study stated that its population was small and there was missing data from both the emergency department and ultrasound records which could have skewed the results. Additionally, with multiple physicians reading the ultrasounds, there may have been rater inconsistencies as well (39). However, this data still illustrates how bedside scanning was able to improve patient safety by ensuring they were not sent home with a non-IUP. While this research was not conducted in Canada, considering the vast number of remote and underserved communities throughout the country, such as Northern Ontario, the similarities of poor healthcare access are relevant. The literature also demonstrated a variety of ways POCUS has been applied to guide other obstetrical clinical decisions. Other examples of POCUS include assessing amniotic fluid levels, as well as determining the presence of abdominal bleeding, a hematoma or a shortened cervix (32,38,39). POCUS is a tool that

provides timely and efficient information that informs clinical management in pregnancy.

With integrating POCUS technology into clinical care, the Certificate in Clinician Performed Ultrasound explicitly highlights how medical practitioners need to stay within their respective scope of practice and are to only use POCUS for indications they have received training for. Examples of on non-complex bedside ultrasound scans perinatal care providers may also include finding a fetal heartrate to confirm viability, determining free fluid levels, assessing bleeding, and measuring crown-rump length (32). The breadth of possible clinical applications for POCUS in obstetrics requires careful consideration as to which of these indications may be best suited for Ontario midwives and how the McMaster-Mohawk POCUS course can reflect these indications.

#### *POCUS Being Used Globally in Midwifery:*

There were several studies specifically exploring the use of POCUS in midwifery outside of Canada. There has been a focus on how POCUS aids midwifery care in low- and middle-resource countries such as Zambia, Rwanda, Kenya, and Liberia, particularly in rural and remote communities (30,40–42). The overarching messages of these studies in these underserved areas were how POCUS can improve prenatal care and clinical decision making (30,40–42). The demand for portable ultrasound technology in low-resource regions was a common theme in the literature. POCUS may be the only way for many clients to have an ultrasound in these remote communities. These study designs involved evaluating various POCUS courses with both quantitative and qualitative

analyses. The quantitative analyses included closed-ended survey questions and course assessments such as OSCE scores; the qualitative methods examined participant interviews and focus group discussions. For example, Holmlund et al.'s (30) study followed 23 midwives in six focus groups to qualitatively understand how POCUS could support midwifery care. This study emphasized the importance of understanding practitioners' perspectives of this new POCUS technology and revealed the importance of ultrasound training to support remote midwifery clinics (30). Quantitative studies included work by Bentley, Hexom, and Nelson (41), where 23 midwives completed a POCUS course, with 14 participants followed over one-year (41). The aim of this study was to understand how midwives learned and retained POCUS knowledge and skills through OSCE assessments over time. These researchers found a statistically significant difference between pre- and post-course OSCE scores, with negligible differences in comparing the initial and one-year post-course scores (41). This research illustrates the importance of initial training and how learners are able to retain their new sonography knowledge and skills (41). A common limitation throughout these studies were their small sample sizes. A possible explanation to the minimal number of participants in these studies may be the small size of the midwifery profession as well as the busyness of practitioners' schedules which hinder them to participate in research and continuing education initiatives. Additionally, the small sample sizes of these data sets may be that these devices are not available in many clinics and therefore there may be minimal opportunities for midwifery sonography education. Despite these limitations, the

literature demonstrates the benefits of POCUS in obstetrical care and its respective continuing education courses for midwives.

Midwives were also consistently able to successfully learn and clinically apply POCUS. Study participants indicated their high sonography comfort level and the use of POCUS to help diagnosis of IUPs, dating, placental location and fetal presentation (19,30,41–43). Midwives were able to achieve over 99% accuracy on bedside scans despite the uncertainty of the image quality of a portable device in a study by Vinayak et al. (19). With a high scan accuracy, midwives were able to inform their clients' next clinical steps based on the ultrasound images from POCUS. While this study only followed three midwives, they completed almost 300 scans collectively to demonstrate their detailed and accurate sonography skills (19). The accuracy midwives were able to obtain in conducting ultrasound scans speaks to their capabilities to learn sonography despite not being accredited sonographers or radiologists.

#### *POCUS for Ontario Midwives:*

A recent Ontario study shared how enthusiastic midwives were to learn and apply POCUS in their practice. This needs assessment survey explored Ontario midwives' perspectives regarding integrating ultrasound within their clinical practices after the announcement of the 2018 CMO scope expansion in a survey (34). The results indicated that midwives felt POCUS training was an opportunity for their personal self-advancement, which would allow them to become more independent healthcare practitioners. With POCUS providing them with more clinical skills, survey respondents



felt that this new technology would also improve the public perception of the midwifery profession. There was also a desire to incorporate ultrasound into provisional care as it would help give more comprehensive care, improve accessibility of healthcare services, and lead to faster treatment for their clients (34). Midwives expressed an interest of having specific training for routine clinical scans. Examples of indications for which Ontario midwives were specifically interested in using POCUS included: fetal position, fetal heart rate, first trimester viability, placental location, and gestational dating (34). These stated indications and the previous stated literature helped to inform the McMaster Mohawk POCUS course content to reflect midwives' sonography needs. However, there were concerns by survey respondents regarding the high cost of purchasing a device, the need for continuous device maintenance, and financial compensations for their time and additional skills (34). Despite these concerns, Ontario midwives felt that the 2018 CMO ultrasound scope expansion was beneficial for both midwifery clients and practitioners. Further consideration is needed to how these aforementioned barriers can be minimized and what POCUS training would look like for Ontario midwives.

#### *POCUS Ethics in Midwifery:*

A key concept of midwifery is the principle of informed choice, which allows clients to choose their clinical care plans based on the evidence presented and discussed by their midwife. Therefore, midwives need to receive their clients' consent to use POCUS after an explanation of the risks and benefits, and the purpose of this technology in their care

(44). A Swedish study by Edvardsson et al. (45) reported the importance of educating their midwifery clients on the clinical relevance of POCUS and obtaining their consent

(45). In order for midwives to educate their clients on the purposes and benefits of bedside scanning, they need to have strong POCUS clinical knowledge and skillsets from training.

In considering the implications of POCUS, clients shared their receptiveness of midwives using POCUS in their perinatal care. Clients reported positive feelings of safety, reassurance, and comfort with midwives performing POCUS scans —demonstrating the support and importance of this technology being used in perinatal care (19). The real time images a POCUS scan provides also allow parents to bond with their developing baby (19). However, clinicians must remember that to conduct a POCUS scan, a medically necessary objective is needed. Adverse findings can also be found on bedside ultrasound images, therefore additional diagnostic scans and tests may be required. It is important to recognize that going for additional tests may be distressing for some clients (45). In these situations, it was commented on how midwives needed to provide the appropriate support, clinical care, and consolation for these clients during these anxious times of further testing based on the negative or inconclusive findings from a POCUS scan (45). Altogether, with integrating a new clinical skill like POCUS, midwives need to be mindful of the ethical implications such as the importance of client education, the purposes for POCUS scans, and providing continuous supportive client care to help ensure their safety.

## 2.2 POCUS Curriculum Design:

It is evident that POCUS can help different medical professions, however many practitioners do not have the training to conduct bedside scans. Therefore, there is a demand for continuing sonography education for clinical learners such as midwives (18,46). The overarching goal of medical education is to teach clinicians the necessary skills and knowledge in a certain area so they can provide good healthcare to their patients. To facilitate medical learning, competency-based education (CBE) focuses on the outcomes of each students' abilities with how they understand and perform the required skills. A key distinguishing factor of CBE is that educators rely on students' abilities to showcase their skills and knowledge as opposed to if they have simply completed the required training (47–54). For example, in CBE postgraduate medical education, residents are able to focus on the complexities of their new learning in different clinical cases, receive consistent feedback on their clinical skills, and continuous assessments to demonstrate their competency to evaluators (52,53). CBE also informs educators of learners' critical thinking skills and clinical decision-making processes to have a more well-rounded understanding of students' clinical behaviours (54). As POCUS is a new skill for many midwives, it is important to incorporate CBE into curriculum design to teach as well as evaluate good clinical skills and knowledge of bedside ultrasound in maternity care.

Clinical skills teachings, like POCUS training sessions, are often taught by an experienced practitioner, but they may not have a pedagogy background. Therefore,

introducing clinical skills curricula designers to educational phenomena would be beneficial in improving their teaching materials. An educational guide helps clinical instructors ensure their curriculum is constructively aligned with their learning goals, teaching activities, and assessments (55,56). Instructors need to actively think about what skills are important for their learners to have, how to conduct learner assessments, and the greater clinical impacts of this new training, such as how learners will apply this training to provide better patient care.

In the literature, POCUS curricula have been demarcated into different sections to account for the challenging material surrounding sonography knowledge and skill acquisition. The phases include: introductions to the fundamental knowledge and principles of POCUS, practice time to conduct and interpret scans for various indications, and POCUS assessments (57). Within curricula design, educators also need to be mindful of the purpose of the course learning objectives and its relevancy to learners (18). Additionally, learning objectives motivate educators to focus on the purpose and outcomes of the course. In this context, the learning goals speak to what learners will be taking forward into their clinics from this education. Focusing on learner achievement is also referred to as constructive alignment, which promotes connections between the intended learning outcomes, teaching activities, and assessments (58). Aligned curricula have also helped to promote learner engagement because the course assessments not only represent the content covered but what learners can directly translate into real life. In a midwifery context, POCUS education may involve having learners practice

transabdominal scanning on a patient volunteer to represent what they would see in their clinics.

Various educational models have been used throughout the literature to provide purposeful learning for clinical learners. For example, asynchronous online module-based courses have been well received by continuing education learners due to their flexibility. Online learning should especially be considered in designing courses for clinicians, like midwives, who have very busy schedules (40,57,59–61).

The International Federation for Emergency Medicine (IFEM) has also developed a competency-based curriculum framework to help educators understand how they can facilitate sonography learning. The IFEM clearly stated the required skills and outcomes learners must possess to be competent in POCUS with adequate training (18). While the IFEM is not directly related to obstetrical care, these curriculum guidelines provide helpful tools in POCUS curriculum design in general. Altogether, instructors need to think about how their learners, in the context of this study, primary maternity care providers, can learn and remain competent in their POCUS skills to help ensure good clinical practice.

### 2.3 POCUS Primary Maternity Care Curriculum Design:

Continuing education initiatives allow clinicians to build upon their previous knowledge to advance their skills. Examples of existing midwifery continuing education include: a Caesarean surgical assist course, as well as contraceptive counselling and care (62).

These continuing education initiatives allow midwives to further expand their skills to provide more perinatal care services in their communities.

POCUS midwifery courses in other regions have been created and analyzed, with the results showing that these sonography educational initiatives were well received by midwives. These courses revealed that POCUS education is beneficial for developing the required competencies for real-life clinical care. For example, Bentley, Hexom, and Nelson (41) designed a one-week curriculum composed of modules such as an introduction to ultrasound, normal pregnancy throughout the three trimesters, and pregnancy complications (41). To supplement the didactic materials, clinical skills sessions and ultrasound practice on patients were incorporated to help teach trainees to integrate their sonography skills within their practice (30,41,42). When developing POCUS curricula, educators need to be mindful of how health practitioners need both didactic and clinical learning to provide midwives with a detailed understanding of POCUS and how it can inform clinical decisions and patient care.

Another study evaluated a six-month training curriculum for Zambian midwives which had three two three-week training sessions (42). These sessions allowed trainees to become familiar with the technology and introduced clinical skills such as determining gestational age (42). In contrast to a week course, having the course spread over multiple week sessions, allowed learners to engage with the material for longer to feel more comfortable with their knowledge and skills. However, longer courses are more

challenging to coordinate because of the extra time required of instructors and learners as well as the larger costs associated with the training.

Interprofessional collaboration has also played a role in guiding midwifery POCUS training. In the literature, midwives have been taught how to conduct bedside scans by sonographers and physicians. Experienced physicians and sonographers have helped to ensure that midwives were well equipped in sonography knowledge and skills to support their communities (42,43). In Kenya for example, a radiologist and sonographers worked with midwives to teach them how to apply POCUS in their clinical assessments over four weeks to provide more comprehensive obstetrical care and improve access to sonography for their clients (43). Altogether, educational collaboration allows the midwifery professions to continue to grow and helps midwives better serve their communities.

Sonography is extremely challenging to learn and requires a significant amount of time for learners to acquire all the knowledge and skills. Therefore, a well-designed ultrasound curriculum is vital (57). Sonography Canada highlights the need for both sonography skills and 'core skills' such as communication, professionalism, patient assessment, and safety in all training programs (63,64). Critical thinking skills are also required for learners to display good clinical judgement regarding when sonography should be used in their clinics (64). Teaching materials and assessments consequently need to be challenging enough to promote deep thinking that will help learners replicate the real clinical scenarios they will see in the future. POCUS assessments should also be

aligned with Sonography Canada's national competency standards that aim to ensure that learners can perform scans independently and consistently amongst POCUS trainees (63,64). It is important to note however, currently, there is no formalized or standard training for POCUS (32). In Ontario midwifery, POCUS is supplemental to their undergraduate education, it is on-top of a midwife's existing demands such as clinical responsibilities.

Additionally, the Canadian Association of Radiologist's position statement for POCUS highlighted how there is significant variability in how practitioners learn POCUS and the quality of their images (44). For example, some learners may struggle with orienteering the ultrasound probe and may need more practice time than other learners. This calls into question if a short course, such as a two-day workshop, is sufficient to teach midwives introductory POCUS skills.

For health professionals, continuing education is essential to keep them up to date with recent research and knowledge so they can evolve to provide the best patient care. As adult learners, curriculum design should account for the experiences midwives are able to share regarding their work as a clinician to enhance their continuing education (65,66). Experiential education allows adult learners to translate the course objectives into direct activities, as opposed to only learning the didactic materials, to expand their current skillsets as well as promote personal reflection and evaluation (65,67,68). An example of how experiential learning can be included in POCUS curriculum could be when learners have hands-on practice with a device for different



clinical scenarios that represent real patients they may see in their clinics. Experiential education activities permit adult medical to reflect on their past and emerging competencies to evaluate their current strengths and areas of improvement to facilitate their learning.

Adult health professions learners also come into continuing education initiatives with clear goals, objectives, and motivations to improve their clinical practice. To accommodate these learning goals, educators can provide clinicians with relevant problem-solving activities that allow learners to directly apply and understand how their new knowledge connects to their clinical work (65). Critical reflection is also encouraged for adult learners to improve their independent learning and personal assessments to help continue their professional development outside of formalized training (65–67). Embodying critical reflection in curricula design may involve learners analyzing their academic performance and experiences throughout the course as well as how can they continue to engage with learning to advance their clinical skills.

*POCUS Learning Barriers:*

Despite health practitioners' overall interest in learning POCUS, there were barriers that hindered learners from applying bedside sonography into their practice. The literature highlighted the challenges of the costs of purchasing and maintaining a POCUS device as well as the costs of training (34,69). Learners were also inhibited by the significant amount of knowledge they were expected to learn and the time associated with training in addition to their other responsibilities (34,69). Curricula designers need to be mindful

of the number of topics within a program and the corresponding time commitment of the training to help minimize learners' stress (70). Despite these barriers, studies have reported increases in learner confidence in their sonography skills —highlighting the significance of formalized POCUS education (59,71). It is important for educators to learn from previous challenges to guide their personal curricula developments to minimize future learning barriers.

## 2.4 Assessments of POCUS Competency in Continuing Midwifery Education:

The International Confederation of Midwives has provided educators with an evidence based framework of the expected competencies of practitioners to help standardize midwifery education across the world (54,72). To aid educators, the midwifery competency framework includes the responsibilities of midwives throughout pre-pregnancy, antenatal, labour, and postpartum care. For example, it is expected that all midwives conduct thorough clinical examinations, as well as be able to detect and manage client health complications (72). In educational assessments, midwifery learners can showcase their didactic knowledge and their respective skillsets for evaluators to determine their competency; typically, if a learner is able to complete the required tasks successfully, they are considered competent in these respective new skills (54). Health professionals and trainees experience significant stressors throughout their careers; therefore, it is essential that they have extensive competencies in clinical knowledge and skills to provide the best care to their patients. Rigorous assessments help to assure that

practitioners have the required competencies in their respective profession (54,73).

Specifically, Ontario midwifery students have commented on the importance of challenging assessments to assure that in the future, they will be competent midwives (74). Therefore, there is a continued need for rigorous evaluations in midwifery.

As POCUS is not currently within undergraduate midwifery curricula in Canada, the majority of midwives have very minimal sonography knowledge or skills unless from personal experiences (10). Without previous sonography training, years of midwifery experience may not correlate with faster POCUS learning since years of residency training did not impact a medical doctors' ease with acquiring POCUS skills (75). POCUS learning and their respective competencies are not a linear relationship, some students may need more time to develop competency in their new sonography skills and knowledge than others. Clinical skills competencies are also associated with patient safety; a competent healthcare practitioner involves correctly performing the intended task consistently and easily (76–78). Therefore, clear curriculum goals centred around how learners can obtain POCUS competency are needed. To supplement these curriculum goals, clear and thorough evaluation schemes are required to correctly assess clinical learners' abilities to help ensure patient safety (77).

#### *Assessing POCUS Competency:*

Assessments ask learners to complete intended tasks, such as recall knowledge, to evaluate if the learner can complete them correctly. Currently, there are no guidelines for the minimum training standards that must be met to ensure competency amongst

point of care trainees. Therefore, educators need to think about student expectations with respect to the skills and knowledge they should have at the end of this training, and how their curriculum and assessments can reflect these goals.

There are various educational methods to assess clinical competency levels in the literature. Often multiple assessments are used in combination to improve the rigour of the competency-based evaluations. The complicated nature of competency evaluations may also explain why multiple assessments are often used in combination to determine a trainee's skill and knowledge levels. Examples of educational exercises used to assess clinical skills and didactic knowledge include OSCEs, knowledge based tests, and simulations of different clinical scenarios (19,30,41–43). Provided the challenges of determining a learner's competency level, educators need to have clear definitions of what skills and knowledge learners would need to demonstrate to be determined competent in POCUS and how different evaluations can assess these skills. For example, when assessing pregnancy viability, instructors may ask learners to share their clinical knowledge in multiple choice questions and new skills in an OSCE station. Another important factor in assessing competency is gathering evidence which illustrates that learners can make good clinical judgments regarding when and how POCUS scans should be conducted for different indications (50,77). Altogether, it is necessary for educators to have clear objectives to their curriculum and how their assessments can reflect these goals to help consistently determine learners' competencies.

Kumar, Kugler and Jensen (77) also commented on how quickly POCUS health professions continuing education is expanding and proposed a conceptual framework to guide competency assessments (77). Their POCUS competency framework included five phases: acquisition and application of POCUS knowledge, demonstration of skills competence, clinical integration of POCUS skills, and re-certification of sonography skills (77). The IFEM also shares similar suggestions with how POCUS assessments should focus on learners capturing and interpreting ultrasound images for different indications as well as clinical integration to determine a trainee's sonography competency level (18). Specifically, clinical knowledge has been frequently tested through multiple choice examinations as this method encourages content recall (77,79). In POCUS continuing education, multiple choice examinations have been used to identify a learner's strengths and areas of improvement in their new didactic knowledge (40). Sonography skills have been evaluated through OSCEs as these examinations allow learners to perform various skills that replicate their clinical practice by identifying measurements such as gestational age and crown-rump length (18,77,80). Overall, OSCE assessments can be tailored to specific learning objectives, they have also been well received and are an appropriate tool for POCUS clinical skills evaluations. OSCEs can also help educators determine a learner's knowledge and skills, areas of improvement, and if learners can responsibly integrate these skills into their clinics.

Additionally, Sonography Canada has provided guidelines to inform sonography competency assessments in obstetrics. It has been recommended for obstetrical

ultrasound evaluations to have students identify the gestational sac, fetal number, yolk sac, maternal adnexa, fetal anatomy, placental location, chronicity, fetal pole, and fetal heartrate across the three trimesters on simulation patients or virtually through a ScanTrainer machine (63,64). Including indications which primary maternity care practitioners will encounter frequently in their clinics, such as fetal presentation, or having learners identify any abnormalities are critical in order to evaluate students' preparedness to apply these new clinical skills. It was also advised for evaluators to consider if learners required help during sonography assessments to understand their gaps in knowledge or skills when determining their POCUS competency (63,64). In all, competency assessments are essential to quantify if a learner can start integrating POCUS within their clinic.

Timing of assessments also play roles in promoting students' academic successes. Learner performance on an OSCE was enhanced if the evaluation was completed immediately after POCUS training, upon additional POCUS training, or following a refresher course (40,60). Evaluating students immediately after training helped ensure that their POCUS knowledge is more recent and easier to recall during the OSCE to help them complete the test. Bentley, Hexom, and Nelson (41) found that after completion of the course and the post-course OSCE, participants had significantly higher confidence levels in performing POCUS scans; there were no significant differences in the OSCE scores one-year after initial evaluation. While Bentley, Hexom, and Nelson (41) reported the difference in OSCE scores throughout the one-year study period were not

statistically different between the two time periods, overall there was a decline in OSCE scores over time. Decreased assessment scores indicated a loss of sonography knowledge and skills in certain areas, most likely those which midwives were not using in their daily clinical care in this study (41). To help minimize knowledge loss in the future, POCUS course designers should understand what indications are not being used as often to help restructure the course to improve the relevancy of the teaching materials. Focusing on content which learners are more inherently interested in may also improve their engagement with the learning activities or abilities to perform well on assessments.

Bentley, Hexom, and Nelson's (41) study participants were able to maintain more than the majority of their POCUS skills in the one-year post-training OSCE (41). This speaks to the benefits of continued competency assessments in assuring a clinician's skills for patient safety (41). For example, poor performances on post-training POCUS assessments may indicate the need for these clinicians to complete further education to ensure the appropriate and correct use of bedside scans on patients. Connecting continued POCUS tests to Kumar, Kugler and Jensen's (77) POCUS conceptual framework, on-going evaluations of competency after the initial exposure and training would facilitate a better understanding of how learners have clinically applied the training. For example, it may be beneficial to understand learners' clinical judgments surrounding POCUS since the last evaluation, as well as their competency levels to inform if there is a need for re-certification of skills (77). In all, assessment timing plays a

key role in supporting learners' academic successes demonstrating their skills competencies and how they maintain them overtime to support their clinical practice.

Demonstration of successfully completing POCUS training and assessments can then be used to certify individuals or provide evidence of course completion which may be required for clinical learners to indicate their competency to regulatory bodies. This has been an area of growing importance as health professionals broadened their scope of practice. For example, in response to the expanding field of Family Medicine, the College of Family Physicians of Canada has designed a series of formal Certificates of Added Competency (CAC), in areas such as palliative care, to establish skill standards amongst advanced care family physicians. CACs are presented to medical doctors who successfully demonstrate their extensive expertise and competency in their respective domain to a structured review committee (81,82). The formalized structure of CACs, such as the extensive training standards and evaluations, provide validation and credibility for the services practitioners provide to their communities (81). Altogether, skills certifications help to communicate the explicit expectations and required competencies of clinicians to ensure quality patient care.

With the McMaster-Mohawk POCUS course, participants were presented with a certificate upon completing all the sonography teaching activities and passing all assessments to indicate their POCUS competency. POCUS certification has been reported to minimize peers' hesitancy in trainees' additional skills (83,84). Certification of completion of continuing education courses would also be beneficial in ensuring



consistency of POCUS competency as all learners would receive the same acknowledgement for successfully passing the training. Especially as POCUS courses become more prevalent in midwifery, given the various ways POCUS may be used in primary maternity care, different courses may not teach all the same indications or may have different standards of what constitutes POCUS competency. Course certification would be important in distinguishing courses by their respective learning goals and learners' POCUS competencies.

## 2.5 Evaluating Continuing Health Professions Education Initiatives:

Program evaluations need to be done in continuing health professions education courses to understand the greater clinical impacts of this training. Course evaluations are also opportunities to revise materials to better educate future learners. Program evaluators need to ask if the course met learning outcomes while probing deeper to assess the overall educational impact (85). This critical appraisal of an education program illustrates the benefits of the education program under review and helps to identify if any program revisions are required. Clinical program evaluators are also able to explore if the learners' viewpoints have shifted from this education and how this new learning impacts their patient care. Common examples of course evaluations included student or colleague feedback through surveys or discussions (46,86). These methods provided course coordinators with evidence to advise that their curricula revisions are aligned with future learners' needs.

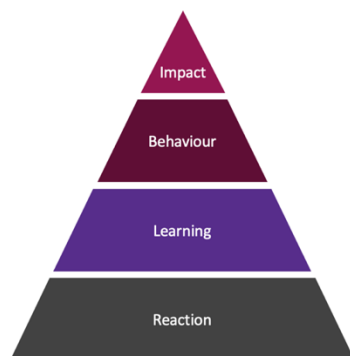
However, the rigor of the evidence collected for an educational evaluation depends on the methods used. For example, online surveys often are closed ended question that are easier to administer and for learners to answer; but with no option for elaboration, learners may not be able to share everything they want to disclose. Therefore, evaluators may need to consider including qualitative methods such as open-ended questions or interviews. Qualitative methods are often required to widely understand learners' thoughts that cannot be expressed numerically as well as provide the flexibility for them to deeply share their personal experiences and opinions. Therefore, it is important to clearly state the purpose of the analysis and the data collection methods to develop a detailed program evaluation.

*Evaluation of the McMaster-Mohawk POCUS Course Curriculum using the Kirkpatrick Model:*

The Kirkpatrick model is a four-level pyramid framework commonly used to evaluate the various effects of education interventions (87). The model measures learner reaction, learning, behavioural change, and impact (Figure 2, Table 1). On the lower sections of the pyramid, reaction refers to participants' thoughts about the training and how students acquired this new knowledge (87–90). Examples of methods that measure the reaction and learning levels are participant surveys that ask about participants' learning experiences and to disclose knowledge, which are often quantitatively analyzed. The upper portions of the pyramid focus on deeper learning including how the curriculum changed the participants behaviour, whether participants use these new skills in their practices, and how the training has changed the way they provide care. The top-level

impact, or organizational performance, refers to how an educational intervention impacted both learners and their greater populations. In the context of midwifery these greater populations could include their clients, communities, and colleagues (87,91). Details about the behaviour changes and the impacts can be appraised in interviews and surveys throughout an extended study period, such as six-months following the educational initiative. By evaluating education with respects to its greater impacts surrounding utility, learner knowledge, perspectives, behaviour, the Kirkpatrick model is a rigorous tool that can be applied to understand the different planes of health professions education (85,89,90). The Kirkpatrick model has also been employed in obstetrics to evaluate a clinical emergency skills program to understand how this new education initiative influenced clinical care and improved patient outcomes (88,92). Therefore, the Kirkpatrick model is an appropriate method to evaluate the McMaster-Mohawk POCUS course. The Kirkpatrick framework will allow researchers to understand participant learning throughout this course, how they have applied this training into their clinical care routines, and the greater impacts of this training in their communities.

*Figure 2 The Kirkpatrick Model*



*Table 1 The Kirkpatrick Model for Evaluating Education Interventions*

<b>Level 1</b>	Reaction	Learners' views on the learning experience
<b>Level 2</b>	Learning	Acquisition of knowledge/ skills/ attitudes
<b>Level 3</b>	Behavioural Change	Behaviour change, utilizing learning in practice, changed professional practice.
<b>Level 4</b>	Organizational performance	Wider changes in the organization and delivery of care, impact on patients.

## 2.6 Literature Summary:

The aim of this chapter was to explore the current literature surrounding POCUS in midwifery, POCUS learning assessments, and program evaluation to inform the background research to analyze the McMaster-Mohawk POCUS Primary Maternity Care Course. The literature highlighted the diversity of indications POCUS can be used for within midwifery and obstetrical care. Therefore, it is important for clinical educators to evaluate sonography competencies for different POCUS indications to help ensure patient safety. In education evaluation, the Kirkpatrick model is highly valued in assessing educational outcomes and has also been applied in continuing clinical education appraisals. As the CMO scope expansion to include ultrasound was only in 2018, there are demands for further research to understand the roles POCUS can play in midwifery care to improve client care. There is also a need to understand how POCUS can be effectively taught to Ontario midwives based on their recent sonography needs assessment. It is important to comprehend how midwifery remain competent in their new sonography skills, as well as the greater impacts POCUS being used in midwifery to help inform future curriculum development.

## CHAPTER THREE: RESEARCH DESIGN AND METHODS

### 3.0 The Research Question:

The purpose of this project was to evaluate the POCUS course for maternity care providers developed by the McMaster Midwifery and the Mohawk-McMaster Collaborative Medical Radiation Sciences programs. The overarching research question for this thesis was:

*For Ontario midwives, what are the educational impacts of the McMaster-Mohawk Point of Care Ultrasound for Primary Maternity Care course?*

This research question seeks to answer how effective the course was in developing POCUS knowledge and skills among maternity care practitioners. It was hypothesized that the POCUS course would be positively received by Ontario midwives. Based previous work, it was also hypothesized that this course would be effective in facilitating POCUS knowledge and skill acquisition in Canadian perinatal care.

The Kirkpatrick model was the chosen evaluation framework for this project to assess various learning impacts. This four-level pyramid encompasses various levels of learning starting with participants' engagement and retention of the course materials. The upper levels of the framework focus on the learners' perspectives and applications of the education initiative subjected to analysis (Figure 2 and Table 1). Specifically, to examine level one, reaction, of the Kirkpatrick model, we explored learners' thoughts on the POCUS course. Learning was measured by examining sonography skills and knowledge acquisition. Shifts in behaviour were explored by the educational and the

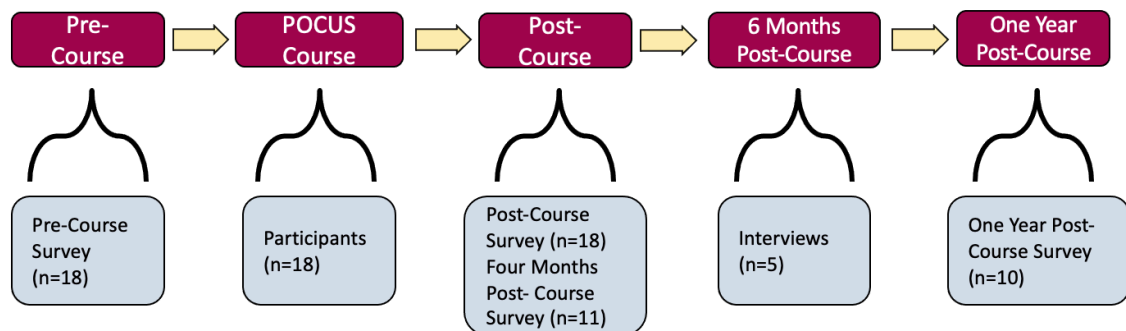
professional changes from the McMaster-Mohawk POCUS course. This appraisal was also aimed to understand how this additional POCUS training alters organizational performance, for example the influences of POCUS training in midwifery clinical practice. Altogether, this four-level framework provided a structure to enhance understanding of how learners react, learn, behave, and the greater societal impact. This evaluation ultimately laid the foundation to understand the impacts of the ultrasound expanded scope and POCUS training in Ontario midwifery care.

### 3.1 Study Design:

The aim of the continuing education course was to provide learners with entry level sonography skills across the three trimesters of pregnancy. The research protocol of this project can be found in *Appendix B: Research Proposal*. To facilitate learning, this educational intervention included online modules, a two-day hands-on workshop (also referred to as the weekend training sessions), and a clinical practicum. To explore the complexities of this POCUS course as well as to understand how it promoted learning and influenced clinical practice, a mixed methods research design was selected (93). A mixed methods design allowed for a combination of both quantitative and qualitative data throughout the study to validate the results across the different data components for a deeper evaluation. The quantitative and qualitative data were given approximately equal weight and priority in the study to ensure thorough analyses. Briefly, the quantitative data was collected through four surveys which were conducted before the

course to establish a baseline, upon completion of the course, as well as at 4- and 12- months post course. These are further referred to as surveys one through four respectively (Figure 3). The qualitative data included participants' open-ended responses in the four surveys and the semi-structured interviews. The variation in methods allowed us to see a broader range of phenomena from the results with respect to POCUS continuing education and clinical application (Figure 3) (94,95). These aforementioned mixed methods were selected to give a well-rounded understanding of the impacts of the McMaster-Mohawk POCUS course without imposing harm to the participants (93,94,96).

Figure 3 Study Timeline



A concurrent triangulation design was employed for all qualitative and quantitative data components. All data was collected and analyzed sequentially and then combined to understand the broader themes in the results (94,97). Through triangulation, we were able to see if the findings affirmed or disputed each other to generate rigorous answers to the research question (93,94). Incorporating both

qualitative and quantitative methods provided a more comprehensive understanding of how midwives were able to learn and apply POCUS within maternity care.

To maintain data security, all digital results were password protected. The written consent forms were stored in a locked filing cabinet to maintain participant confidentiality. Additionally, no identifying factors are presented throughout the thesis or will be in any future publications to ensure participant anonymity.

*Study Population and Recruitment:*

The study population was based on the total number of learners registered in Fall 2019, the first offering of the McMaster-Mohawk POCUS continuing education course. For study enrollment, the inclusion criteria required participants to be registered in and complete the Fall 2019 McMaster Midwifery and Mohawk Rational Sciences Primary Maternity POCUS course. Learners were also required to provide written consent for study participants at the course (Appendix C). If potential participants did not meet both of these criteria, they were excluded. In total, there were 18 participants in this study.

Study recruitment involved e-mailing course registrants with an invitation to be a study participant on October 21<sup>st</sup>, 2019, approximately two weeks before the online modules were available for learners (Appendix D).

To respect learner autonomy, study participation was voluntary and participants could withdraw at any time. Participants were also able to leave questions unanswered throughout the four surveys and interviews as well. There were no monetary incentives for participants to complete the study.



*Self-Location:*

This research was conducted in Hamilton, Ontario, Canada at McMaster University. I, the primary researcher, completed this thesis in partial degree requirements of the Master of Health Sciences Education program at McMaster University. Coming into this project, I had very minimal knowledge about sonography and midwifery, but in conducting this research, I really learned a lot about these two fields. To account for reflexivity, I reflected on how my personal experiences throughout graduate school would impact my project (98). However, qualitative researchers often embrace their personal biases to help shape a research project to their interests (94). For example, I noted how my engagements with different research organizations, such as the McMaster Midwifery Research Centre (MMRC), helped me move from an uninformed outsider to a more informed insider, who is knowledgeable and aware of the midwifery profession. I thought about my activities with the MMRC and how this research centre contributed to my midwifery knowledge as well as my thesis. Although, I am not a registered midwife or physician; working on a thesis centered around midwifery, my personal interests in perinatal health, and the close contact I had with the MMRC, I recognized that I was no longer a distant observer to the issues presented in this work. My personal biases towards maternity and midwifery care informed my analyses and motivated me to continue doing perinatal research with the aim of improving these fields. Study participants were aware that I did not have any clinical experience and was a trainee, therefore, they were encouraged to contextualize their experiences to help provide

more detailed results. All participants, myself, and the other researchers involved with this project self-identified as female during this study as well. There were no direct comments from participants if the interviewer's gender influenced their responses, however, matched gender has played a positive role in interview dynamics and quality (99). During this research, I was also a minimum of seven years younger than the participants. This age gap helped me to facilitate professional distance and boundaries between myself and the participants to ensure data objectivity. Additionally, throughout this study, myself and other researchers in this project reported no conflicts of interest.

### 3.3 Quantitative Methods:

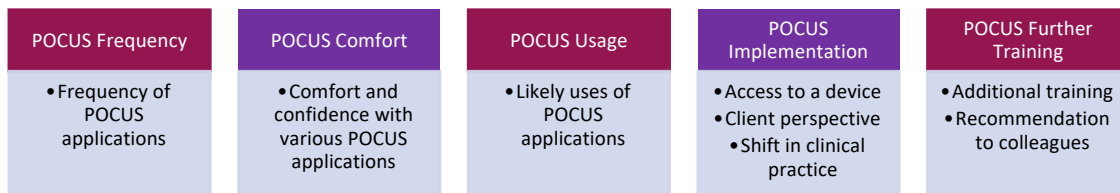
The quantitative portion of the project included the numerical data from the four surveys (Figure 3). The surveys allowed participants to directly express and evaluate their experiences through both quantitative, closed-ended questions, and open-ended questions. The open-ended questions were treated as qualitative data and will also be discussed in 3.4 Qualitative Methods.

#### *Survey Development:*

The questions within the survey were developed in reference to the literature to further understand how past studies directed their questions regarding midwifery, the need for POCUS training, sonography course components, and future curricula improvements (Appendix E) (19,41,43). The surveys also included questions aimed at understanding how Ontario midwives are using POCUS, personal comfort with their new sonography skills, and course feedback. The surveys were organized into five categories centred

around: the frequency of use of POCUS for different clinical indications, comfort, and confidence with using POCUS, POCUS implementation in clinical practice, and interest in further sonography training (Figure 4). The variation in questions encompassed what the participants learned, their reactions to the course, and POCUS integration within midwifery practice (Appendix E). It was decided that the surveys would be online to ensure that participants could easily access and complete them in a timely manner for analysis throughout the one-year study period. The chosen survey platform for all the surveys was REDCap because it is a reliable program with a secure password protected database to ensure confidentiality. To respect the participants' privacy and voluntary engagement, none of the survey questions were mandatory for completion.

Figure 4 Survey Categories



As these were online surveys, the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) was consulted to ensure rigorous surveys were created. CHERRIES provides an extensive checklist for researchers to consider during survey development, administration, data collection, and analyses (100).

Before being administered to participants, the surveys were tested on REDCap by myself, my graduate thesis supervisor, two researcher coordinators, and four health

sciences peers to ensure clarity of questions for participants and that the online platform was functioning correctly.

The survey questions were a series of multiple choice, arrays, and a few open-ended responses. In some cases, adaptive questions became available if participants had selected certain options. For example, if a participant would not recommend the course, a dropdown textbox appeared for them to elaborate on their answer. To help break up the information presented, the survey spanned several pages: four pages for survey one and five pages for surveys: two, three, and four. Arranging the surveys on to multiple paged helped participants focus on the specific questions on the page as opposed to whole survey, which could have been overwhelming. At the bottom of the last page there was a submission button for participants to indicate they had completed the entire survey. Provided the small number of study participants, the risk of the survey link being sent to those outside of the course was low. Importantly, individual participants' responses were not followed overtime, but rather as a whole group. This was done to analyze learning progression of the entire group because of the close contact researchers had with the participants throughout the course. Group analyses also respected participant privacy given the small size of the study cohort.

All survey responses were quantitatively measured using 5-point and 7-point Likert scales. Likert scales are frequently employed tools in research to directly measure participants' attitudes and agreement towards a question or topic (101–103). The 5- and 7-point Likert Scales were appropriate for this study as they permitted researchers to

directly compare responses over the entire study period. The 7-point scale offered more room for opinion due to the larger scale size, this was beneficial for questions on POCUS in identifying different clinical indications, such as pregnancy viability, to accommodate the larger variance of participant usage. In other questions like POCUS comfort level, there was less variability in opinions throughout the literature, therefore the 5-point scale was used. It has also been reported that the 5-point scale is more likely to produce more usable data for analysis and comparison in smaller participant groups therefore, it was used more frequently than the 7-point scale (101–103). Altogether, these quantitative questions encompassed a variety of relevant topics surround POCUS education and clinical application through the 5- and 7-point Likert Scales.

### 3.3.1 Data Collection:

As previously mentioned, the four surveys were administered before the course to establish a baseline, upon completion of the course, as well as 4- and 12- months post-course (Figure 3). Participants provided written and electronic consent for the four surveys; they were administered: October 23<sup>rd</sup> 2019, November 4<sup>th</sup> 2019, March 9<sup>th</sup> 2020, and October 7<sup>th</sup> 2020, respectively. On survey three, participants indicated their interest in completing an interview and were followed up on April 6<sup>th</sup> 2020 to commence interview scheduling (Appendix C and Appendix E).

To ensure participants clearly understood the risks and benefits of participating in the study, the surveys included: a clear study description and contact information for research team members were provided. Participants were also informed that the study

received Hamilton Integrated Research Ethics Board (HiREB) approval. Participants were sent an email with the survey link and received two subsequent reminders. As survey four was an amendment to this project and participants did not initially provide their consent, a mandatory online consent form was given. This online consent form was required to be completed at the beginning of the survey to allow participants to respond to the subsequent survey questions (Appendix C and Appendix E).

### 3.3.2 Data Analysis:

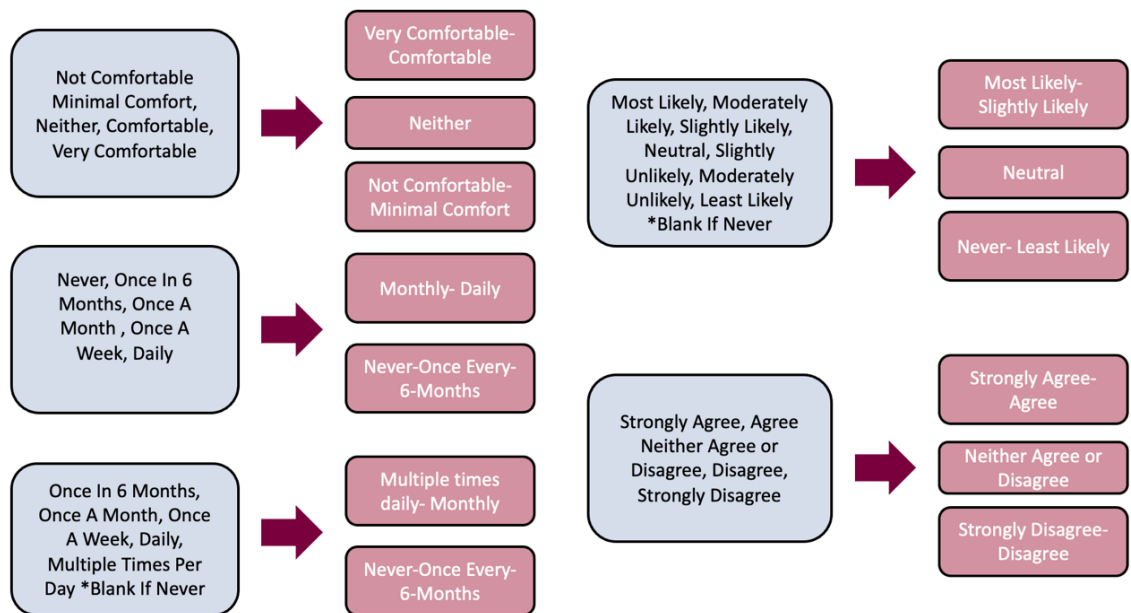
Descriptive statistics were used for all quantitative analyses in this project. This statistical test was used to provide an understanding of the general data patterns across the four surveys and provided a detailed summary and highlighted data trends (104–110). These statistical analyses involved measuring the frequencies, percentiles of the data, the mean, the median, and data distributions across the four surveys using R and Excel (105). Communicating the study results through descriptive statistics was also the most appropriate method for the study's intended audience of health professions educators and clinicians to comprehend the data. As the study sample size was small and the survey data was unpaired, tests of statistical significance were not appropriate.

### *Data Groupings:*

Within the surveys, data groupings were made for quantitative analyses. The data groupings were decided upon based on dividing the 5- and 7-point Likert scales into representative groups of the frequency and clinical volume in midwifery clinical care. In Ontario, a full caseload midwife follows 40 primary clients per year, the volume of opportunity for some clinical indications, such as an ectopic pregnancy, may arise

infrequently in their practice (111). Examples data groupings included combining 'very comfortable' and 'comfortable' or 'not comfortable' and 'minimal comfort,' with 'neither' being its own category. With respect to frequency data, groupings combined 'monthly' and daily' or 'never' and 'once every six months.' Likert scale questions pertaining to the likelihood of POCUS usage were organized into three categories of: 'never'- 'slightly unlikely', 'neutral', and 'likely-slightly likely' to match similar options. In all, the data groupings were proportional to represent a midwife's caseload as well as group the survey options by similar sentiments (Figure 5).

Figure 5 Survey Data Groupings



*Logic Rule:*

A logic rule was applied in relation to the question order on surveys one through three.

The organization of a survey question was confusing to participants and needed to be accounted for in our analyses. In the order of appearance on these surveys, the first

question was: "Please state for the following applications how likely you are to use them. Please leave applications blank if you feel you would never use them." This was followed by the question "How frequently do you use point of care ultrasound for each of the following applications." The later question, "How frequently..." had an extremely low response rate in comparison to all other questions in the surveys. Therefore, a logic rule was applied because of the order of the questions, researchers assumed that since the first question: "please leave blank if never used," that same logic was applied for the subsequent frequency of POCUS use by indication array question. This meant that the blank responses for the question "how frequently do you use point of care ultrasound for each of the following applications" were also interpreted as they were never used as opposed to omitting the data (Appendix E). This logic rule was done to represent what the participants had completed earlier within the surveys.

### 3.4 Qualitative Methods:

The qualitative methods included within the study were the open-ended questions throughout the four surveys and the semi-structured interviews. An average of four open-ended questions were embedded within the surveys for participants to further understand and elaborate on their responses from the Likert scale questions. Written responses to these questions were qualitatively analyzed for both implicit and explicit ideas using grounded theory methods.



Grounded theory was implemented as the methodological approach for the qualitative portion of the project. It was an appropriate methodology in reference to the study design of concurrent triangulation as it allowed for data collection and analysis to occur concurrently (112,113). Given the semi-structured interviews and qualitative survey questions, as well as the novelty of POCUS education for midwives, grounded theory provided an appropriate approach to explore a fairly unexplored topic (114,115). As POCUS is a new component of Canadian midwifery, grounded theory helped to develop a theoretical explanation to the participants' experiences regarding what they learned, the clinical impact of POCUS, and how participants maintained POCUS competency (113).

*Question Development:*

Development of the open-ended questions embedded in the four surveys is described above in section 3.3.1 *Survey Development*. For the semi-structured interviews, a question guide was created to help facilitate the interviews and allow participants to state their opinions freely (113). The questions for the semi-structured interviews were designed to get a deeper understanding of the learners' thoughts about POCUS in perinatal care, the McMaster-Mohawk POCUS course, as well as how they are using POCUS within their practice (Appendix F). The semi-structured interviews supplemented the surveys and were used to further clarify and provide more depth and richness to the participants' thoughts (116). Relevant studies about POCUS and midwifery by Holmlund et al. (30) and Edvardsson et al. (45) were consulted during the phase of question

development to inform the interview guide (Appendix F). For example, these sources were referred to in generating questions surrounding participants' experiences, POCUS indications, and learning challenges (30,45). Within the interview guide, the questions were open-ended with some additional prompts to guide participants if needed. Open-ended interview questions allowed participants to have the freedom to share their thoughts and to promote a deep discussion that resembled a conversation, characteristics that are not available within closed-ended interview questions (Appendix F) (117).

The consolidated criteria for reporting qualitative studies (COREQ) checklist was consulted for interview question development and conducting research in the domains of: the research team, study design, and guidance in detailed data collection (118). A semi-structured interview allowed interviewers to further understand the participants' perspectives of the course with the freedom of their own words (39). With participants able to openly share their perspectives and experiences, we were able to probe deeply to try and fully understand their opinions as much as possible. By also having the interviews approximately six-months after course completion, it allowed participants to reflect upon the course and have time to try to complete the clinical practicum as well as potentially start to use POCUS within their practice. Throughout the interview questions, constant comparison was done to compare participants' responses throughout the other interviews and survey results to inform the emerged data concepts (Appendix F).

All 18 participants were invited to participate in the interviews; however, the aim was to have a minimum of five participant interviews. A convenience sample was used for the interviews because given the purpose of this study, it was important to have interviewees willing to participate and share their engagement with the course. Interview volunteers would help fulfill a study goal of having rich discussions with dedicated participants who would honestly tell their stories which included the both positives and negatives views of the course (118,119).

#### 3.4.1 Data Collection:

Survey data collection is described in 3.3.2 *Quantitative Data Collection*. Interviews were scheduled at a convenient date and time for each participant and were conducted through private video and telephone calls. It was important for me to establish rapport with the interviewees to ensure their comfort during the interview to share their perspectives. The purpose of the interviews was explained, including assurance that participants only needed to answer questions they were comfortable with and reminded them that no identifying factors were going to be collected. The interviews were audio recorded and a verbatim transcript was created; the average length a participant interview was forty minutes. The transcripts were sent to the participants for member checking before any analyses occurred (94,120). This step ensured that the participants felt the transcripts were reflective of their interviews and were accurate transcriptions. Memoing in the form of written field notes was completed to aid the development of the qualitative concept maps and initial codes.

### 3.4.2 Data Analysis:

Data analysis of the qualitative data followed the principles of grounded theory. In keeping with grounded theory, data analysis began at the same time as data collection to facilitate an iterative process of constant comparison (112,113). The constant comparison between interviewees ensured the interviews evolved during data collection, which refined the emerging theory of how midwives were able to learn and use POCUS. NVivo 12 software was used to organize and code the data for all qualitative analyses.

A grounded theory based qualitative research plan was developed with combination of Corbin and Strauss as well as Charmaz's qualitative coding methods. Charmaz, Corbin and Strauss grounded theory approaches have been used together to provide a detailed approach in uncovering the themes and theories rooted in participants' responses (20,21,35,36). The interpretive nature of Corbin and Strauss provides clear coding guidelines (open, axial, and selective) to direct qualitative analyses in comparison to Charmaz coding which emphasizes coding flexibility to help develop pragmatic explanations within the data. Blending Corbin and Strauss and Charmaz principles provided clear methods to constructively incorporate and evaluate participants' beliefs and experiences surrounding the POCUS course (112,113,115,122,123). All transcripts were analyzed and coded individually, codes were then compiled to see both their similarities and differences. Additionally, two people independently reviewed all codes to minimize pre-dispositions or coding errors.

The specific steps taken for qualitative analyses were rooted in the participants' responses and included a clear multi-step coding plan to ensure consistency. First, the transcripts were read in full before any coding occurred. The concept maps and initial codes were written out in a journal to visually represent the patterns and to help identify codes within the data. A clear representation of the data trends in these concept maps illustrated the similarities and differences between each participant and started to reveal emerging theories. Open coding was done by attaching extremely specific codes to describe what each participant was saying. Open codes helped to describe the underlying theories by asking general questions such as: who, what, where, when, how (long, much), what for, and why (112,124). The transcripts and open codes were reviewed by a second coder (an experienced qualitative researcher) to improve the consistency and the reliability of the codes. Having multiple sources of data, from interviews and surveys respectively, aided with ensuring dependability and validity of the research before any further coding was completed. After open coding was finished, axial coding was completed. This involved relating the codes and creating categories and subcategories to show how the open codes were connected and where they differed. This was achieved by clustering the open codes into groups. These data code groups were organized and the relationships between them were explored in selective coding. Throughout selective coding, data categories were created to represent the major data themes. These themes were also reviewed by my graduate supervisor and the previously

mentioned second coder for agreement and to ensure consistency, these themes will be presented in *Chapter Four: Results*.

### 3.5 Integration of Quantitative & Qualitative Methods:

Throughout the study, the quantitative and qualitative results were brought together to provide a holistic perspective of the data (94,125,126). This involved comparing the quantitative and qualitative data pieces concurrently throughout the study period to answer the study's research question. Inductively combining and comparing both the quantitative and qualitative data pieces presented integrated results offered deeper perspectives into the benefits and drawbacks of the POCUS primary maternity course, where separate analyses would not provide as much insight (94,96). For example, it was mentioned how throughout the interviews, participants were asked to share their thoughts about the preliminary survey results. This data convergence provided a detailed evaluation of how the results in the surveys and interviews validated each other and their relations to the research question. These different methods also connected how participants learned and applied POCUS into their clinics, which improved the rigor of the study (93,94). This was evident in how the interview discussions further informed which indications were most readily used from the survey results. Altogether, these steps informed the major findings of the participants' experiences and thoughts with the McMaster Mohawk POCUS course and POCUS in midwifery. Therefore, in *Chapter Four: Results*, the quantitative and qualitative results will be integrated and presented in

tandem to compare and validate the emerging findings from the evaluation of this POCUS course.

### 3.6 Trustworthiness of the Data:

To ensure the transparency of the qualitative data, the four major principles of trustworthiness: credibility, dependability, confirmability, and transferability were taken into consideration throughout this study (127,128). Briefly, these four principles are centered around ensuring that the presented results are well represented from data collection, reliable, and valid in their interpretations. Reflexivity is also something else to be mindful of in defining data trustworthiness because it is important to take into account the influences researchers may have on the project; such as my interactions with participants during data collection (98,129). Throughout the study design, different research methods were used to improve the credibility of results as similar data trends were affirmed in the various methods. Employing a triangulated study design helped to ensure the validity and trustworthiness of the results. For example, this study design allowed the findings from one data source, such as the surveys, to be compared and contrasted to another, the interviews. Before any interview analyses were done, participants were able to review their transcripts to ensure they were reflective of their thoughts and also helped inform a trusting relationship between participants and researchers. Multiple data reviewers helped to account for reflexivity as well as the dependability and reliability of the data themes. A clear qualitative analysis plan rooted

in grounded theory, helped to ensure all analyses were clearly reported and documented. This clear documentation helped to demonstrate both the consistency and replicability of results. In all, these multiple steps taken by the researchers ensured reliability and that all results were consistently rooted in the participants' thoughts.

### 3.7 Impacts of COVID-19 on the Research Methods:

In Spring 2020, we adapted the research protocol for this thesis to take into the impacts of the COVID-19 pandemic on our participants. The first Ontario lockdown began at the time of data collection for survey three, so an additional survey (survey four) was added for additional follow up in response to the pandemic. This was done to give participants more time to try to complete their clinical practicum and continue practicing POCUS as well as consider their potential additional clinical duties with COVID-19. The study participants were midwives and one family physician from across Ontario, provided their busy schedules, coordinating interviews were not always possible. The onset of the pandemic only made interview recruitment harder. The challenges of interview organization were due to both their regular clinical responsibilities and the increased demands on healthcare practitioners during the pandemic. In accordance with McMaster's COVID-19 protocols and for safety, all interviews were conducted remotely, either through video or telephone calls.



### 3.8 Ethics Approval:

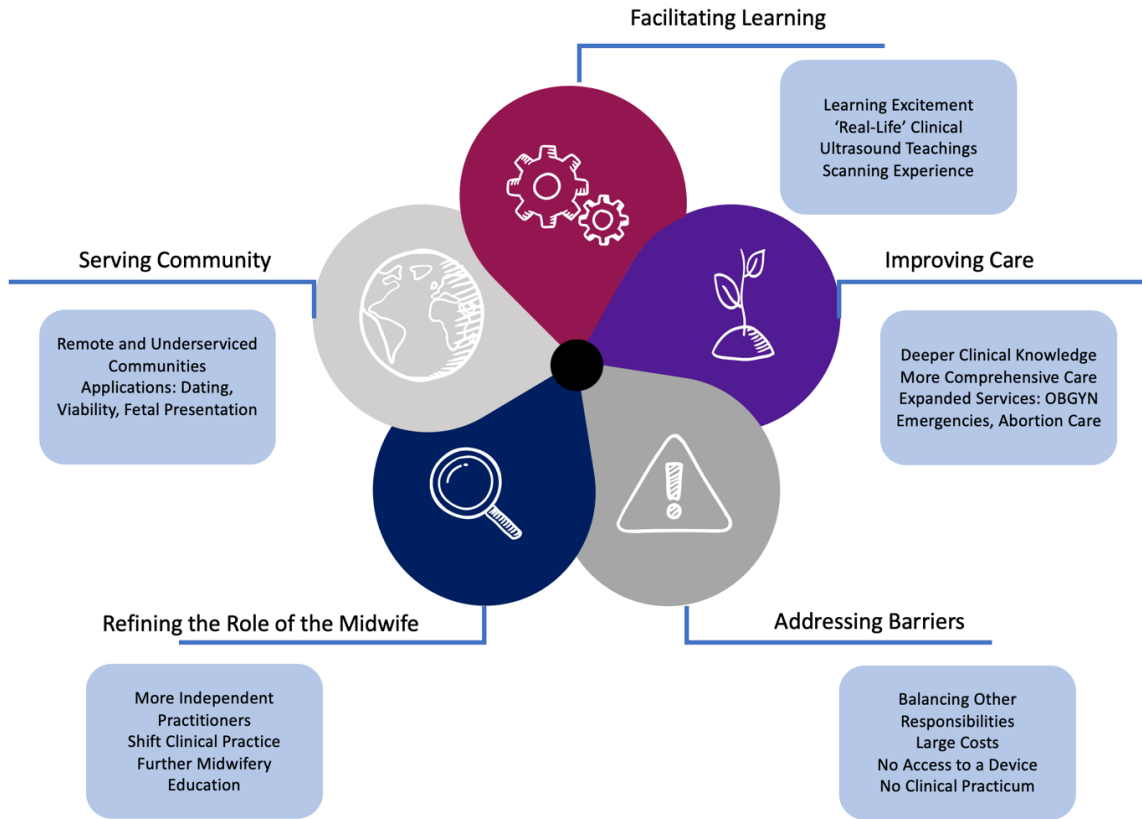
Ethics approval was received by HiREB, reference number: 2019-7525-GRA. There were no anticipated risks for the enrolled participants. Participation in this study was voluntary and participants could withdraw at any time.

## CHAPTER FOUR: RESULTS

### 4.0 Results Introduction:

This chapter presents the results from the surveys and interviews. The quantitative and qualitative results are presented by descriptions, statistics, and quotation excerpts in an integrated manner within this chapter. The combination of both the quantitative and qualitative results provide holistic comprehensive views of participants' thoughts and experiences during this study. The integrated quantitative and qualitative research analyses generated five major themes of: facilitating learning, improving care, addressing barriers, refining the role of the midwife, and serving community, which will be presented in turn throughout this chapter after a description of the participants (Figure 6). Qualitative results are described and illustrated by quotations from participants. Alternative names have been used to keep the participants anonymous but at the forefront of the data (130). The quantitative survey results will be presented as line graphs to provide readers with better visualizations of the participants' shifts in learning, personal sentiments, and clinical applications over the study period, despite no time series analyses being done in this research. Bar graphs of each trendline figure can be found in *Appendix I: Bar Graph Study Figures*.

Figure 6 The Five Major Data Themes



#### 4.1 Description of Participants:

The study participants included 17 midwives and one family physician. Geographically, 83% of participants were practicing in Southern Ontario and 17% were working in Northern Ontario. The participants had varying years of midwifery experience which ranged from less than five years to greater than twenty years (Table 2).

Table 2 Participant Information

<b>Demographics</b>			
<b>Location</b>	<b>N</b>	<b>%</b>	
Southern Ontario	15	83.3	
Northern Ontario	3	16.7	
<b>Total</b>	<b>18</b>	<b>100.0</b>	
<b>Practitioner Age</b>			
<b>Practitioner Age</b>	<b>N</b>	<b>%</b>	
20-29	0	0.0	
30-39	4	22.2	
40-49	10	55.6	
50-59	4	22.2	
60-69	0	0.0	
<b>Total</b>	<b>18</b>	<b>100.0</b>	
<b>Years of Midwifery Clinical Practice</b>			
<b>Number of Practice Years</b>	<b>N</b>	<b>%</b>	
0-5 Years	4	22.2	
6-10 Years	8	44.4	
11-15 Years	2	11.1	
16-20 Years	2	11.1	
20+ Years	1	5.6	
None (Physician)	1	5.6	
<b>Total</b>	<b>18</b>	<b>100.0</b>	

*Survey Response Rates:*

Surveys one and two both had 100% response rates and were given to participants on October 23<sup>rd</sup> 2019, November 4<sup>th</sup> 2019, accordingly. Surveys three and four were sent to participants on March 9<sup>th</sup> 2020, and October 7<sup>th</sup> 2020; these surveys had lower response rates of 61% and 56%, respectively. The lower response rates in the final two surveys were most likely attributed to the extended time that had passed from the course and the onset of the COVID-19 pandemic. All quantitative survey data can be found in

*Appendix G: Quantitative Results Data Tables.*

On survey three, there was one occurrence of a participant completing the survey twice. This participant's doubled entries were discovered because the same e-mail address was provided for interview contact on two survey responses. We used the timestamps of the survey responses to identify and include the participant's first survey answers for analyses because they were their initial thoughts. The second survey responses were omitted from all data analyses.

#### *Interviews:*

Five participants volunteered to partake in the semi-structured interviews during the Spring of 2020; all interviewees identified as female. Open coding revealed 137 unique codes that covered a diversity of topics such as POCUS course reflections, the midwifery model of care, and the relevance of POCUS in midwifery. Axial coding involved bringing together and refining the open codes which resulted in 33 different categories. Selective coding examined five overarching themes of facilitating learning, improving care, addressing barriers, refining the role of the midwife, and serving community. These five themes and their respective codes can be found in *Appendix H: Qualitative Data Codes*.

#### 4.2 Facilitating Learning:

One of the major goals of the McMaster-Mohawk POCUS course was to facilitate sonography learning to our participants. Learning was defined as the growth of new knowledge and skills pertaining to POCUS and sonography. A major motivator to attend this POCUS course described by our participants was their inherent excitement for learning. The participants' love of learning was represented in the following excerpt,

"I'm fascinated by work due to evidence, to understanding why we do things, to having more skills and information" (Avery).

Participants' sonography clinical and theoretical learning was facilitated through three educational methods: the online modules, the two-day workshop, and the clinical practicum. Each educational method will be discussed in their own subsection in this chapter.

#### *Online Modules:*

Before the workshop, participants had to complete five online modules to provide them with background sonography knowledge. Given the minimal experience or understanding our participants had of POCUS prior to the course, they needed to take a significant amount of time, more than expected for some, to understand sonography basic principles. Some participants thought that the quantity of didactic information learners were required to complete in the online modules before the workshop was overwhelming. With respect to the module content, it was shared by many participants that the physics module was found to be the most challenging. Some participants also struggled with understanding POCUS technology because it was very different to their previous clinical learning. One participant shared in their interview: "I'm not familiar with using that type of technology. So, it was really abstract to me, to be introduced to this for such a short time period when my skill training is definitely more hands-on experience where I just found the technology confusing" (Taylor).

*The Two-Day Workshop:*

The two-day workshop gave our participants the opportunity to learn POCUS clinical skills. Participants expressed how they benefitted from lots of hands-on ultrasound training during the workshop because they found acquiring sonography skills challenging. For example, some of our study participants reported having difficulty connecting the didactic material to the clinical skills in the workshop, such as how to recreate the ultrasound images they saw in the online modules. It was also shared how beneficial the workshop was for our participants to further understand the module content. One participant expressed this best: “the coursework leading up to it was... abstract... In the moment, when you’re trying to do this stuff, it really did come together in the end and so I appreciated that” (Taylor).

Participants articulated that the time they spent with sonographers during two-day workshop was also instrumental in their learning. One participant felt that a highlight of the workshop was “being able to work with really experienced sonographers that were extremely helpful and really good at guiding me when I had no idea what I was doing” (Quinn).

With respect to the workshop content, there were conflicting comments from participants about the quantity of information that was covered in the two-days. Some described that the right amount of material was expected to be learned in the weekend. While others found it challenging to keep up with all the material and as a result needed more clinical practice time. One participant stated that “to get as much scanning

experience as you can in a very small amount of time, I found that I really hoped that we had just a couple of more bellies” (Harper).

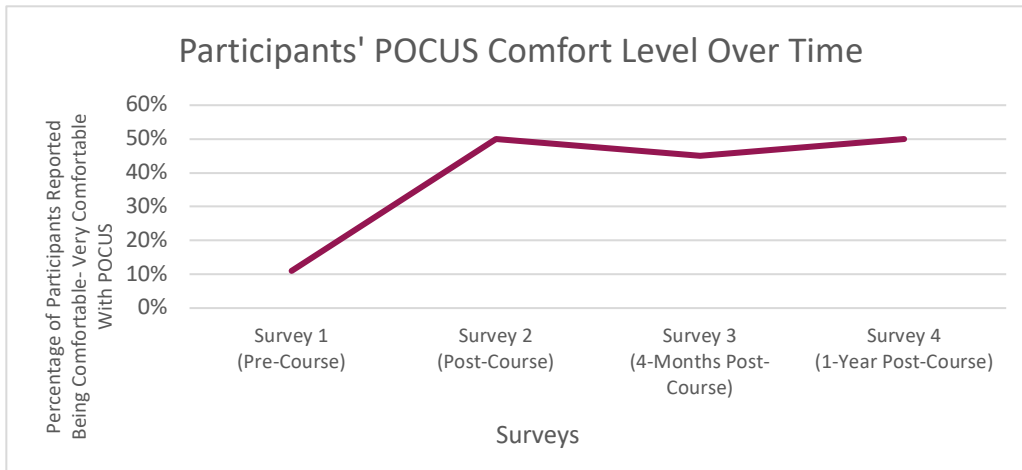
Another contributing factor that aided participants’ POCUS learning during the two-day workshop was their access to pregnant standardized patients across the three trimesters. In comparing other educational methods in this course such as the ScanTrainer, a computerized ultrasound simulator, standardized patients were preferred. Participants perceived that the standardized patients provided more accurate representations of what they would experience in their clinical practice in comparison to simulation-based learning methods.

*POCUS Comfort After Completion of the Online Modules and Two-Day Workshop:*

Another indication of participant learning was their increase in POCUS comfort level during the course. For context, comfort can be described as participants ability to perform a POCUS scan easily without personal anxiety. Between surveys one and two, participants’ overall comfort level in performing POCUS grew from 11% after completion of the online modules to 50% after the two-day workshop (Figure 7).

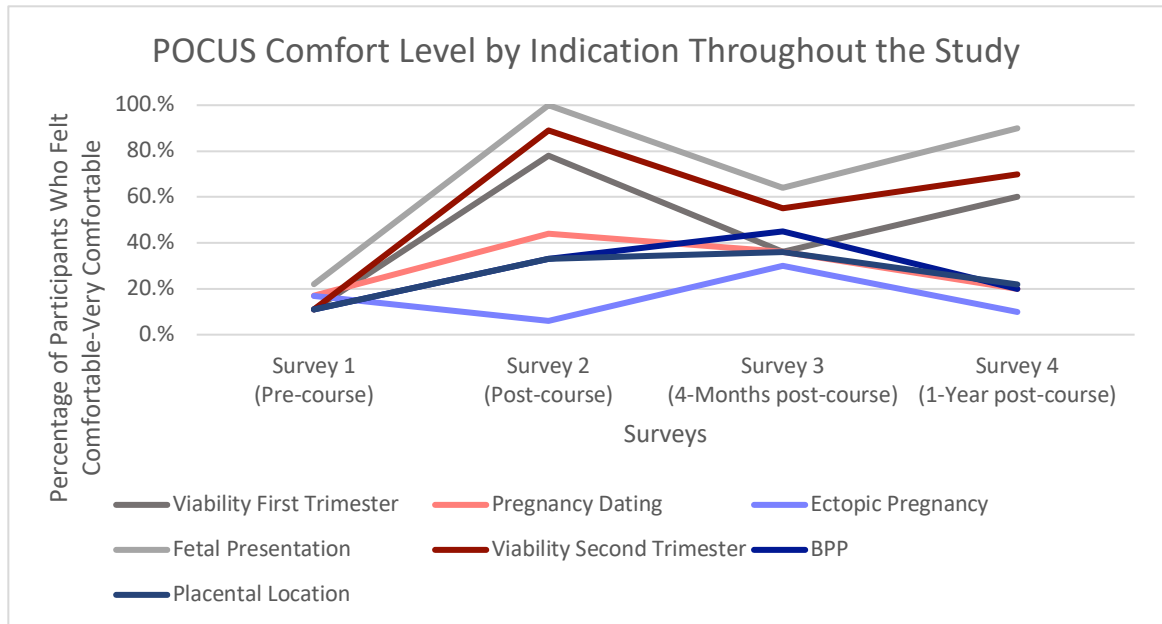


Figure 7 Participants' POCUS Comfort Level Over Time



Participants had the most growth in their personal comfort levels with using POCUS to confirm fetal presentation, which increased from 22% to 100% after the workshop (Figure 8). When using POCUS for confirming viability in the first and second trimesters, initially only 11% of participants were comfortable in both these indications, however, participant comfort level grew to 89% and 78% respectively after the didactic learning and workshop. Other clinical indications where POCUS comfort level grew among participants after course teachings included pregnancy dating (44%), identifying placental location (33%), and conducting a biophysical profile (BPP) (33%). The only clinical indication for which participants reported a decrease in comfort level after the modules and the workshop was detecting an ectopic pregnancy. This decreased which dropped from 17% to 6% in the first two surveys respectively (Figure 8, Appendix G).

Figure 8 POCUS Comfort Level by Indication Throughout the Study



*The Clinical Practicum:*

Many participants articulated that the practicum was essential for solidifying their sonography clinical skills since the two-day course was only an introduction to the clinical applications of POCUS. It was shared that the clinical practicum was seen as an essential opportunity for continued ultrasound practice and for our participants to ask further questions to refine their POCUS knowledge.

Unfortunately, only two participants were able to complete their clinical practicum during our study. The challenges that prevented participants from organizing and completing the clinical practicum will be discussed further in section *4.4 Addressing Barriers*.

Participants who completed the clinical practicum described feeling comfortable and confident in conducting ultrasound scans easily and quickly for their clients. The

importance of the clinical practicum was demonstrated in one participant's statement, "if I didn't do the placement, I don't know how comfortable I would be" (Harper).

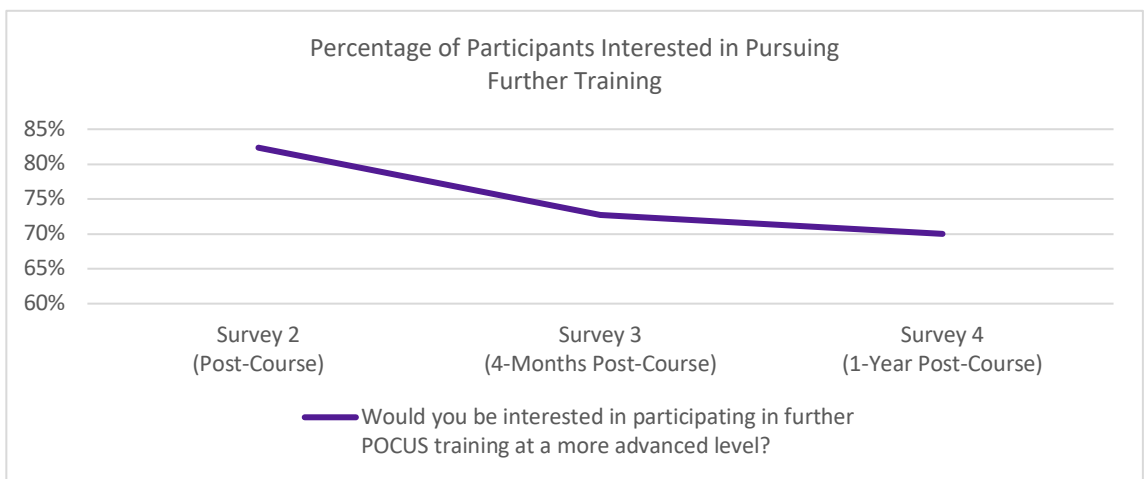
Participants who did not have access to a practicum stated that they unfortunately did not make any significant advances with their POCUS skills as a result. One participant outlined the negative implications of not having placement training when they stated:

Because I've had no access to more training, obviously the knowledge that I had or learned over the course has faded. I have the materials that I would review if I would get access to clinical training but at this point, [I am not] more comfort with POCUS then... prior to the training (Blair).

#### *POCUS Additional Education and Training:*

Our participants noted that they would be interested in completing additional POCUS education to maintain and further refine their current sonography skills. Eighty-two percent of participants stated an interest in another POCUS continuing education course in survey two, but this percentage declined to 73% and 70% in surveys three and four respectively (Figure 9).

*Figure 9 Percentage of Participants Interested in Further Training*



In particular, participants who were unable to organize a clinical practicum thought that a refresher course would be beneficial before starting their placement. One participant remarked:

I would love to have the opportunity to do a refresher course in tandem with planning a practicum, so that I could go back and do a refresher course, even a day in a safe place be reminded about all the things that I learned, and then go into m practicum feeling like, "Okay, I know how - I know at least how to approach this," instead of, "I feel like if I was to go start a practicum now, I might need that sonographer to actually teach me." (Quinn)

### 4.3 Improving Care:

Participants described several ways that POCUS education and technology could improve their perinatal client care.

Many participants reported being personally motivated to take this POCUS course to build their clinical skills to give more comprehensive client care. One participant thought it was of "great value to have midwives do obstetric ultrasounds because we also have the ability to interpret it in a clinical way right away for the client" (Blair). By providing timely clinical assessments with POCUS, midwives were able to immediately counsel their clients throughout their examinations. One participant shared how they were "able to speed along [a client's] assessment process by being able to look at the images and say everything looks pretty normal" (Taylor). With POCUS providing more clinical information, participants expressed that they were able to offer more personalized care to their clients as well. This was demonstrated in the following quote:

I'm sure that the midwives will then be booking more ultrasounds for presentation and fluid levels and that sort of thing. And it's just that extra step, that extra appointment that somebody needs to make. Especially times like this, you know it... would have been better and easier to have a few midwives able to do this type of assessment, keeping people out of clinics and appointments that they don't necessarily have to go for (Taylor).

In another example, the real time images from a POCUS scan were helpful for one participant who had a client with a fibroid that required further investigation by an obstetrician. The bedside scan images allowed this client to understand the significance of the fibroid and the midwife's clinical recommendations to consult a physician:

I had a client who came to us and we knew she had a fibroid. She was only 13 weeks pregnant, and this was a pretty big fibroid, and I wanted to consult, and she was no, no, no, I don't see the big deal, so I did a scan. This fibroid at 13 weeks was 13 x 13 x 12, so I measured it, and so I had already had an ultrasound report from her dating scan that said it was somewhere around there, but then this was a month later... I said, do you want to see it?" She'd never seen it before... I showed her, and she said, "Oh, my gosh, that's the fibroid." I said, "Yeah, you know you can see how, here's your baby, and then here's the fibroid - so, baby, fibroid." I measured it for her, and said, "Yeah, like it's the same size, and maybe even slightly bigger now than it was. (Harper)

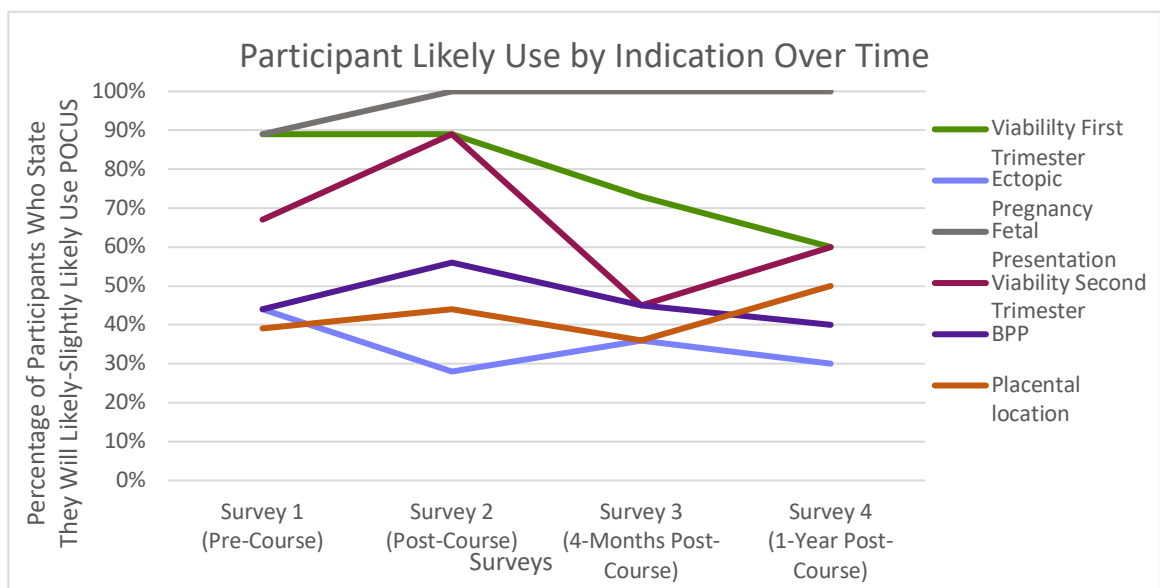
The long-term impacts of education are what clinical learners take from their new learning and apply to their clinical practice. Participants shared how ultrasound could help in other perinatal health circumstances such as abortion care, intrauterine device insertions, ectopic pregnancies, external cephalic versions, and obstetrical emergencies as well.

#### *POCUS Frequency:*

After training, our participants started frequently using POCUS technology in their clinical care. The indications participants hoped to address using POCUS the most

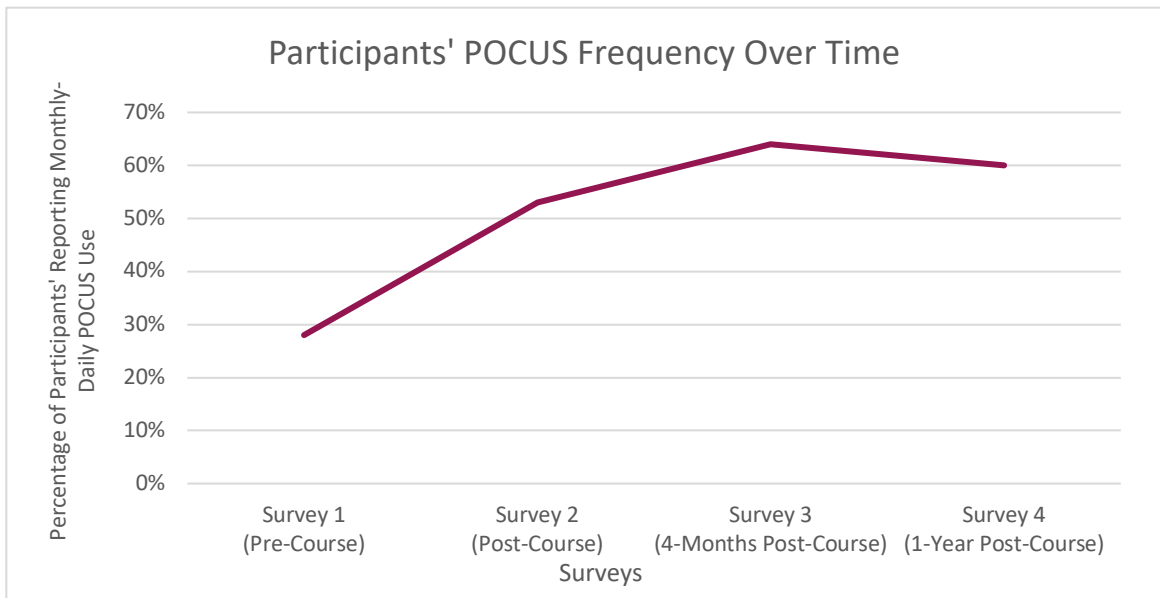
frequently included fetal presentation, and gestation viability. In all surveys 100% of participants were interested in using POCUS for fetal presentation (Figure 10). On survey two, many participants (89%) indicated an interest in using POCUS to determine the viability in the first trimester, but this interest decreased to 60% on survey four (Figure 10). The use of POCUS to determine viability in the second trimester had the most variability throughout the study period. For example, before the course, 67% of participants agreed that they would likely use POCUS for viability in the second trimester, this number of participants increased to 89% immediately post-course. However, the percentage of agreement decreased on the final two surveys to 45% and then increased to 60% respectively (Figure 10). Clinical indications where POCUS was less likely to be used included: ectopic pregnancy, BPP, and placental location (Figure 10, Appendix G).

Figure 10 Participant Likely Use of POCUS by Indication Over Time



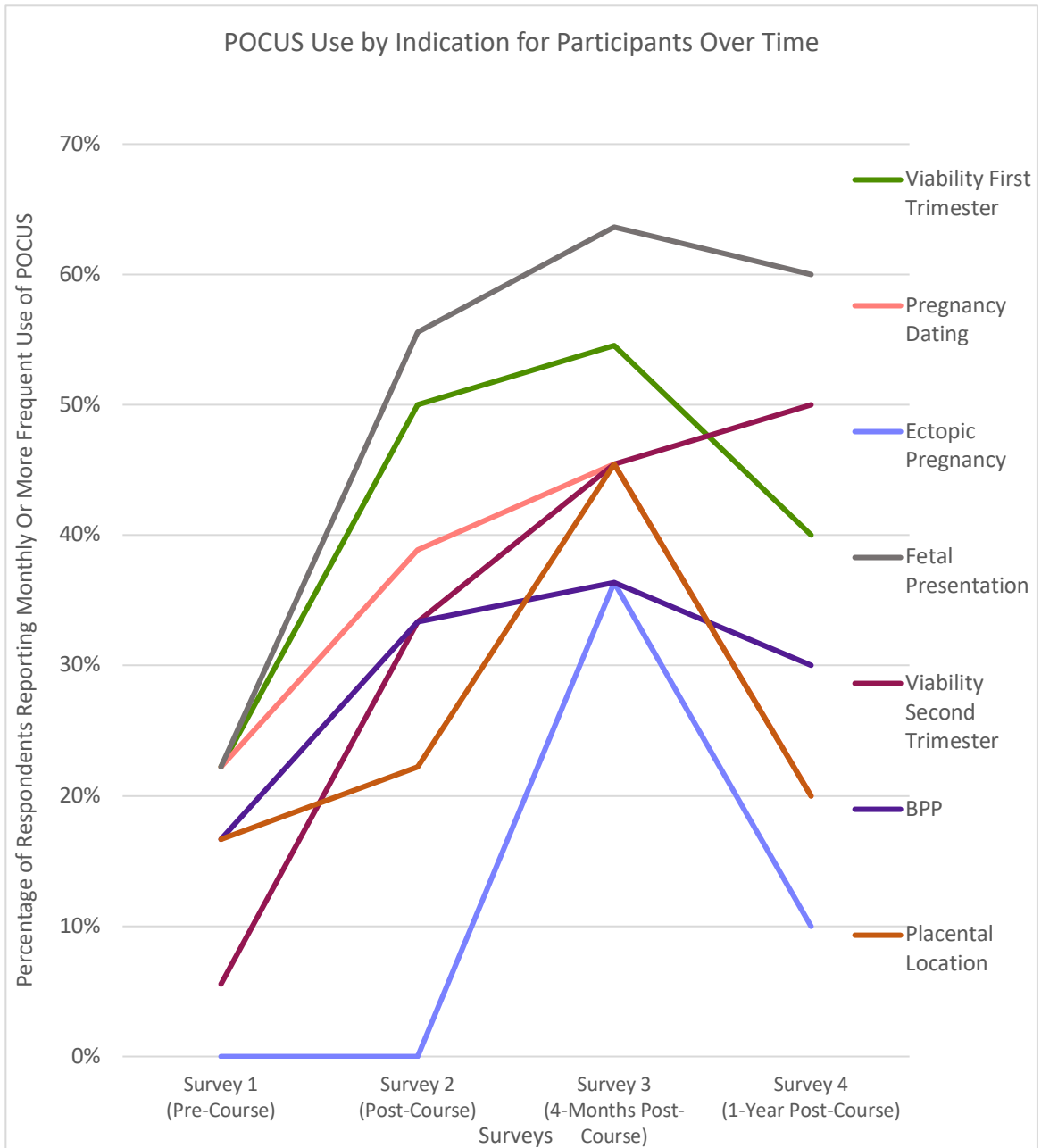
In general, the percentage of participants who stated that they were using POCUS within their clinical care increased from 28%, to 53%, 64%, and 60% respectively across the four surveys (Figure 11, Appendix G).

Figure 11 Participants' POCUS Frequency Over Time



The clinical indications that our participants reported using POCUS the most frequently throughout the four surveys were assessing fetal presentation (up to 64%) and confirming viability in the first trimester (up to 55%) (Figure 12). Indications with less than 50% of participants reporting usage over the study included: ectopic pregnancy, dating, BPP, and confirming viability in the second trimester (Figure 12).

Figure 12 POCUS Use by Indication for Participants Over Time





*Alignment of POCUS with Midwifery Professional Standards:*

As POCUS is a new within Ontario midwives' scope of practice, our participants commented on how this technology connects to midwifery professional standards to ensure the safety of their clients. Many participants articulated the importance of only using POCUS when clinically relevant as a way of upholding the CMO's professional standards of displaying good clinical judgement. For example, one participant shared: "I find when I'm in clinic, I use it whenever I get a chance for something that's indicated" (Harper). Practitioners were also mindful to only order diagnostic ultrasounds when clinically required to prevent further use of potentially limited healthcare resources. This was represented in one participant's experiences:

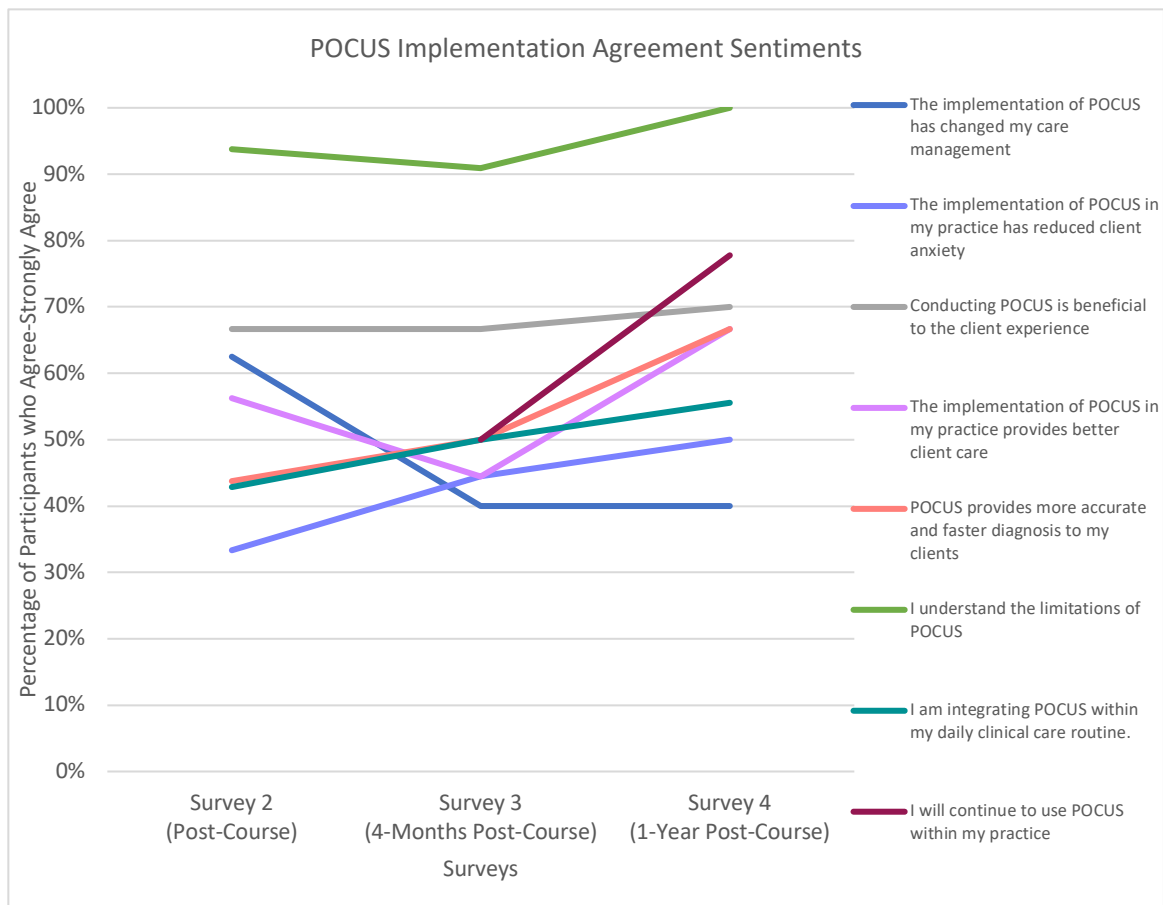
We're sending people for completely unnecessary scans, which as a clinician, I was just gobsmacked at, but as a clinician myself, I do not send people for scans unless it's necessary, because it's an unnecessary draw on the system. (Harper)

Participants also commented that they were nervous of becoming overly reliant on ultrasound technology and feared that their other clinical skills or professional knowledge would suffer as a result. This hesitancy towards sonography technology was highlighted by one participant who stated she was worried "that you would lose other skills, like palpation skills for example if you just take out the ultrasound to look at what position the baby is in instead of actually feeling it" (Blair).

#### 4.4 Addressing Barriers:

Throughout the three post-course surveys and interviews, there were several comments about how participants' POCUS learning was hindered by the costs associated with POCUS, issues related to the clinical practicum, and personal challenges. As a result of these barriers, only 56% of respondents stated they were using POCUS in their clinics in survey four (Figure 13).

Figure 13 POCUS Implementation Agreement Sentiments



### Cost Barriers:

Participants shared how significant the cost was for enrolling in the McMaster-Mohawk POCUS course and to purchase an ultrasound device for their clinics. One participant mentioned that this course was a significant expense because of both the financial and time commitment to consolidate sonography skills. Another participant had to travel outside of their community for their clinical practicum. Traveling for their placement was a huge financial decision they chose to finish their POCUS training. This participant highlighted that “to go, and to get a hotel, and then to go for two different practicums - to the same practicum but two different times, plus hotel, plus missing work, plus, plus” (Harper).

The expenses incurred by our participants continued beyond the cost of attending POCUS training and included buying and maintaining a bedside ultrasound device. Purchasing a sonography machine and ensuring required maintenance are significant financial undertakings for midwifery clinics, particularly for smaller clinics. One participant described how the size of a midwifery practice impacted the amount of additional income a clinic would have to spend on a bedside ultrasound device:

We're a small practice, so - big practices that have 15 midwives, they have more disposable income than small practices, and because the cost of running a practice tends to be fairly consistent, and then you just have more people and more clinicians to maintain that cost. (Harper)

For many clinics, without designated funding from the MOHLTC such as a capital purchase grant, or a grant from another organization, they would not be able to purchase a bedside ultrasound device.

Finally, some midwives highlighted in their interviews that they are not paid additionally for the clinical application of their sonography skills. One participant shared: "it's a general problem within midwifery... just the scope is expanding, and the money is not, and the time is not, and the ways to get paid are not. I think that needs to catch up" (Quinn). Along similar lines, another participant felt that:

Midwives don't get paid more for this, so it's more for the fun of doing it, and the benefit to the client, but meanwhile you're adding X-amount of hours a week... we don't get anything back for that. (Harper)

*Clinical Practicum Barriers:*

After completing the two-day workshop, many participants were unable to complete the practicum. Only two of our participants stated that they were able to organize and finish the practicum; all other participants shared their frustrations with not having access to a placement. The difficulty of arranging the clinical practicum was heightened by the COVID-19 pandemic. Several participants mentioned that they had tried to organize a practicum, but they were not able to find a sonography clinic with room for a midwifery learner. One participant indicated the degree of their dedication to finding a practicum as they "tried 17 different sites within an hour and a half radius of me and did not get a placement" (Harper). It was also stated by one participant how they felt unsupported by course administrators as they tried to organize a placement. They mentioned, "I

understood it was said that if you have problems with the clinical training, we can help you find places. But that hasn't been the case" (Blair).

Ultrasound clinics only have a limited capacity for clinical placement learners. Examples of other trainees include postgraduate and undergraduate medical learners, as well as sonography and nursing students. Since midwives have only recently been able to start using ultrasound, sonography clinics may have previous commitments to train other learners before they have the space and time for midwives, for example one participant described:

I spoke to the head of obstetrical ultrasound, and he basically just said we're overwhelmed with the residents and I can't accommodate you. And this is somebody that I had a relationship within terms of like a professional sort of been on committees with and things like that. I've worked with him for 13 years. (Taylor)

It was also mentioned that other practitioners, such as radiologists, were hesitant to accepting a learner for a clinical practicum because they did not have the extra time and resources to teach:

We have one radiology group who actually are all the radiologists at the hospital who run the clinics in our area, and they've all said no, like we don't have like the business side of it. They don't want to take the time to have a student who's going to take four times as long to do any ultrasound. We don't have the time or quite frankly, it's going to eat into our budget to have a student sit there and, you know, when we have to redo the ultrasound anyways. (Avery)

Another barrier identified by participants with organizing the practicum was that sonography preceptors were not financially compensated for their supervision. To address these barriers, participants suggested having the course instructors and

organizers play a more active role in coordinating the clinical practicums, including maintaining a list of potential placements. Additionally, a participant recommended that future learners “find a clinical placement first and then you take the course” (Blair) to minimize the barriers surrounding the struggles of finding a placement after completion of the modules and the workshop.

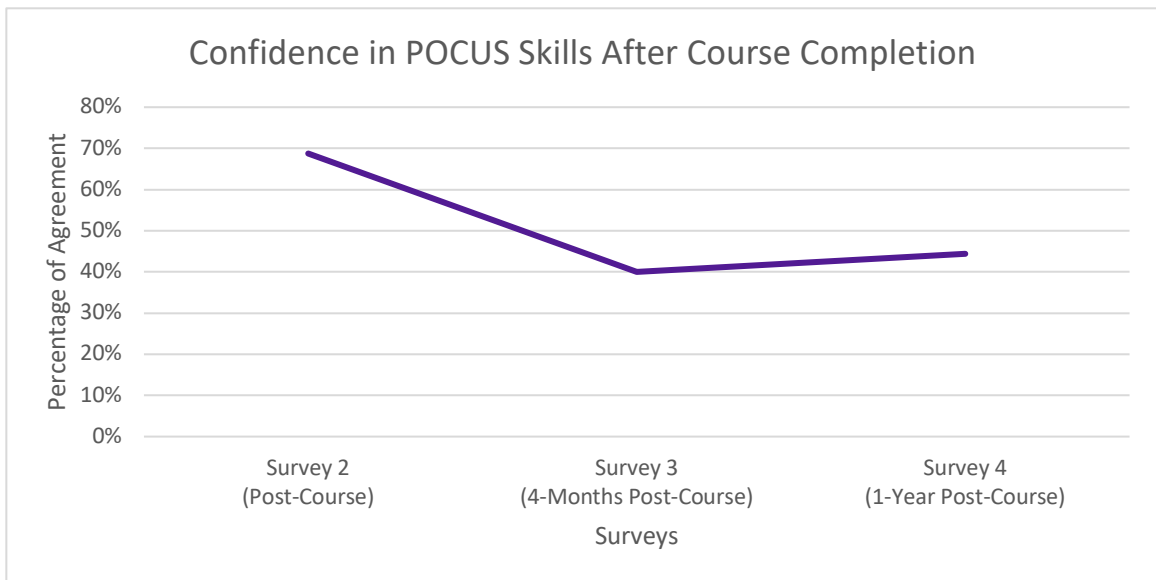
Furthermore, the outbreak of the COVID-19 pandemic in Spring 2020 meant that participants had to stop looking for clinical practicums because of safety concerns. Not obtaining a practicum was described as frustrating for participants because they had already put so much work into the course in the modules and the workshop to pursue their personal desire to learn POCUS.

Despite these challenges with the practicum, participants stated that they still wanted to organize and complete the practicum so in the future, they could use POCUS in their midwifery practice. One participant said: “I still have hope I can practice somewhere at some time but am not feeling hopeful about this. I would love to practice POCUS otherwise and think I would use it for expanded scope” (Kit). The compounding impacts of the challenges of obtaining a clinical practicum were illustrated in the minimal increase in POCUS frequency after course completion. For example, the rate of change in general POCUS frequency between surveys one and two was 25%. The rate of change between surveys two and three was smaller at 9%. However, there was a decrease in POCUS usage in surveys three and four by 4% (Figure 11).

*Personal Barriers:*

Many study participants did not have access to an ultrasound device after the workshop. Therefore, participants were unable to keep practicing their sonography skills and as a result their personal comfort and confidence with using ultrasound suffered. One participant shared: "I think if I had done my practicum, I assume I would be feeling more comfortable" (Quinn). In this study, comfort was described as completing a POCUS scan easily without stress or anxiety. The surveys indicated that participant comfort level shifted from 11% in survey one to 50% after completion of the modules and the workshop; indicating that participants became more comfortable with their POCUS skills and competency. In survey three, there was a slight decline of POCUS comfort (45% of participants reported being comfortable), however in survey four this percentage increased to 50% (Figure 7). Confidence was defined as being able to conduct POCUS scans self-assuredly and reliably for its intended indication. After the course, the percentage of agreement in participants' confidence in sonography skills were 69%, 40%, and 44% respectively in the three post-course surveys (Figure 14).

Figure 14 Confidence in POCUS Skills After Course Completion



Another personal barrier that participants identified as a factor that may prevent some midwives from learning POCUS skills was personal motivation. Participants mentioned their personal motivation to complete this course because they wanted to work within their full scope of practice to better support their clients. However, our participants felt that this strong personal drive was not held by all midwives since ultrasound is not currently a required competency in midwifery. For example, one participant thought that “motivation might be a barrier because not everyone...wants to absolutely work to the bare outer limits of their scope as midwives” (Avery).

The time required for participants to learn sonography skills and the challenges of personal time management were also barriers in POCUS education. This was highlighted in the following excerpt:



I think a barrier is just that midwives are busy and it's hard to incorporate such a big time [commitment], onerous skill development, and, of course, we need to develop our skills, but there's not much support for midwives financially to spend time improving their skills, doing a whole practicum, and then also doing their full-time job. (Quinn)

The interviewees described their challenging clinical workload, as well as being overburdened and short staffed at times. These career obstacles were seen as factors that made it more difficult for midwives to dedicate time to continuing education, such as POCUS. For example, one participant said they “found that it was too hard to incorporate [POCUS] into my full-time midwife life” (Quinn).

The significant number of hours midwives work and the struggles of constantly being on-call to attend deliveries were also discussed as a time barrier in their POCUS training. These challenging working hours have caused participants to question if they will be able to sustain being a midwife as they get older and whether they may need to make a career change to support their personal wellbeing. In thinking of their future career, participants were motivated to take additional courses like the McMaster-Mohawk POCUS course to provide clinical services outside of attending deliveries and thereby potentially reducing their number of on call hours.

Remuneration was also a topic discussed by participants because of their concerns to financially support their careers and personal affairs. Participants mentioned their motivation to learn and use POCUS to increase earnings for their clinical services:

I'm really interested in ways to both expand my skill set and also figure out alternative ways of working so that as I age, I don't have to work on call or do as many call outs as I do right now. I think that's kind of my long view about is that I would like to just expand my skill set so that if there ever are expanding ways of midwives to be getting paid that I could move my practice into a slightly different area. (Quinn)

#### 4.5 Refining the Role of the Midwife:

Midwifery as a profession is continuously evolving to provide optimal client care. The 2018 CMO scope expansion allows midwives to perform ultrasounds for clients, provided they have the appropriate knowledge, skills and judgement following a training program. These midwifery scope expansions help to further shape the profession and define the role of the midwife.

##### *The Public Perception of Midwifery:*

Throughout the interviews, comments were made about the general public's minimal knowledge of midwifery. With the novelty of POCUS in midwifery, there were concerns that the public would not know that a midwife could have sonography training.

Additionally, participants felt they required proof of certification to validate their POCUS skills. One participant mentioned that "it would be important for me to defend having the machine by saying I've taken the course. Here's the certificate" (Avery). However, participants felt that the scrutiny or questioning they would experience regarding their sonography abilities would not be translated to other perinatal care professions such as physicians:

I am aware that if [an obstetrician] picks up an ultrasound wand, nobody really questions it in general. I always feel that as a midwife we need to have certification and have our T's crossed and our I's dotted in order to cover our butts, and use new technology, and that sort of thing. You might well have somebody saying, "What are you doing with that? You're not allowed to do that." Then, you can wave the piece of paper saying, "No, I'm trained in this," which is why I really needed to get that placement done and get the piece of paper saying, no, I can do this. (Harper)

The pushback participants received regarding their POCUS skills extended to their midwifery colleagues as well. Participants shared how some colleagues were hesitant to see midwives using POCUS within their clinical practice. Participants felt that their colleagues assumed that because they were not sonographers or radiologists, they were not qualified to use POCUS in their clinical examinations. A potential explanation for their midwifery colleagues' distrust was their minimal awareness of the CMO sonography scope expansion and "probably... not understanding... the course, the reasoning behind it, how it would be used appropriately and just sort of trusting the new skill. There was a lot of resistance from that" (Taylor).

At the health policy level, participants reported that midwives are generally underutilized in healthcare systems. One participant stated how they "think midwives are underutilized in not just in Ontario but in general" (Avery). Participants felt policy makers have minimal knowledge of midwives and their clinical capabilities; resulting in midwives being left out of policy decisions that impact perinatal care:

Here's a problem, in the system where whether it be the government who isn't recognizing us for our skills and expertise, whether it be certain hospitals whose administration is not recognizing midwives for their skill and expertise and

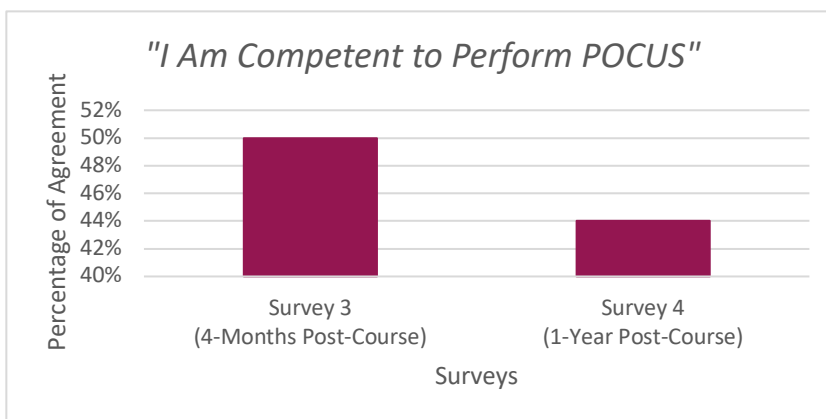
limiting scope, whether it be sometimes potential clients who think that midwives are great but really need a doctor to be safe, anything that midwives do that integrates them - and they are seen more as grown-up health providers, or health providers, dissolves those preconceived notions that we're just women with long skirts and a handful of herbs. Those myths still persist, which is really annoying, especially when it comes to big decisions that are made about midwives without the participation of midwives. (Harper)

### *Achieving Personal Competency:*

In this study, competency was defined as a learner being able to perform a POCUS scan for its intended clinical indication successfully and within their scope of practice.

Following completion of the McMaster-Mohawk course, 50% and 44% of participants reported feeling competent in their POCUS skills in surveys three and four respectively (Figure 15).

*Figure 15 Participants' Personal Competency Sentiments*



Participants also demonstrated personal competency by continuously acknowledging the strengths and limitations of POCUS technology. Throughout the surveys, a minimum of 90% of respondents, and 100% on the final survey, stated that they understand the limitations of POCUS (Figure 13, Appendix G). This speaks to participants' strong knowledge and clinical judgment in POCUS. Generally, learners who acquired

sonography skills more readily felt competent. For example, one participant who easily understood the didactic material and how to conduct ultrasound scans, felt competent with their POCUS skills. This participant was reassured of their competency by the high marks they received in course assessments. They stated:

I felt like I grasped it fairly quickly and coming out of that weekend intensive I felt like, yeah, actually I'm not bad at this. I'm pretty good. I got good grades. I got good marks on my practical exams. I don't know what one was, the other one was 100. (Harper)

Participants articulated that to achieve and maintain competency, continued POCUS usage was needed. One participant mentioned how important it was to keep practicing different indications because they realized how easy it was to start losing their clinical skills. They highlighted how “repetition is key, and I already feel like I've lost some of the things I learned” (Quinn).

Participants who were able to obtain a clinical practicum and who had access to an ultrasound device described themselves as competent overall. These participants were repeatedly able to use POCUS with ease for different indications, such as fetal presentation. However, some learners struggled with determining their personal competency level. They felt that competency was challenging to determine because “obviously you have to do some volume [the number of scans] to maintain competency, but competency is not only based on volume” (Quinn).

Additionally, many participants did not have access to an ultrasound device at their clinical practices, which made it difficult for them to continue their sonography

learning and become competent in POCUS. One participant highlighted their frustrations because they “haven't had any hands-on performing ultrasounds since [the course] ... I can't say that I have anything really else that the course gave me” (Blair). For learners to build upon their new sonography skills to become competent, continued practice was required.

#### 4.6 Serving Community:

Midwives play a key role in providing perinatal healthcare for their communities.

Midwives who were competent in POCUS were seen as valuable additions to their communities. In the three post-course surveys, 56%, 44%, and 67% of participants respectively agreed that POCUS improves client care (Figure 13). Midwives performing ultrasounds during their clinical exams may save assessment time and money as well.

This was highlighted by one participant who stated:

[POCUS] would be really helpful for people, especially people that it's harder for them to get to a facility...We have lots of non-OHIP clients, which, of course, they don't have to pay for their ultrasounds, but I think that lots of people would like to access a little bit more like a one-stop-shop. (Quinn)

Especially during the COVID-19 pandemic, participants commented that their clients were hesitant to travel to the hospital for ultrasounds out of fear of contracting the virus. Although POCUS does not replace a diagnostic ultrasound, in comparison to the past, midwives would be able to gather more clinical information with bedside scanning if their client did not attend their scheduled ultrasounds.

Particularly in rural and remote communities with minimal health resources, community members may need to travel great distances for perinatal or sonography care. POCUS could provide an opportunity to improve health services in these underserved regions. One participant explained how they hoped to use POCUS in a new rural community where there were going to establish its first midwifery practice. This participant highlighted their goals to “get midwifery started, like really moving forward... over this next year and that [POCUS] will be something that will be part of... our scope of practice” (Taylor). Another participant commented on the great distance their clients must travel to access medical care:

If you're not looking at the hospital, you're looking at an hour in either direction, and so I've had people who need BPPs and no way to get one for them in a timely manner. For us, that's huge...Especially if in your community you don't have regular access to another way to do that” (Harper).

Support of POCUS in rural midwifery care was also discussed in the qualitative survey data. For example, a participant stated, “our small practice is rural, and clients have many barriers to care including financial, transportation and geographic isolation. The hospital we refer to is 1.5-hour drive away. Quick access to POCUS would improve care for our community” (Kit). Further, participants felt that POCUS was useful to help further grow the midwifery scope of practice. For example, participants saw how POCUS could aid other medical services, such as abortion care or intrauterine device insertion —to better serve their communities. For participants, POCUS was an excellent way to

continue their philosophy to “provide a service to women and to families that is going to lead to good outcomes” (Taylor).

#### *POCUS Implementation:*

POCUS implementation speaks to how our participants have applied this training to their clinical work. Throughout the study period, POCUS integration into clinical care grew from 43% in survey two, 50% in survey three, and 56% in survey four (Figure 13).

Seventy-eight percent of participants shared that they would continue to use POCUS in their practice at the end of the study (Figure 13, Appendix G). The majority of participants (67%) felt that POCUS provided better, more accurate care and that this additional clinical information led to faster diagnoses. Further, one year after the course over half of participants felt that POCUS was beneficial to minimize client anxiety.

However, many participants were not using POCUS on a regular basis within their clinical practice (Figure 13, Appendix G). With respect to clinical care management, 63% of participants commented that POCUS had positively impacted their clinical care management immediately upon course completion; but this percentage of participant agreement dropped to 40% in the two final surveys (Figure 13, Appendix G).

#### *Client Perspectives:*

Throughout the study results, our participants repeatedly mentioned how supportive and excited clients were to have POCUS used in their care. The study interviews and surveys also described how bedside ultrasounds provided more opportunities for parents to connect with their developing baby. Specifically, up to 70% of survey



respondents stated that they thought POCUS was beneficial for their clients (Figure 13).

Participants shared how bedside scanning enhanced client experiences:

[Parents] love [POCUS], because whenever I do a scan like a BPP, usually I spend more time - you show them the baby's face, and how the baby's sucking, and you can see the lips, and you can see the baby swallowing, and we talk about that, and we go through parts of the anatomy, and they love that. (Harper)

The interviewees stated that their clients were enthusiastic about POCUS, and they were very comfortable with their midwife performing scans. Some clients were even disappointed that POCUS was not used during all their appointments. One participant shared that their clients “are extremely excited about it and really happy to have had a midwife who is able to do it” (Taylor).

Pregnant clients can experience anxiety for many reasons, such as the fear of pregnancy complications. For example, one participant stated how beneficial POCUS was to relieve their clients' anxieties, “for parents who are... worried about various things, it's very handy to have” (Harper). Another example shared by our participants was how the ability to conduct a bedside scan was helpful to finding a heartbeat in early gestation. One participant stated that at times when the viability of the pregnancy was uncertain clients experienced delays in access to ultrasound, “sometimes we would wait three, four days for a scan [for] viability, especially over a weekend” (Avery). Confirming the fetal heartbeat instantly in clinic was reported as favourably reducing parents' anxieties surrounding the wellbeing of their developing baby.

#### *Interprofessional Relations:*

In addition to the positive impacted on access to care and client experiences, these additional sonography skill sets influenced interprofessional relationships between midwives and physicians. In some Ontario communities, it was described that some of their obstetrician colleagues were very supportive of midwives performing POCUS and felt midwives had similar knowledge and comparable skills to obstetricians. One midwife shared how their “OB colleagues at our hospital are pretty supportive for us to work to our fullest scope and within our training, and also we have really good access to ultrasounds” (Quinn). However, these sentiments of support and collaboration with midwifery were not universal amongst physicians. Some participants felt that their physician colleagues would be hesitant towards midwives using POCUS. For example, one participant shared how they were: “not sure that [POCUS would] be welcomed by the obstetrician if we did [a scan] in hospital because that would take away from their remuneration” (Blair).

#### 4.7 Results Summary:

In all, the quantitative and qualitative data illustrated five major themes of facilitating learning, improving care, addressing barriers, refining the role of the midwife, and serving community (Figure 6). This study demonstrates the numerous benefits of perinatal POCUS education and application within midwifery to provide more comprehensive client care. The study findings and the implications of our work will be discussed further in the next chapter, *Chapter Five: Discussion*.

## CHAPTER FIVE: DISCUSSION

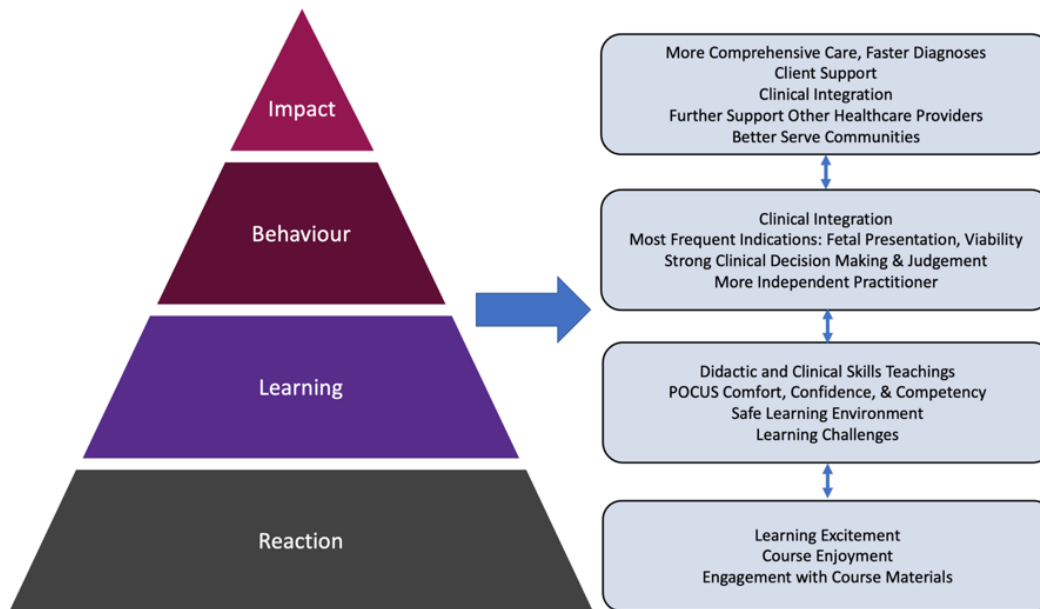
### 5.0 Discussion Introduction:

Our results support the existing literature and provide new insights with how midwives learn and apply POCUS technology to positively impact client care. The results of the five data themes will be discussed in this chapter regarding their significance, as well as their connections to the literature, the Kirkpatrick model to evaluate this POCUS course, and Kolb's experiential learning cycle (Figure 6,16).

### 5.1 Facilitating Learning:

Student interest and the applicability of course materials are essential in encouraging learning. Our participants shared their enthusiasm to enroll in continuing education initiatives, like this POCUS course, because of their personal love of learning and desire to provide more health services to their clients. Their excitement, enjoyment, and interest in the course content speaks to its positive reception and their reactions to the training, level one of the Kirkpatrick model (Figure 16).

Figure 16 Project Findings in Relation to the Kirkpatrick Framework



Personal interest has also been reported as a continuous driving factor in facilitating adult education in the literature (131,132). Given these results and the literature, it is hypothesized that POCUS enthusiasm will continue to motivate future health professional continuing education learners to complete the training amongst their demanding schedules. Salmon et al. (57) also state the importance of course materials being intricately designed with learners in mind to make the best use of teaching time (57). Before the Fall 2019 cohort, Ontario midwives were surveyed to share their thoughts about the sonography scope expansion and their personal interests in conducting bedside scans for their clients. This POCUS survey for midwives included questions such as what indications they would use in their clinics to inform the curriculum developments of this course (34). Overall, our participants appreciated the content of the course as they saw how the modules and the clinical skills workshop

aligned with their clinical cases. Therefore, it is recommended for other POCUS curriculum designers follow similar steps as this course and keep their learners at the forefront in their course development to ensure relevancy of teaching materials. Our participants also expressed interest in focusing their attention to practice scanning time for common POCUS indications in perinatal care, such as fetal presentation and pregnancy viability as opposed to BPPs. Therefore, these priority areas should continue to be given lots of learning and scanning time in future course iterations to provide learners with teaching materials they will apply to their clinics. In all, the results of this thesis demonstrate how learner motivation, personal interest in the education topic, and relevancy of course materials all contribute to facilitating continuing education learning for health professionals.

The online modules, the two-day workshop, and the clinical practicum played different roles in facilitating participant learning throughout this study. Analyzing our results in reference to Kolb's cycle of experiential learning can help to further understand how our participants acquired and embedded POCUS into their clinical work after completion of this training. Briefly, Kolb's cycle incorporates four phases, starting with instructors giving learners opportunities to engage in new situations to form concrete experiences. Learners are then encouraged to reflect upon their concrete experiences by identifying their strengths and areas of improvement to guide their future learning in stage two: reflective observations. Thirdly, abstract conceptualization refers to learners drawing conclusions from the previous two sections in Kolb's cycle so

they can actively apply and experiment with their new knowledge. The cycle of experimental learning re-starts when learners are able to refine, practice problem-solving, and actively experiment their new knowledge and skills to other situations (133–135). Together, the four phases of Kolb's cycle will help uncover the learning process our participants underwent to develop and apply new sonography skillsets in this project.

Although our participants have extensive clinical experiences working as midwives, sonography is challenging to learn and is very different from other midwifery clinical skills. For example, some of our participants struggled with maneuvering the probe on a simulated patient's abdomen because conducting bedside scans are very different from their previous clinical skills training. The literature also supports how some learners need more time than others to learn introductory sonography skills, such as how to conduct scans for different clinical indications (32,42). Our research highlights the benefits of extensive ultrasound scanning time to give learners concrete experiences to help overcome the challenges of acquiring new sonography skills. Unfortunately, as the workshop was only two-days and many were not able to complete the practicum, some of our participants were unable to develop their POCUS skills and knowledge as much as they would have expected throughout this training. These sonography learning challenges and frustrations our participants had with the course materials also connects to level two of the Kirkpatrick framework by highlighting the barriers that impeded POCUS learning (Figure 16). It is encouraged that these barriers be taken into

consideration in other POCUS curriculum designs and minimized as much as possible to promote learning.

The online modules provided the knowledge required for students to understand the sonography skills delivered during the two-day workshop. Our participants reflected on the importance of having background POCUS didactic knowledge to help facilitate their clinical learning in the workshop. The module quizzes also allowed learners to reflectively observe their current strengths and knowledge gaps to guide their revisions to prepare for the workshop. Therefore, the module quizzes are encouraged to continue in future iterations of this course. Our participants also appreciated completing the modules before the workshop because of the limited in-person training time, they were able to specifically focus on applying their POCUS didactic knowledge to clinical skills to make the most of the training. Other POCUS courses have also acknowledged the benefits of combined didactic and clinical educational methods in sonography learning (136–138). However, clinical learning has been attributed with being more important than didactic learning because this educational method allows learners to build clinical skills they can use in their clinical work (138). Similar sentiments were shared by our participants and in other studies in terms of how instrumental clinical learning is to provide concrete experiences that replicate learners' clinics to improve their clinical skills (137). Clinical simulations, such as working with simulated patients also allow learners to apply their new POCUS knowledge by actively experimenting with how bedside scans can be included into different pregnancy assessments. Therefore, it is

advised that clinical simulation exercises and OSCE assessments continue to be actively included in POCUS training.

Additionally, the clinical practicum played a key role in refining our participants' POCUS clinical and problem-solving skills. Participants felt that they needed the practicum to feel confident and competent in their sonography skills (Figure 16). Specifically, clinical placement learning has learners focus on concept formation in Kolb's learning cycle such as improving their critical thinking skills and decision-making processes. For example, in the practicum, learners discussed how POCUS scans would be beneficial in certain clinical scenarios. The practicum also gave midwives ample clinical skills practice so they could successfully and efficiently scan for different transabdominal obstetrical indications. Midwives' clinical experiences may also encourage them to connect their past midwifery experiences by thinking about if and how POCUS could have been used in these scenarios. This active engagement in clinical placements help learners further understand how sonography and midwifery can be brought together to enhance client care (133,134). Several studies also support the significance of clinical placements helping learners validate their sonography skills and improve their confidence (57,139). Studies evaluating the maintenance of POCUS skills in healthcare providers found that upon completion of POCUS training, those who regularly apply ultrasound in their clinical settings had higher skills and knowledge levels in comparison to those who did not perform or who rarely conducted scans (41,42,140). Continued POCUS usage after training improved our participants' perceptions of their sonography



skills which also likely serves as an intrinsic motivator for continued POCUS usage in their clinics.

In summary, the three educational methods (the modules, the workshop, and the clinical practicum) played vital roles in facilitating different aspects to POCUS learning. The online modules gave learners the didactic information they needed for the workshop where they were then able to start to learn sonography skills that were refined in the practicum. Based on our results and the literature, challenging clinical skills teachings, such as POCUS education, should incorporate multiple educational methods to facilitate both the didactic and clinical aspects of learning for health practitioners.

Our results also demonstrate the importance of a safe learning environment for students (141–143). Our participants emphasized how appreciative they were to learn in a space where they felt comfortable to ask questions on the difficult subject matter of POCUS. In this course, the ratio of learners to instructors was approximately three to one respectively; our participants expressed how glad they were to work in small group learning environments throughout the workshop. The literature has also attributed small class sizes with improving advanced learners' abilities to acquire new teachings (144). Therefore, it is encouraged that safe and small group learning environments continue in the McMaster-Mohawk POCUS course and in other sonography continuing education initiatives to aid learning.

As our participants struggled connecting the didactic material to the POCUS clinical skills in the two-day workshop, it would be beneficial to extend this element of the training. Our participants shared that they wanted additional scanning time to have more opportunities to reflect on their learning experiences and their knowledge gaps as well. To improve our course, it is recommended for the two-day workshop be extended to accommodate learners' needs in future iterations of this POCUS course. Extending clinical skills training sessions would also be advantageous to other POCUS courses as well or other clinical skills training to ensure learners have ample opportunity to practice and to start feeling comfortable with their new skills. However, there is no clear answer to how long POCUS workshops should be to teach obstetrical introductory sonography skills as the length of continuing education POCUS courses for midwives cited in the literature varied significantly. For example, some courses were one-week long while others spanned over a six-month period (41,42). One potential solution for this course would be to provide learners with an additional full day of scanning to provide learners more time to engage with the material before their placements. However, given the busy schedule of practicing clinicians, clear learning objectives for the workshop are needed to ensure all scheduled sonography teaching time is required.

## 5.2 Improving Care:

Our participants shared how they hoped to use POCUS to provide timelier comprehensive client care. According to the literature, bedside ultrasound education has organizational impacts in the delivery of perinatal care, such as improving the efficiency and accuracy of obstetrical assessments. For example, emergency room stays decreased by approximately 20% for IUPs using POCUS (38). Decreasing the time to diagnosis not only enhances the client experience by expediting their time to start treatment, but may also allow more time for practitioners to educate and discuss with their clients to ensure they are well informed on their healthcare decisions. Improved clinical efficiency also positively impacts a midwife's ability to see other clients or perform other clinical duties; therefore, POCUS technology and training should continue to be supported and made available for midwives.

The wider impacts of POCUS training in midwifery are also evident in how open and supportive clients are towards this technology being used in their care. Specifically, our participants highlighted how receptive and eager their clients were to having POCUS used in their prenatal care. Client support for midwives using POCUS is a continuous theme throughout the literature as well, with one study reporting that 100% of surveyed midwives stated that their patients requested POCUS be used in their care (42). Another study found that 100% of patients felt safe incorporating this technology in their antenatal care (19). As clients are supportive and consented to their midwives using POCUS in their care, this technology can be readily used throughout pregnancy provided

practitioner training and medical necessity. For example, Zambian midwives were able to consistently use ultrasound, approximately ten times a week after training for indications such as fetal presentation, placental location, gestational age, and the presence of multiples (42). Additionally, our participants frequently used POCUS to improve care in assessments of fetal presentation and pregnancy viability in the first and second trimesters (Figure 16). POCUS has also been routinely used in pregnant peoples' care for fetal monitoring and for identifying complications, such as fetal abnormalities in the literature (30,45). Therefore, our study provides more evidence for how POCUS can be used in pregnancy care of course with client consent and how this technology should be made readily available to enhance client care.

It is important to be mindful that the benefits of POCUS in obstetrical care are greatest when this technology is used only when clinically necessary. Practitioners can face pressure from pregnant people to use this technology when it is not medically required, most likely because they want to see their developing baby (30). Using healthcare technologies excessively or inappropriately can also hinder patient care. For example, a midwife may see a shadow in a POCUS scan which would require further testing to confirm the presence of abnormalities. However, going for additional testing may cause significant client anxiety, even if the results come back normal; therefore, this additional POCUS scan did more harm than good. POCUS technology needs to be carefully considered before it is clinically applied. Despite client demands for increased ultrasound scans in pregnancy, our participants did not give into this pressure and felt

that to maintain good clinical practice, POCUS was only to be used when clinically required. Understanding bedside ultrasound technology's limitations also speaks to this curriculum meeting a major course objective of ensuring learners understand when POCUS is appropriately used in antenatal care. Connecting back to the Kirkpatrick model, the clinical decision making and critical thinking skills our participants described regarding when POCUS should be used speaks to their clear knowledge of the benefits and limitations of the technology from this training (Figure 16). Together, the findings from our study and the literature demonstrate the need to thoroughly discuss the ethical impacts and limitations of POCUS with learners during their training. In addition, clinical learners need to understand how to conduct their clinical duties with this technology to improve patient wellbeing.

### 5.3 Addressing Barriers:

Our participants faced many barriers with their POCUS education and clinical integration throughout this study. The most prominent barriers throughout the data were the high costs associated with POCUS training and acquiring a bedside ultrasound device, the challenges in finding a clinical practicum, and personal struggles.

The financial costs associated with purchasing POCUS technology and attending training are too expensive for many clinicians. It is evident that the costs of a portable, or handheld POCUS devices are more affordable than larger devices used for diagnostic scans, which make this bedside technology more affordable for low resource areas

(19,37,42,61,80). However, our participants mentioned how due to the way Ontario midwives are funded, they are unable to buy an ultrasound device without additional investments from the MOHLTC or another organization. Midwifery is also a primarily female identifying profession and pay equity has only recently started to be addressed in Ontario (145,146). Therefore, shifts in the current pay structure are needed to increase midwives' wages to better reflect the health services they provide. This would include increasing compensation for the expanding scope of Ontario midwifery as well as accounting for previous and current gender inequities. With more appropriate remunerations for the health services midwives provide, it is perceived that they will have more funds to partake in POCUS training and to purchase a device for their clinics. It is critical for the MOHLTC to recognize the value of POCUS in midwifery care and to improve access to this technology by offering more financial support with sonography training and device costs. It is also expected that in the future, the costs of a portable ultrasound device will continue to decrease, which would make this technology even more accessible across the world.

While our participants were excited for this POCUS course, many were not able to complete the practicum despite its importance as discussed in *5.1 Facilitating Learning*. This barrier needs to be overcome to aid future student learning. Our participants provided some suggestions to improve their access to the practicum such as learners coordinating a placement before course enrollment or instructors providing lists of sonography clinics able to take midwifery learners. Payment for preceptors could also

be considered as a strategy to incentivise taking midwifery learners for their practicum.

As a next step, it is essential for course coordinators to reflect upon participants' challenges and the results from our study to help improve access for the practicum.

Midwifery is a challenging profession, our participants shared that constant on-call duties make them feel over-worked. Some participants feared that they may need to leave the midwifery profession because of the high demands placed on them. One motivation our participants had with enrolling in this POCUS course was to perform other clinical duties outside of attending deliveries to hopefully minimize their on-call time. They felt that having less on-call time for deliveries would help them sustain a long midwifery career. The literature and media have also shown how overwhelmed and unsupported Canadian midwives feel. While midwives are very passionate to provide perinatal care, many practitioners are feeling burnt out with some intending to leave the profession; sentiments only amplified by the COVID-19 pandemic (147–149). Even in midwifery undergraduate education, learners hold high values for work-life balance and the challenges they face within their placements, such as mental and physical exhaustion, influence their likelihood of staying within the profession (150). Therefore, it would also be beneficial for midwifery students to learn POCUS in their undergraduate education to clearly understand the entire scope of practice for Ontario midwives. Including POCUS training in undergraduate education would allow students to have a deeper appreciation for the midwifery profession, and also start thinking about how they want to structure their clinical work. Overall, to improve the wellbeing of Ontario

midwives, structural changes need to be made within the profession to give midwives more accommodating schedules that included introductions to health services they can provide outside of deliveries, such as POCUS, for their wellbeing. This may involve midwives rotating between delivery services and other antenatal care services such as POCUS scans in obstetrical assessments with the other practitioners in their clinics. Bedside ultrasound training not only gives midwives additional skills to better aid their clients but hopefully helps to reshape the profession to be more flexible and sustainable for practitioners as well.

#### 5.4 Redefining the Role of the Midwife:

This project and the current literature support how sonography training allows midwives to provide additional care services and gives them more clinical independence (34). Our participants shared how the POCUS training lets them make more informed decisions in their clinics. Midwives able to gather more information to advise their clinical decisions speaks to the overall success of the training —level four of the Kirkpatrick framework (Figure 16).

Competency has been described when learners are able “to do” assessments that replicate clinical practice to determine their abilities to give high quality care (18,151). Competency was determined by our participants’ abilities to perform bedside scans correctly and efficiently for their intended clinical indication. Our results also support that POCUS competency and the amount of practice scanning time are not a



linear relationship —they are two different concepts (151). We found that a variety of factors, such as continued usage of POCUS skills, theoretical ultrasound knowledge, personal confidence, and academic achievement are needed for learners to feel competent in POCUS.

Assessments of learning, such as the workshop OSCEs included as part of the workshop helped our participants see their strengths and areas of improvement to further understand their sonography competencies. Other studies evaluating perinatal POCUS clinical skills and knowledge found OSCEs to be a valid tool in assessing learner retention of the course materials and sonography competencies (41,42). OSCEs are very flexible educational assessment tools allow educators to develop clear evaluation guidelines, such as how to determine POCUS competencies to help ensure consistency among evaluators. Some of our participants shared the challenges they encountered with the OSCE assessments such as the difficulty of the stations. However, difficult examinations are appreciated by midwifery students to ensure the rigour of these assessments and to assure their competencies (74). As our participants were able to correctly perform scans for various indications in their course assessments (such as the OSCE and the logbook), they felt personally competent, and consistently applied their new skills in their clinical work (Figure 16). How our participants were able to directly translate their POCUS training to their clinics, such as to aid their assessments for fetal presentation, speaks to how this course can teach midwives tangible skills that positively impact clinical care.

The CMO can also play a key role in standardizing midwifery POCUS competency. In Family Medicine, the formalized nature of CACs which requires both rigorous skill evaluation by a committee and clear distinction of skills amongst colleagues may be a useful framework for expanded scopes of practice in the CMO (81). Developing a structured POCUS competency evaluation within the CMO may also encourage the college to reflect upon their POCUS evaluations to establish a set of standards regarding how midwives are to apply POCUS within midwifery care. Particularly in the future as there are more POCUS courses available for midwives, a competency evaluation by a committee would be helpful to standardize how POCUS may be used in midwifery and practitioners' respective skills. Designing standard CMO competency evaluations may also be an opportunity to communicate and solidify the standards of care. For example, what clinical scenarios or indications would it be appropriate for a midwife to conduct a bedside ultrasound scan. Using a committee to evaluate midwifery POCUS skills would also improve the validity of the CMO's POCUS evaluation and the credibility of midwives' sonography skills (53). Therefore, it is recommended that the CMO work to establish POCUS competency guidelines and assessments to help ensure that this technology is appropriately used in midwifery and to ensure demonstration of competency amongst practitioners.

Many people are not familiar with the midwifery profession and the extensive training midwives have in perinatal care, including this new expanded scope provision to perform ultrasounds. Specially, hesitations from physicians surrounding a midwife's

knowledge have been noted in this study and the literature. For example, some physicians doubt midwives have the skillsets to prescribe medications to their clients. These physicians felt that because midwives provide low-risk obstetrical care, they do not have enough pharmacological knowledge to prescribe medications —despite pharmacology being included in Canadian midwifery education (10,15). Ontario health policy makers also often overlook midwives in health policies that impact perinatal care (152). The misconceptions and neglect surrounding midwifery need to be rectified to better support these practitioners. A possible solution may be for the MOHLTC or midwifery professional organizations, like the CMO, to fund midwifery education initiatives for the public to learn about the midwifery scope of practice and the extensive skillsets they bring to their communities. Increasing public knowledge of the profession will help to ensure that midwives are well represented and included in healthcare systems and health policies.

Increased collaboration between different healthcare providers, such as midwives and physicians may also help minimize their hesitance or lack of knowledge about the midwifery profession. The literature shares the benefits of interprofessional collaboration amongst different primary maternity care practitioners to provide better care and support for pregnant people throughout the world. For example, bringing together midwives, physicians, and allied health professionals such as lactation consultations, can provide more holistic and comprehensive health services to patients (153). However, the dynamics of interprofessional collaboration can be challenging to

establish as practitioners' scope practices and workplace dynamics vary by jurisdiction (153–157). Specifically in Canada, collaborative care models between midwives and physicians have improved health access and clinical efficiency in remote areas, such as rural communities in British Columbia (153,157). However, there are major barriers which impede interprofessional collaboration in perinatal care. Some examples include the personal conflicts between perinatal care providers, the minimal knowledge of other health professionals, as well as the lack of time and resources for various practitioners to connect to discuss how they can work together (153,157,158). In reference to POCUS technology, midwives who can perform more clinical skills with bedside scans may give more opportunities to work with their colleagues and other healthcare professionals. For example, midwives may be able to assist their physician colleagues by conducting bedside scans.

Additionally, our participants also shared how they felt a need to continually provide evidence of their POCUS training as a way to validate their skills —something they felt not required of physicians. Our participants wanted their public image to be more reflective of the services they provide. As a result of more POCUS training and sonography integration in the future, hopefully POCUS will become more synonymous with midwifery, and doubts regarding a midwife's sonography skills will wane. With more iterations of this POCUS course and others like it, more midwives and health providers will have the opportunity to engage or familiarize themselves with POCUS in midwifery.

## 5.5 Serving Community:

Our research demonstrates the essential roles midwives play in their communities by providing perinatal care for all people. Particularly in remote communities, such as Northern Ontario, our participants shared how many of their clients cannot easily access a sonography clinic. Many of the midwifery POCUS courses described in the literature were targeted to remote underserved regions, such as low- and middle-income countries, where there is currently little or no access to diagnostic ultrasound clinics (19,40–42). In these underserved regions, POCUS may be a client's only option for an ultrasound scan. Another communal benefit of POCUS scans shared by our participants and other researchers was how parents appreciated being able to see and bond with their developing babies through a bedside scan (19,30,45). For clients unable to access diagnostic ultrasounds during their pregnancies, in a medically necessary POCUS scan, they would now have the opportunity to visually connect with their baby during obstetrical assessments to improve their parent-child relationship. Altogether, POCUS technology has the potential to positively shift midwifery practices to give more holistic comprehensive care and improve healthcare access —illustrating the organizational impacts of this training or level four of the Kirkpatrick pyramid (Figure 16).

## 5.6 Limitations:

Despite the multitude of results and important recommendations stemming from our study, our findings are limited by the lower response rates on the final surveys (as discussed in *4.1 Description of Participants: Survey Response Rates*). Possible explanations for the decreased response rates on the final two surveys were the large number of surveys in this study, the time passed from the start of the course, and the impacts of the COVID-19 pandemic on midwives' personal and professional lives (159). As a result of lower response rates, fewer perspectives were heard surrounding the long-term effects of POCUS learning, such as knowledge retention of the course material and POCUS integration after this training. It may have been helpful to provide incentives, such as gift card draws, in the final surveys to improve their response rates.

During the study period, only two participants were able to complete the clinical practicum of the McMaster-Mohawk POCUS course and approximately six participants had access to an ultrasound device. Therefore, only a few voices regarding POCUS clinical integration were shared. The data surrounding the indications participants frequently used this technology for were very important to understanding the organization and greater impacts of this training. A potential solution to further understand how participants are clinically applying POCUS would be to follow them further in a subsequent study.

Additionally, provided the low response rates in the final surveys and the frustrations participants had with organizing a practicum and having access to an

ultrasound device, response bias could have been introduced. For example, participants who had more positive or negative emotions may have been more motivated to complete the surveys to share their appreciation for the course or voice their concerns to help guide improvements for future cohorts.

No identifying factors were collected throughout this study for confidentiality reasons due to the small number of learners and thus all study evaluations were of the entire cohort of learners enrolled in the course. However, individualized learning was not analyzed in the surveys and was only commented in the interviews if the interviewees discussed their personal learning growth. In future work, it would be interesting to evaluate individual learning with the McMaster-Mohawk POCUS course to supplement this work by further understanding how different midwives acquire and maintain sonography skills. Collecting identifying data may have also improved the response rates of surveys three and four as researchers could personally remind each participant as opposed to larger group correspondences in this research. Potentially, participants may have been more inclined to respond to a personal email instead of a general reminder.

Another limitation of the study was the reliance on self-assessments from participants' surveys responses and interviews. An OSCE was planned for Spring 2020 to quantitatively evaluate how participants had maintained their POCUS skills; but this data collection method was eliminated from the study in response to the COVID-19 pandemic. Participants' self-assessments have been shown to be unreliable in the

literature, therefore, ideally self-assessment data would be triangulated with additional quantitative sources to determine the agreement between what participants say and actually do (160,161). Future research accounting for the limitations of self-assessments in POCUS education is advised.

Finally, there was also no comparison group included in this study as all participants completed the online modules and the workshop of this course. Including a comparator group may have been beneficial to understand more specifically the implications of this training. For example, comparisons of assessment scores between the control group and the education group would have showed if current midwifery curricula impact learners' sonography knowledge. The assessment scores from the control group would identify any previous sonography knowledge learners may have to better understand participants' POCUS learning growths.

### 5.7 Emerging Theory from the Data:

The educational impacts of the McMaster-Mohawk POCUS course can be summarized by their relations to the Kirkpatrick framework to showcase the emerging theory surrounding POCUS education and this technology's clinical applications in midwifery. Midwives are excited and enjoy the opportunity to partake in POCUS training despite the difficulties of sonography learning. Didactic and clinical educational methods are both important in facilitating POCUS learning. However, there is more value in clinical training as these activities replicate real-life clinical scenarios to improve learners'



comfort, confidence, and competency with POCUS scans in comparison to didactic teachings. POCUS training gives midwives wider clinical skillsets, which makes them more independent practitioners. Midwives use bedside ultrasound technology in their clinical care for indications such as pregnancy viability and fetal presentation when clinically necessary. Overall, POCUS education allows midwives to better serve their communities by providing clients with faster and more comprehensive care (Figure 6, Figure 16). Therefore, POCUS training should continue to be offered and supported in midwifery to expand and improve the perinatal care services midwives can provide to their clients.

## CHAPTER SIX: CONCLUSIONS

### 6.0 Key Findings:

The quantitative and qualitative analyses of the McMaster-Mohawk POCUS generated five major themes: facilitating learning, addressing barriers, refining the role of the midwife, serving community, and improving care (Figure 6). The online modules provided the didactic knowledge participants needed to understand the clinical aspects and applications of POCUS in the two-day workshop and the practicum. Barriers in this study were that only two participants completed the clinical practicum and minimal participants had access to a portable ultrasound device. Together, these challenges unfortunately hindered midwives' sonography training and clinical integration respectively. These barriers need to be overcome to allow midwives to be more independent practitioners who can give more comprehensive client care to improve perinatal health outcomes. Altogether, the McMaster-Mohawk POCUS course was well received mechanism to learn and implement POCUS into pregnancy care. Therefore, this course should continue to be offered in the future to help improve primary maternity care (Figure 6, Figure 16).

### 6.1 Implications of Key Findings:

Our research illustrates how sonography training gives midwives more clinical skills to help guide their decision making to improve client health outcomes. The CMO ultrasound scope expansion stated that midwives needed appropriate POCUS training,

however, no other guidance was provided surrounding POCUS education, clinical applications or how to ensure competency maintenance over time (1). This thesis states the importance of evaluating continuing health professions education courses to understand their various learning levels and clinical impacts. This study may be used to refine future POCUS training courses and support additional research regarding how healthcare practitioners can learn and clinically apply bedside ultrasound skillsets. Our results can also inform future POCUS curriculum designs in maternity care for midwifery learners and other healthcare professions such as physicians, physician assistants, and nurses. Although our goal was not to be able to generalize the findings to other populations, the insights from this course would be relevant for other primary care providers in obstetrics.

Furthermore, the positive comments from our participants regarding how they were able to learn and clinically apply POCUS shows the benefits of expanding health practitioners' scope of practice. This research can be used to inform further scope expansions in midwifery and other professions. For example, Ontario nurse practitioners are able to "apply ultrasound," however, their current standards of care have no mention of nurse practitioners performing ultrasound scans (162,163). Hopefully, the results of this study and other research can help to encourage policy development and education surrounding bedside ultrasound so that nurse practitioners or other healthcare providers can offer more health services to improve patient care.

## 6.2 Future Research:

It is recommended that additional studies be done to continue evaluating participant learning regarding their retention of sonography skills and knowledge over time. This further research will help to understand the long-term competency and the impacts of POCUS technology being used in pregnancy care. As our participants had significant challenges with organizing the clinical practicum and many had minimal access to a device in their clinics, it would be beneficial to conduct another study in the future. Future study with our participants would also evaluate if anything has changed for them since the completion of this research. This additional follow up would allow researchers to see if more participants were able to complete the practicum to further understand the clinical applications of this technology, and the organizational impacts of this training.

To supplement this research, a longitudinal study would also be beneficial to further understand how Ontario midwives retain their POCUS knowledge and skills maintenance. This may involve following our participants and future cohorts over an extended period, to understand skill and knowledge maintenance and POCUS competency for different clinical indications. This longitudinal research would also illustrate if there is a need for re-certification of sonography skills. For example, this research would try to understand how POCUS re-certification can connect to the CMO's continued competencies in their renewal of registration process (164,165). Further follow up with midwives on their experiences using POCUS would help researchers

understand the logistics of bedside ultrasound devices being brought into clinics, for example how often do POCUS machines need to be serviced for maintenance. Another objective of this longitudinal research would be to work with the CMO to establish more definitive guidelines with when POCUS should appropriately be used in midwifery care. This will provide more guidance to POCUS curriculum designers, midwives, and the public to the standards of care with respect to how sonography can be applied to midwifery.

As mentioned previously, to account for the limitations of participants' POCUS self-assessments in this thesis, it would be beneficial to quantitatively compare their OSCE scores in future work. This would involve participants completing a series of OSCEs at different time points, such as the four time points in this study, to better understand their development and maintenance of POCUS skills from the training. Chart reviews would also be beneficial to clearly understand how participants are applying POCUS into their clinical work as opposed to their self-reported usage. Additionally, clients' perspectives on POCUS were only shared through our participants' perceptions. Therefore, it is recommended that future research be dedicated to directly hearing clients' experiences with POCUS being used in their pregnancy care through a mixed methods design encompassing surveys and focus groups to deeply understand their perspectives.

It would also be beneficial to improve current public knowledge gaps about the midwifery in further education research as well. Therefore, it is recommended that this

research be used to help develop, test, and assess an educational initiative surrounding refining public knowledge of Ontario midwives. Further program evaluation research could share recommendations with how to inform the public about the profession, how to provide more support for Ontario midwives' wellbeing, and how midwives can be at the forefront of health policy maker's mind surrounding perinatal care.

Additionally, this study was mainly focused on midwives, however, one participant was a family medicine physician who provides pregnancy care. It would be valuable to expand this POCUS course to more physicians, so this technology can be more readily used in pregnant peoples' care. If this curriculum expands to more physicians, comparing the experiences and clinical applications of this POCUS curriculum between physicians and midwives would illustrate the differences in their learning experiences, and the educational impacts of POCUS training. Research comparing physician and midwifery learning would also help determine if the course content needs to be further amended to better accommodate sonography learning for different health practitioners.

### 6.3 Conclusions:

This project demonstrates the significant roles POCUS plays in improving perinatal care and the need for continuing education initiatives in midwifery. Ontario midwives are excited to learn POCUS because they feel sonography training will help them become more comprehensive and independent healthcare practitioners. Acquiring sonography

skills can be challenging, therefore learners need lots of practice time with an ultrasound device and preferably a standardized patient to replicate what they will see in their clinics. Completion of a POCUS clinical practicum and having access to an ultrasound device are essential for consolidating clinical learning as well as competency skill maintenance. Midwives consistently use POCUS to aid in their assessments for pregnancy viability, fetal presentation, and gestational dating, with this technology being well received by clients. Midwives believe that POCUS improves their care management and provides greater healthcare access to clients, particularly in remote regions. The positive reception of this POCUS education demonstrates the merits of including sonography in midwifery care and continuing the McMaster-Mohawk POCUS course in future years.

## References:

1. Scope of Practice Changes – Ultrasound | College of Midwives of Ontario [Internet]. [cited 2021 Mar 11]. Available from: <https://www.cmo.on.ca/changes-to-the-controlled-acts-regulation-ultrasound/>
2. Thiessen K, Haworth-Brockman M, Nurmi MA, Demczuk L, Sibley KM. Delivering Midwifery: A Scoping Review of Employment Models in Canada. Vol. 42, Journal of Obstetrics and Gynaecology Canada. Elsevier Inc; 2020. p. 61–71.
3. Maps Archives - CAM ACSF [Internet]. [cited 2021 Mar 11]. Available from: <https://canadianmidwives.org/category/maps/>
4. Midwifery across Canada- CAM ACSF [Internet]. Canadian Association of Midwives. [cited 2021 Mar 11]. Available from: <https://canadianmidwives.org/midwifery-across-canada/>
5. Midwifery Services | Government of Prince Edward Island [Internet]. [cited 2021 Jun 7]. Available from: <https://www.princeedwardisland.ca/en/information/health-pei/midwifery-services>
6. Aylward now says P.E.I. will have midwives operating this fall | CBC News [Internet]. [cited 2021 Jun 7]. Available from: <https://www.cbc.ca/news/canada/prince-edward-island/pei-politics-midwives-aylward-1.5898191>
7. Standards of practice for Yukon midwives [Internet]. 2021 [cited 2021 Jun 7]. Available from: [https://yukon.ca/sites/yukon.ca/files/standards\\_of\\_practice\\_for\\_yukon\\_midwives\\_jan\\_2021\\_1.pdf](https://yukon.ca/sites/yukon.ca/files/standards_of_practice_for_yukon_midwives_jan_2021_1.pdf)
8. Regulations and standards for the practice of midwifery approved | Government of Yukon [Internet]. [cited 2021 Jun 7]. Available from: <https://yukon.ca/en/news/regulations-and-standards-practice-midwifery-approved>
9. Midwifery in Ontario - Programs and Services - Public Information - MOHLTC [Internet]. [cited 2021 Mar 11]. Available from: <https://www.health.gov.on.ca/en/public/programs/midwife/>
10. Butler MM, Hutton EK, McNiven PS. Midwifery education in Canada. *Midwifery*. 2016;33:28–30.
11. Midwifery Act, 1991, S.O. 1991, c. 31 [Internet]. Government of Ontario 2011. Available from: <https://www.ontario.ca/laws/statute/91m31>
12. Professional Standards for Midwives | College of Midwives of Ontario [Internet]. [cited 2021 Mar 25]. Available from: <https://www.cmo.on.ca/resources/standards-of-practice/professional-standards-for-midwives/>
13. Ministry expanding health care professionals' responsibilities. | College of



- Midwives of Ontario [Internet]. [cited 2021 Mar 11]. Available from: <http://www.cmo.on.ca/ministry-moving-towards-expansion-of-scope/>
14. Midwives applaud process to expand scope of practice | AOM [Internet]. [cited 2021 Mar 10]. Available from: <https://www.ontariomidwives.ca/midwives-applaud-process-expand-scope-practice>
  15. Varner C. Ontario ponders expanded prescribing by midwives. Vol. 192, CMAJ : Canadian Medical Association journal. NLM (Medline); 2020. p. E293–4.
  16. Ontario Regulation 107/96 Controlled Acts [Internet]. Regulated Health Professions Act 2021. Available from: <https://www.ontario.ca/laws/regulation/960107>
  17. Sonography Canada Professional Practice Guidelines and Member Policies [Internet]. 2019 [cited 2021 Mar 11]. Available from: <https://sonographycanada.ca/resources/professional-practice-guidelines>
  18. Atkinson P, Bowra J, Lambert M, Lamprecht H, Noble V, Jarman B, et al. Point of Care Ultrasound Curriculum Guidelines. Vol. 17, Canadian Journal of Emergency Medicine. Decker Publishing; 2014. 161–170 p.
  19. Vinayak S, Sande J, Nisenbaum H, Nolsøe CP. Training Midwives to Perform Basic Obstetric Point-of-Care Ultrasound in Rural Areas Using a Tablet Platform and Mobile Phone Transmission Technology—A WFUMB COE Project. *Ultrasound Med Biol.* 2017;43(10):2125–32.
  20. Expanded Models | Association of Ontario Midwives [Internet]. [cited 2021 Mar 11]. Available from: <https://www.ontariomidwives.ca/expanded-models>
  21. Corey J, MacDonald T. Management of the Uncomplicated Pregnancy Beyond 41+0 Weeks Gestation Insurance and Risk Management Program Steering Committee [Internet]. 2010. Available from: <https://www.grandvalleymidwives.ca/wp-content/uploads/2018/06/Management-of-the-Uncomplicated-Pregnancy-Beyond-41-0-Weeks-Gestation.pdf>
  22. MacDonald T, Saurette K. Clinical practice guideline 13: management of prelabour rupture of membranes at term. Association of Ontario Midwives. 2014.
  23. Midwifery Scope and Model of Care -British Columbia [Internet]. 2021 [cited 2021 Mar 11]. Available from: <https://www.bcmidwives.com/scope-practice.html>
  24. Midwives Regulation British Columbia [Internet]. 2020 p. 52242. Available from: [https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/281\\_2008](https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/281_2008)
  25. Health Professions Act Midwives Profession Regulation Alberta [Internet]. Available from: [https://www.qp.alberta.ca/documents/Regs/2018\\_237.pdf](https://www.qp.alberta.ca/documents/Regs/2018_237.pdf)
  26. The Midwifery Act: Manitoba [Internet]. Available from: <https://web2.gov.mb.ca/laws/statutes/ccsm/m125e.php>
  27. Midwives Act: Québec [Internet]. Available from: <http://legisquebec.gouv.qc.ca/en/ShowDoc/cs/S-0.1>
  28. Midwifery Act: New Brunswick [Internet]. Available from:

- <https://www.gnb.ca/legis/bill/editform-e.asp?ID=653&legi=56&num=2>
29. Nova Scotia Legislature - Midwifery Act [Internet]. 2006. Available from: [https://nslegislature.ca/legc/bills/60th\\_1st/1st\\_read/b107.htm](https://nslegislature.ca/legc/bills/60th_1st/1st_read/b107.htm)
  30. Holmlund S, Ntaganira J, Edvardsson K, Lan PT, Sengoma JPS, Åhman A, et al. Improved maternity care if midwives learn to perform ultrasound: A qualitative study of Rwandan midwives' experiences and views of obstetric ultrasound. *Glob Health Action*. 2017;10(1).
  31. Hands-On Ultrasound Education Obstetrics (HOUSE OB) | UBC CPD [Internet]. [cited 2021 Mar 11]. Available from: <https://ubccpd.ca/house-ob>
  32. Collins K, Collins C, Kothari A. Point-of-care ultrasound in obstetrics. *Australas J Ultrasound Med*. 2019;22(1):32–9.
  33. College of Midwives of Ontario [Internet]. Consultation and Transfer of Care. 2014. p. 1–9. Available from: [http://www.cmo.on.ca/resources/STANDARDS-OF-PRACTICE/3.CLINICAL\\_PRACTICE/FINAL-CONSULTATION\\_AND\\_TRANSFER\\_OF\\_CARE.pdf](http://www.cmo.on.ca/resources/STANDARDS-OF-PRACTICE/3.CLINICAL_PRACTICE/FINAL-CONSULTATION_AND_TRANSFER_OF_CARE.pdf)
  34. Ling A. An Exploration Of Ontario Midwives' Interest In Ultrasound Imaging And Their Attitudes Toward Adopting It In Clinical Practice [Internet]. 2019. Available from: <https://macsphere.mcmaster.ca/handle/11375/25061>
  35. Aziz A, Fuchs K, Nhan-Chang CL, Zork N, Friedman AM, Simpson LL. Adaptation of prenatal care and ultrasound. *Semin Perinatol*. 2020 Nov 1;44(7):151278.
  36. Routine ultrasound – Pregnancy Info [Internet]. [cited 2021 May 5]. Available from: <https://www.pregnancyinfo.ca/your-pregnancy/routine-tests/ultrasound/>
  37. Harris RD, Marks WM. Compact ultrasound for improving maternal and perinatal care in low-resource settings: Review of the potential benefits, implementation challenges, and public health issues. Vol. 28, *Journal of Ultrasound in Medicine*. John Wiley and Sons Ltd; 2009. p. 1067–76.
  38. Morgan BB, Kao A, Trent SA, Hurst N, Oliveira L, Austin AL, et al. Effect of emergency physician–Performed point-of-care ultrasound and radiology department–Performed ultrasound examinations on the emergency department length of stay among pregnant women at less than 20 weeks' gestation. *J Ultrasound Med*. 2018 Nov;37(11):2497–505.
  39. French S, Henry T, Williams EW. Evaluation of waiting times and sonographic findings in patients with first trimester vaginal bleeding at the University Hospital of the West Indies. Can emergency department ultrasound make a difference? *West Indian Med J*. 2014;63(3):247–51.
  40. Wanjiku GW, Bell G, Wachira B. Assessing a novel point-of-care ultrasound training program for rural healthcare providers in Kenya. *BMC Health Serv Res*. 2018;18(1):1–7.
  41. Bentley S, Hexom B, Nelson BP. Evaluation of an obstetric ultrasound curriculum for midwives in Liberia. *J Ultrasound Med*. 2015;34(9):1563–8.
  42. Kimberly HH, Murray A, Mennicke M, Liteplo A, Lew J, Bohan JS, et al. Focused

- maternal ultrasound by midwives in rural zambia. *Ultrasound Med Biol*. 2010;36(8):1267–72.
43. Vinayak S, Brownie S. Collaborative task-sharing to enhance the Point-Of-Care Ultrasound (POCUS) access among expectant women in Kenya: The role of midwife sonographers. *J Interprof Care*. 2018;32(5):641–4.
  44. Canadian Association of Radiologists. 2013 Position Statement on the Use of Point of Care Ultrasound. 2013;(June):1–10. Available from: <https://car.ca/wp-content/uploads/CAR-Position-Statement-on-the-Use-of-Point-of-Care-Ultrasound.pdf>
  45. Edvardsson K, Lalos A, Åhman A, Small R, Graner, MD, PhD S, Mogren I. Increasing possibilities – Increasing dilemmas: A qualitative study of Swedish midwives' experiences of ultrasound use in pregnancy. *Midwifery*. 2016;42:46–53.
  46. Schiekirka S, Feufel MA, Herrmann-Lingen C, Raupach T. Evaluation in medical education: A topical review of target parameters, data collection tools and confounding factors. *GMS Ger Med Sci*. 2015;13.
  47. Holmboe ES, Sherbino J, Englander R, Snell L, Frank JR. A call to action: The controversy of and rationale for competency-based medical education. *Med Teach*. 2017 Jun 3;39(6):574–81.
  48. Lockyer J, Carraccio C, Chan MK, Hart D, Smee S, Touchie C, et al. Core principles of assessment in competency-based medical education. *Med Teach*. 2017 Jun 3;39(6):609–16.
  49. Frank JR, Snell L, Englander R, Holmboe ES. Implementing competency-based medical education: Moving forward. *Med Teach*. 2017 Jun 3;39(6):568–73.
  50. Lichtenberg JW, Portnoy SM, Bebeau MJ, Leigh IW, Nelson PD, Rubin NJ, et al. Challenges to the Assessment of Competence and Competencies. *Prof Psychol Res Pract*. 2007 Oct;38(5):474–8.
  51. Powell DE, Carraccio C. Toward Competency-Based Medical Education. *N Engl J Med*. 2018 Jan 4;378(1):3–5.
  52. Wagner N, Acai A, McQueen SA, McCarthy C, McGuire A, Petrisor B, et al. Enhancing Formative Feedback in Orthopaedic Training: Development and Implementation of a Competency-Based Assessment Framework. *J Surg Educ*. 2019 Sep 1;76(5):1376–401.
  53. Acai A. Understanding Competence Committee Implementation and Decision-Making Practices in the Era of Competency-Based Medical Education [Internet]. 2021 [cited 2021 Jun 15]. Available from: <https://macsphere.mcmaster.ca/handle/11375/26182>
  54. Fullerton JT, Thompson JB, Johnson P. Competency-based education: The essential basis of pre-service education for the professional midwifery workforce. *Midwifery*. 2013 Oct;29(10):1129–36.
  55. Sutkin G, Wagner E, Harris I, Schiffer R. What makes a good clinical teacher in medicine? A review of the literature. *Acad Med*. 2008 May;83(5):452–66.

56. Norman G. RCT = results confounded and trivial: The perils of grand educational experiments. Vol. 37, *Medical Education*. John Wiley & Sons, Ltd; 2003. p. 582–4.
57. Salmon M, Landes M, Hunchak C, Paluku J, Malemo Kalisya L, Salmon C, et al. Getting It Right the First Time: Defining Regionally Relevant Training Curricula and Provider Core Competencies for Point-of-Care Ultrasound Education on the African Continent. *Ann Emerg Med*. 2017;69(2):218–26.
58. Biggs J. Enhancing teaching through constructive alignment. *High Educ*. 1996;32(3):347–64.
59. Kotagal M, Quiroga E, Ruffatto BJ, Adedipe AA, Backlund BH, Nathan R, et al. Impact of point-of-care ultrasound training on surgical residents' confidence. *J Surg Educ*. 2015;72(4):e82–7.
60. Shokoohi H, Raymond A, Fleming K, Scott J, Kerry V, Haile-Mariam T, et al. Assessment of Point-of-Care Ultrasound Training for Clinical Educators in Malawi, Tanzania and Uganda. *Ultrasound Med Biol*. 2019;45(6):1351–7.
61. Shaw-Battista J, Young-Lin N, Bearman S, Dau K, Vargas J. Interprofessional Obstetric Ultrasound Education: Successful Development of Online Learning Modules; Case-Based Seminars; and Skills Labs for Registered and Advanced Practice Nurses, Midwives, Physicians, and Trainees. *J Midwifery Women's Heal*. 2015 Nov 1;60(6):727–34.
62. Continuing Education-McMaster Midwifery [Internet]. Available from: <https://midwifery.mcmaster.ca/education/continuing-education>
63. Sonography Canada: National Competency Profiles [Internet]. Vol. 6.0. 2019 [cited 2021 Mar 11]. Available from: <https://sonographycanada.ca/resources/competencies-standards>
64. Sonography Canada: Canadian Clinical Skills Assessment: Generalist Sonographer [Internet]. Vol. 6. 2020. Available from: <https://sonographycanada.ca/certification/canadian-clinical-skills-assessment-ccsa>
65. Reed S, Shell R, Kassis K, Tartaglia K, Wallihan R, Smith K, et al. Applying adult learning practices in medical education. *Curr Probl Pediatr Adolesc Health Care*. 2014 Jul 1;44(6):170–81.
66. Mukhalalati BA, Taylor A. Adult Learning Theories in Context: A Quick Guide for Healthcare Professional Educators. *J Med Educ Curric Dev*. 2019 Jan 10;6.
67. Bierema LL. Adult Learning in Health Professions Education. *New Dir Adult Contin Educ*. 2018 Mar 1;2018(157):27–40.
68. Gregory J. Principles of Experiential Education. In: Jarvis P, editor. *The Theory and Practice of Teaching*. Second. Routledge; 2006. p. 205–24.
69. Schnobrich DJ, Gladding S, Olson APJ, Duran-Nelson A. Point-of-Care Ultrasound in Internal Medicine: A National Survey of Educational Leadership. *J Grad Med Educ*. 2013;5(3):498–502.
70. Ma IWY, Arishenkoff S, Wiseman J, Desy J, Ailon J, Martin L, et al. Internal

- Medicine Point-of-Care Ultrasound Curriculum: Consensus Recommendations from the Canadian Internal Medicine Ultrasound (CIMUS) Group. *J Gen Intern Med.* 2017;32(9):1052–7.
71. Schnittke N, Damewood S. Identifying and Overcoming Barriers to Resident Use of Point-of-Care Ultrasound. *West J Emerg Med.* 2019 Oct;20(6):918–25.
  72. Essential Competencies for Midwifery Practice 2018 Update [Internet]. Vol. 32, International Confederation of Midwives. 2019 [cited 2021 Jun 10]. Available from: [https://www.internationalmidwives.org/assets/files/general-files/2019/02/icm-competencies\\_english\\_final\\_jan-2019-update\\_final-web\\_v1.0.pdf](https://www.internationalmidwives.org/assets/files/general-files/2019/02/icm-competencies_english_final_jan-2019-update_final-web_v1.0.pdf)
  73. Lurie SJ, Mooney CJ, Lyness JM. Pitfalls in assessment of competency-based educational objectives. Vol. 86, *Academic Medicine.* Lippincott Williams and Wilkins; 2011. p. 412–4.
  74. Wilson R, Neiterman E, Lobb DK. Student Attrition in the Ontario Midwifery Education Program: A Qualitative Analysis-1. *Personal Issues. Can J Midwifery Res Pract.* 2013;2(1):32–40.
  75. Yamada T, Minami T, Soni NJ, Hiraoka E, Takahashi H, Okubo T, et al. Skills acquisition for novice learners after a point-of-care ultrasound course: Does clinical rank matter? *BMC Med Educ.* 2018 Aug;18(1):202.
  76. Murdoch-Eaton D, Whittle S. Generic skills in medical education: Developing the tools for successful lifelong learning. *Med Educ.* 2012 Jan;46(1):120–8.
  77. Kumar A, Kugler J, Jensen T. Evaluation of Trainee Competency with Point-of-Care Ultrasonography (POCUS): a Conceptual Framework and Review of Existing Assessments. Vol. 34, *Journal of General Internal Medicine.* Springer; 2019. p. 1025–31.
  78. Gallen A, Kodate N, Casey D. How do nurses and midwives perceive their preparedness for quality improvement and patient safety in practice? A cross-sectional national study in Ireland. *Nurse Educ Today.* 2019 May 1;76:125–30.
  79. Levett-Jones T, Lapkin S, Hoffman K, Arthur C, Roche J. Examining the impact of high and medium fidelity simulation experiences on nursing students' knowledge acquisition. *Nurse Educ Pract.* 2011 Nov;11(6):380–3.
  80. Vyas A, Moran K, Livingston J, Gonzales S, Torres M, Duffens A, et al. Feasibility study of minimally trained medical students using the Rural Obstetrical Ultrasound Triage Exam (ROUTE) in rural Panama. *World J Emerg Med.* 2018;9(3):216.
  81. Grierson L, Vanstone M, Alice I. Understanding the Impact of the CFPC Certificates of Added Competence [Internet]. 2020 Mar [cited 2021 Jun 15]. Available from: <https://www.cfpc.ca/CFPC/media/PDF/2020-04-CAC-Impact-Study-Report.pdf>
  82. Certificates of Added Competence in Family Medicine | The College of Family Physicians of Canada [Internet]. [cited 2021 Jun 15]. Available from:

<https://www.cfpc.ca/cac>

83. Geller B, Iglesias S, Johnston S. Certificate of Added Competence for Enhanced Surgical Skills - it's about our privileges. Vol. 22, Canadian journal of rural medicine : the official journal of the Society of Rural Physicians of Canada. Medknow Publications and Media Pvt. Ltd.; 2017. p. 127.
84. Slade S, Ross S, Lawrence K, Archibald D, MacKay MP, Oandasan IF. Extended family medicine training: Measuring training flows at a time of substantial pedagogic change. *Can Fam Physician*. 2016 Dec;62(12):e749–57.
85. Haji F, Morin MP, Parker K. Rethinking programme evaluation in health professions education: Beyond “did it work?” *Med Educ*. 2013 Apr;47(4):342–51.
86. Swanwick T, Forrest K, O'Brien BC, editors. *Understanding Medical Education: Evidence, Theory and Practice*. Understanding Medical Education: Evidence, Theory and Practice. Oxford, UK: Wiley-Blackwell; 2010. 1–446 p.
87. Smidt A, Balandin S, Sigafos J, Reed VA. The Kirkpatrick model: A useful tool for evaluating training outcomes. Vol. 34, *Journal of Intellectual and Developmental Disability*. Routledge; 2009. p. 266–74.
88. Frye AW, Hemmer PA. Program evaluation models and related theories: AMEE Guide No. 67. Vol. 34, *Medical Teacher*. *Med Teach*; 2012.
89. Bates R. A critical analysis of evaluation practice: The Kirkpatrick model and the principle of beneficence. *Eval Program Plann*. 2004 Aug;27(3):341–7.
90. Praslova L. Adaptation of Kirkpatrick's four level model of training criteria to assessment of learning outcomes and program evaluation in Higher Education. *Educ Assessment, Eval Account*. 2010 May;22(3):215–25.
91. Leslie K, Baker L, Egan-Lee E, Esdaile M, Reeves S. Advancing faculty development in medical education: A systematic review. Vol. 88, *Academic Medicine*. Lippincott Williams and Wilkins; 2013. p. 1038–45.
92. Cullinane M, McLachlan HL, Newton MS, Zugna SA, Forster DA. Using the Kirkpatrick Model to evaluate the Maternity and Neonatal Emergencies (MANE) programme: Background and study protocol. *BMJ Open*. 2020 Feb;10(1):32873.
93. Ponce OA, Pagán-Maldonado N. Mixed Methods Research in Education: Capturing the Complexity of the Profession. *Int J Educ Excell*. 2015 Jun;1(1):111–35.
94. Creswell JC. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Fourth. Knight V, Young J, editors. SAGE Publications; 2014. 342 p.
95. Meissner H, Creswell J, Klassen AC, Plano V, Smith KC. Best Practices for Mixed Methods Research in the Health Sciences. *Methods*. 2011;29:1–39.
96. O'Brien BC, O'Sullivan PS. Mixed Methods in Health Professions Education Scholarship. *J Grad Med Educ*. 2017 Apr;9(2):253–4.
97. Castro FG, Kellison JG, Boyd SJ, Kopak A. A methodology for conducting integrative mixed methods research and data analyses. *J Mix Methods Res*. 2010;4(4):342–60.
98. Barrett A, Kajamaa A, Johnston J. How to ... be reflexive when conducting

- qualitative research. *Clin Teach*. 2020 Feb;17(1):9–12.
99. Tang N. Interviewer and interviewee relationships between women. *Sociology*. 2002 Aug;36(3):703–21.
  100. Eysenbach G. Improving the quality of web surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). Vol. 6, *Journal of Medical Internet Research*. *Journal of Medical Internet Research*; 2004. p. e34.
  101. Boone DA. Tools of the Trade Analyzing Likert Data Likert-Type Versus Likert Scales. 2012;50(2).
  102. Finstad K. Response interpolation and scale sensitivity: Evidence against 5-point scales. *J Usability Stud*. 2010;5(3):104–10.
  103. Joshi A, Kale S, Chandel S, Pal D. Likert Scale: Explored and Explained. *Br J Appl Sci Technol*. 2015;7(4):396–403.
  104. McCarthy R V., McCarthy MM, Ceccucci W, Halawi L, McCarthy R V., McCarthy MM, et al. What Do Descriptive Statistics Tell Us. In: *Applying Predictive Analytics*. Springer International Publishing; 2019. p. 57–87.
  105. Mishra P, Pandey CM, Singh U, Gupta A, Sahu C, Keshri A. Descriptive statistics and normality tests for statistical data. *Ann Card Anaesth*. 2019 Jan;22(1):67–72.
  106. Ali Z, Bhaskar SB. Basic statistical tools in research and data analysis. *Indian J Anaesth*. 2016 Sep;60(9):662–9.
  107. Neely J, Stewart M, Hartman J, Forsen J, Wallace M. Tutorials in Clinical Research, Part VI: Descriptive Statistics. *Laryngoscope*. 2002 Jul;112(7):1249–55.
  108. Priestestersbach A, Röhrig B, Du Prel JB, Gerhold-Ay A, Blettner M. Descriptive Statistics The Specification of Statistical Measures and Their Presentation in Tables and Graphs. Part 7 of a Series on Evaluation of Scientific Publications. *Dtsch Arztebl*. 2009 Sep;106(36):578–83.
  109. Larson MG. Descriptive statistics and graphical displays. *Circulation*. 2006 Jul;114(1):76–81.
  110. Vetter TR. Descriptive Statistics: Reporting the Answers to the 5 Basic Questions of Who, What, Why, When, Where, and a Sixth, so What? *Anesth Analg*. 2017 Nov;125(5):1797–802.
  111. Top 11 Questions to Ask at Your New Registrant Interview | AOM [Internet]. [cited 2021 Mar 13]. Available from: <https://www.ontariomidwives.ca/NR-interview>
  112. Ozanne JL, Strauss A, Corbin J. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. *J Mark Res*. 1992;29(3):382.
  113. Morse JM, Bowers B, Stern PN, Corbin J, Charmaz K CA. *Developing Grounded Theory the Second Generation*. Routledge. 2016. 280 p.
  114. Wiesche M, Jurisch MC, Yetton PW, Krcmar H. Grounded theory methodology in information systems research. *MIS Q Manag Inf Syst*. 2017 Sep;41(3):685–701.
  115. Bryant A, Charmaz K. *The SAGE Handbook of Grounded Theory : SAGE Research Methods*. 2007. 602 p.

116. Olson K. Essentials of Qualitative Interviewing. Essentials of Qualitative Interviewing. 2016. 35–50 p.
117. Popping R. Analyzing Open-ended Questions by Means of Text Analysis Procedures. *BMS Bull Sociol Methodol Bull Methodol Sociol*. 2015 Oct;128(1):23–39.
118. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Heal Care*. 2007 Sep;19(6):349–57.
119. Etikan I, Musa SA, Alkassim RS. Comparison of Convenience Sampling and Purposive Sampling. *Am J Theor Appl Stat*. 2016;5(1):1.
120. Pope C. Qualitative research in health care: Analysing qualitative data. *BMJ*. 2000 Jan;320(7227):114–6.
121. Goldkuhl G. What Kind of Pragmatism in Information Systems Research? AIS SIG PRAG Inaug Meet. 2008;41(1986):1–6.
122. Kailah Sebastian. Distinguishing Between the Types of Grounded Theory: Classical, Interpretive and Constructivist. *J Soc Thought*. 2019;3(1).
123. Tie YC, Birks M, Francis K. Grounded theory research: A design framework for novice researchers. *SAGE Open Med*. 2019 Jan;7:205031211882292.
124. Packer-Muti B. A Review of Corbin and Strauss' Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. *Qual Rep*. 2016;2(23):140–3.
125. Guetterman TC, Fethers MD, Creswell JW. Integrating quantitative and qualitative results in health science mixed methods research through joint displays. *Ann Fam Med*. 2015;13(6):554–61.
126. Fethers MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs - Principles and practices. *Health Serv Res*. 2013;48(6 PART2):2134–56.
127. Korstjens I, Moser A. Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *Eur J Gen Pract*. 2018 Jan;24(1):120–4.
128. Prager EM, Chambers KE, Plotkin JL, McArthur DL, Bandrowski AE, Bansal N, et al. Improving transparency and scientific rigor in academic publishing. *Brain Behav*. 2019 Jan;9(1).
129. Watt D. On Becoming a Qualitative Researcher: The Value of Reflexivity. Vol. 12, *The Qualitative Report*. 2007.
130. Corden A, Sainsbury R. Using verbatim quotations in reporting qualitative social research: researchers' views. 2006.
131. Harackiewicz JM, Smith JL, Priniski SJ. Interest Matters: The Importance of Promoting Interest in Education. *Policy Insights from Behav Brain Sci*. 2016 Oct;3(2):220–7.
132. Gatti-Petito J, Lakatos BE, Bradley HB, Cook L, Haight IE, Karl CA. Clinical scholarship and adult learning theory: A role for the DNP in nursing education. *Nurs Educ Perspect*. 2013 Jul;34(4):273–6.



133. Passarelli AM, Kolb DA. The Learning Way: Learning from Experience as the Path to Lifelong Learning and Development. In: *The Oxford Handbook of Lifelong Learning, Second Edition*. Oxford University Press; 2020.
134. Schultz K, McEwen L, Griffiths J. Applying Kolb's Learning Cycle to Competency-Based Residency Education. *Acad Med*. 2014 Nov;1.
135. Amod HB, Brysiewicz P. Promoting experiential learning through the use of high-fidelity human patient simulators in midwifery: A qualitative study. *Curationis*. 2019 Jan 21;42(1):1–7.
136. Florescu CC, Mullen JA, Nguyen VM, Sanders BE, Vu PQP. Evaluating didactic methods for training medical students in the use of bedside ultrasound for clinical practice at a faculty of medicine in Romania. In: *Journal of Ultrasound in Medicine*. American Institute of Ultrasound in Medicine; 2015. p. 1873–82.
137. Cook J, Rao V V., Bell F, Durkin M, Cone J, Lane-Cordova A, et al. Simulation-based clinical learning for the third year medical student: Effectiveness of transabdominal and transvaginal ultrasound for elucidation of OB/GYN scenarios. *J Clin Ultrasound*. 2020 Oct;48(8):457–61.
138. Shah S, Tohmasi S, Frisch E, Anderson A, Almog R, Lahham S, et al. A comparison of simulation versus didactics for teaching ultrasound to Swiss medical students. *World J Emerg Med*. 2019;10(3):169.
139. Bradshaw C, Murphy Tighe S, Doody O. Midwifery students' experiences of their clinical internship: A qualitative descriptive study. *Nurse Educ Today*. 2018 Sep;68:213–7.
140. Schott CK, LoPresti CM, Boyd JS, Core M, Haro EK, Mader MJ, et al. Retention of Point-of-Care Ultrasound Skills Among Practicing Physicians: Findings of the VA National POCUS Training Program. *Am J Med*. 2021 Mar 1;134(3):391-399.e8.
141. Carter AG, Wilkes E, Gamble J, Sidebotham M, Creedy DK. Midwifery students' experiences of an innovative clinical placement model embedded within midwifery continuity of care in Australia. *Midwifery*. 2015 Aug;31(8):765–71.
142. Olive P, Maxton F, Bell CA, Bench S, Tinkler L, Jones S, et al. Clinical academic research internships: What works for nurses and the wider nursing, midwifery and allied health professional workforce. *J Clin Nurs*. 2020 Jan;jocn.15611.
143. Parker V, Giles M, Lantry G, McMillan M. New graduate nurses' experiences in their first year of practice. *Nurse Educ Today*. 2014 Jan;34(1):150–6.
144. Zhang J, Cui Q. Collaborative Learning in Higher Nursing Education: A Systematic Review. Vol. 34, *Journal of Professional Nursing*. W.B. Saunders; 2018. p. 378–88.
145. Durber P. Examining the Issue of Equitable Compensation for Ontario's Midwives [Internet]. 2013 Nov [cited 2021 May 15]. Available from: [https://www.ontariomidwives.ca/sites/default/files/Durber Report -Examining the Issue of Equitable Compn for ONs Midwives Nov 24 2013 \(C0928577xA0E3A\).pdf](https://www.ontariomidwives.ca/sites/default/files/Durber%20Report%20-%20Examining%20the%20Issue%20of%20Equitable%20Compn%20for%20ONs%20Midwives%20Nov%2024%202013%20(C0928577xA0E3A).pdf)
146. Pay Equity for Midwives | AOM [Internet]. [cited 2021 May 15]. Available from:

- <https://www.ontariomidwives.ca/pay-equity-midwives>
147. Stoll K, Gallagher J. A survey of burnout and intentions to leave the profession among Western Canadian midwives. *Women and Birth*. 2019 Aug 1;32(4):e441–9.
  148. Cameron C. Becoming and being a midwife: A theoretical analysis of why midwives leave the profession. *Can J Midwifery Res Pract*. 2013;10(2):22–8.
  149. Fenn K. “It’s quite demoralizing”: Midwives feeling overworked, undervalued in pandemic | CBC Radio [Internet]. CBC Radio. 2020 [cited 2021 Apr 5]. Available from: <https://www.cbc.ca/radio/thecurrent/the-current-for-dec-17-2020-1.5845164/it-s-quite-demoralizing-midwives-feeling-overworked-undervalued-in-pandemic-1.5845816>
  150. HakemZadeh F, Neiterman E, Chowhan J, Plenderleith J, Geraci J, Zeytinoglu I, et al. Work-life interface and intention to stay in the midwifery profession among pre- And post-clinical placement students in Canada. *Hum Resour Health*. 2020 Sep 22;18(1):1–10.
  151. Gruppen LD, Mangrulkar RS, Kolars JC. The promise of competency-based education in the health professions for improving global health. *Hum Resour Health*. 2012 Nov 16;10(1):1–7.
  152. Mattison CA, Lavis JN, Hutton EK, Dion ML, Wilson MG. Understanding the conditions that influence the roles of midwives in Ontario, Canada’s health system: An embedded single-case study. *BMC Health Serv Res*. 2020 Mar 12;20(1):197.
  153. Munro S, Kornelsen J, Grzybowski S. Models of maternity care in rural environments: Barriers and attributes of interprofessional collaboration with midwives. *Midwifery* [Internet]. 2013 Jun [cited 2021 Jun 1];29(6):646–52. Available from: <https://pubmed.ncbi.nlm.nih.gov/22863239/>
  154. Smith DC. Midwife-Physician Collaboration: A Conceptual Framework for Interprofessional Collaborative Practice. *J Midwifery Women’s Heal*. 2015 Mar 1;60(2):128–39.
  155. Morgan L, Carson G, Gagnon A, Blake J. Collaborative practice among obstetricians, family physicians and midwives. *CMAJ*. 2014 Nov 18;186(17):1279–80.
  156. Warmelink JC, Wiegers TA, de Cock TP, Klomp T, Hutton EK. Collaboration of midwives in primary care midwifery practices with other maternity care providers. *Midwifery*. 2017 Dec 1;55:45–52.
  157. Malott AM, Kaufman K, Thorpe J, Saxell L, Becker G, Paulette L, et al. Models of Organization of Maternity Care by Midwives in Canada: A Descriptive Review. *J Obstet Gynaecol Canada*. 2012 Oct 1;34(10):961–70.
  158. Behruzi R, Klam S, Dehertog M, Jimenez V, Hatem M. Understanding factors affecting collaboration between midwives and other health care professionals in a birth center and its affiliated Quebec hospital: A case study. *BMC Pregnancy Childbirth*. 2017 Jun 26;17(1):1–14.

159. Currivan D, Carley-Baxter L. Nonresponse Bias in a Longitudinal Follow-up to a Random-Digit Dial Survey [Internet]. 2006 [cited 2021 May 16]. Available from: <https://www.iser.essex.ac.uk/files/survey/ulsc/methodological-research/mols-2006/scientific-social-programme/papers/Currivan.pdf>
160. Ward M, Gruppen L, Regehr G. Measuring Self-assessment: Current State of the Art. *Adv Heal Sci Educ* 2002 71. 2002;7(1):63–80.
161. KW E, G R. Self-assessment in the health professions: a reformulation and research agenda. *Acad Med*. 2005;80(10 Suppl).
162. Nurse Practitioners [Internet]. [cited 2021 Jun 16]. Available from: <https://www.cno.org/en/learn-about-standards-guidelines/educational-tools/nurse-practitioners/>
163. Practice Standard: Nurse Practitioner [Internet]. 2021 [cited 2021 Jun 16]. Available from: [www.cno.org/standards](http://www.cno.org/standards)
164. 2020 Registration Renewal Guide, APR & QAP Requirements | College of Midwives of Ontario [Internet]. [cited 2021 Mar 11]. Available from: <https://www.cmo.on.ca/members/registration/renewal/renewal-2020-requirements/>
165. Continuing Competencies | College of Midwives of Ontario [Internet]. [cited 2021 Jun 15]. Available from: <https://www.cmo.on.ca/members/continuing-competencies-2/>

## Appendix A: Course Outline

### **Course description:**

This course was designed to provide training in a Canadian context for entry-level skills for point of care ultrasound for primary maternity care. The course will review the anatomy and physiology of the normal gravid pelvis and will emphasize the sonographic technique, normal appearances, and ethical and professional responsibilities.

The core content areas addressed will include:

- a) First Trimester
  - Confirming intrauterine pregnancy
  - Establishing a reliable EDD
  - Confirming viability of early pregnancies
  - Confirming singleton pregnancy
- b) Second Trimester
  - Confirming viability
- c) Third Trimester
  - Confirming viability
  - Confirming fetal presentation
  - Recognition of normal amniotic fluid
  - Recognition of the normal placental location

Confirming singleton pregnancy

There are 3 components to the course:

#### Online Modules:

Online readings and modules are completed independently. Successful completion of this component is required prior to attending the in-person workshop.

#### Hands-on Workshop:

A two (2) day workshop will be completed by all participants. Faculty will review content with participants and facilitate hands-on skills development in workshops. Successful completion of this component is required before beginning the Clinical Practicum.

#### Clinical Practicum:

A clinical practicum follows completion of the hands-on workshop. Obstetrical or Sonographic Preceptors will be community-based members in good standing with their regulatory agencies and hospital boards. Participants will be supported to develop competency in the use of point of care ultrasound under the direct supervision of their preceptor.

**Course learning objectives:**

*Upon completion of the course, the learner will reliably be able to demonstrate the ability to:*

1. *Analyze sonographic images of the normal gravid and non-gravid pelvis*
  - 1.1 *Recognize the relational anatomy and sonographic appearance of the gravid and non-gravid pelvis including the cervix, uterus and vagina.*

*Recognize the general appearance of the fallopian tubes, ovaries, uterine vessels.*
  - 1.2 *Correlate factors including age, menstrual history and reproductive history with sonographic appearances.*
  - 1.3 *Demonstrate knowledge of sonographic techniques, including transabdominal, transvaginal*
  - 1.4 *Recognize the normal sonographic appearances of the fetal membranes, placenta and umbilical cord*
2. *Interpret the sonographic appearance of the normal gravid and non-gravid pelvis*
  - 2.1 *Identify physiologic changes to the reproductive system during pregnancy*
3. *Outline the ethical and professional issues surrounding the sonography of the gravid pelvis*
  - 3.1 *Identify the various sonographic techniques used to image the female pelvis including patient preparation and contraindications to procedure*

*3.2 Discuss the role of point of care ultrasound as a clinical assessment that can complement physical examination and history taking.*

*3.3 Discuss safety, benefits and risks of obstetrical point of care ultrasound*

*3.4 Use problem solving skills to manage difficult/sensitive situations*

*4. Perform normal sonographic examinations using the transvaginal and transabdominal approaches*

*4.1 Practice transabdominal point of care ultrasound examinations of the normal gravid pelvis*

*4.2 Practice transvaginal point of care ultrasound examinations of the normal gravid pelvis*

**Assessment:**

Competency will be confirmed through knowledge assessment in the form of a written examination and demonstration of clinical competence and safe practice in both the simulated environment and in the clinical setting.

Each component of the course has its own specific assessment methods:

Online Modules:

An online multiple-choice exam will assess knowledge and understanding of the content covered in the online modules. Learners must obtain a grade of 80% to proceed to the hands-on workshop. There are not limitations on the number of times a learner can write the exam to achieve this grade.

Hands-on Workshop:

An assessment of competency of the skills learned in the hands-on workshop will be done through simulation.

Clinical Practicum:

The supervising preceptor will sign off on the clinical competencies outlined for the practicum.

**REQUIRED TEXTS:** Stephenson S, Dmitrieva J. Diagnostic Medical Sonography: Obstetrics and Gynecology. 4th Edition. 2017; Lippincott Williams and Wilkins.

## Appendix B: Research Proposal

### **1.0 Background:**

Midwives are regulated healthcare professionals who provide primary care during pregnancy, birth and six-weeks postpartum. The midwifery profession was first regulated in 1994 and is currently regulated by the College of Midwives of Ontario (CMO) (1,12). On January 1<sup>st</sup>, 2018, the CMO expanded the scope of practice for registered midwives to include the ability to perform diagnostic ultrasounds for clients to enhance maternal care during pregnancy and postpartum (1). It is important to recognize that this is an optional, additional skill set. Midwives are not required to perform ultrasounds, but if they choose to include this within their practice, they are required to complete an educational program which provides instruction on the proper techniques to perform and maintain competency in ultrasound (1). Diagnostic ultrasound is a diverse field that includes Point of Care Ultrasound (POCUS), a targeted ultrasound scan, often on a portable device, that can be performed by non-radiologists as part of a clinical exam (19). POCUS is utilized by many healthcare disciplines, especially within emergent situations, to aid in diagnostics.

Ultrasound as a diagnostic imaging tool, affecting client outcomes, and is dependent upon a highly skilled operator in conjunction with high caliber state of the art equipment. Many health care providers ranging from emergency medicine physicians to surgeons, physiotherapists, neonatologists and now midwifery have the support of their colleges to provide diagnostic ultrasound as a point of care tool in clinical practice. With this expansion of ultrasound as an adjunct tool used by practitioners in many specializations, there is a need to establish defined curriculum and training to support the implementation of Point of Care Ultrasound into each individual practice. Currently, there are no guidelines with respect to minimum training standards that must be met to ensure competency amongst point of care trainees.

The development, integration and evaluation of training programs in POCUS for midwives has been explored in other jurisdictions, some low-resources settings, and some high resource. Regions in Zambia, Rwanda, Kenya, and Liberia, particularly rural communities, have reported positive feedback from clients regarding focused maternal ultrasound by midwives, reporting accuracy of scans reaching over 99% (19) and improved prenatal care and clinical decision making (30,41–43). These papers highlight varying educational methodologies for delivery of the curriculum, such as: training modules, mock clinical exams, focus groups, and practical sessions. Competency of learners has been assessed using a variety of educational approaches including objective

structured clinical examinations (OSCEs) (41,42), knowledge-based pre-tests and post-tests, surveys, and interprofessional competencies . Finally, evaluation of participant learning has demonstrated improved knowledge and confidence when using POCUS for clients.

## **2.0 Aim of the Project:**

The aim of this project is to: a) implement a POCUS curriculum for midwives; and b) evaluate learner skill acquisition and application to practice.

### **a) Course Development & Implementation**

A Point of Care Ultrasound for Primary Maternity Care continuing education course has been developed and will be running its first cohort in Fall 2019. This course is designed to encompass various sonographic techniques throughout the three trimesters of pregnancy using a variety of instructional and assessment approaches. The course development has been a collaborative initiative between the Midwifery Education Program and the Program for Medical Radiation Sciences at McMaster University. The course includes online modules, hands-on training, and a clinical practicum to provide students with a wide perspective of educational methods to teach POCUS.

Assessment of learners will include module specific quizzes, OSCE demonstration of skills and completion of a competency checklist signed off by a supervisor in the clinical practicum.

### **b) Evaluation of skill acquisition and application to practice**

Our aim is to evaluate the effectiveness of a point of care ultrasound course for midwives regarding what they learned, how it impacted their practice, how they maintained competency, and identify areas of future improvements. Specifically, the evaluation component will address the following research question: how do midwives in Ontario learn and apply the skills required to use point of care ultrasound in their clinical practice?

The research will involve mixed methods design. We will employ a concurrent triangulation design where all data will be collected concurrently. The data will be analyzed separately but then will be compared and combined to generate a rigorous overview of the outcomes of our evaluation (94). The outcomes of interest include knowledge and skill acquisition, acceptability of the course and educational impact.



<b>Outcome</b>	<b>Data collection</b>
Knowledge acquisition	Module quiz scores, pre/post survey
Skill acquisition	OCSE scores, pre/post survey, ScanTrainer scenario & real time feedback
Acceptability of the course	Interview
Educational Impact	Interview, ScanTrainer scenario and real time feedback

i) Quantitative Survey

Surveys will be used throughout the project to collect information from the course participants regarding knowledge and skill acquisition, integration of point of care imaging within their practice and feedback on the course. These surveys will contain both open ended questions and five-point Likert Scales. These surveys will be administered before the course to establish a baseline, upon completion of the course, six months, and one-year post-course. This will permit an in-depth analysis to how POCUS is being integrated within the field of midwifery, competency of skills, and possible improvements in course material. Some of the questions will be consistent at all three time points of data collection to assess change over time following the course as the educational intervention.

*Population*

All 18 participants in the first offering of the course will be invited to participate in the survey. Participants in the course will be practicing midwives in Ontario. We anticipate a high response rate of 80% for all surveys due to the built-in incentives for completion (discussed below).

*Data Collection*

Survey questions will be developed by the research team based on review of the literature as well as a participant information sheet. The surveys will be tested on 3-5 people before being distributed. To improve the accessibility of the surveys, they will be administered online through REDCap. The online survey link will be sent to participants via email. To help ensure a high response rate, the pre-test survey and post-course surveys will be encouraged to be completed by the course administrator. Additionally, to provide incentive, a draw for a prize will be completed after each survey.

*Data Analysis*

Descriptive statistics and tests of statistical significance using SPSS 14 will be used to analyze the quantitative data. Open ended questions will be analyzed using thematic analysis.

#### ii) Qualitative Interviews

To further analyze how course participants felt about participation in the course and how well they integrated POCUS within their practice and maintain their skills, interviews will be performed. Grounded theory will be used as the theoretical framework for this portion of the project. It is an appropriate methodology as it allows for data collection and analysis to occur concurrently (124). As point of care imaging is a new component of the midwifery profession, grounded theory will help provide a theoretical explanation to the midwives' experiences.

#### *Population*

All 18 participants in the first offering of the course will be invited to participate in the interviews. Participants in the course will be practicing midwives in Ontario. Provided the busy schedules of course participants, it is understandable that not all will be able to complete an interview; our aim is to have a minimum of five participants from this cohort participate in an interview. Participants will be selected on a first come, first served basis and will continue until data saturation is reached. All participants will receive a study identification number.

#### *Data Collection*

Semi-structured interviews will be conducted with participants in person or by phone. The interview questions will be developed by the research team based on the survey and the existing literature. The interview guide will be piloted on two people before commencing data collection. Participants will be contacted through email and invited to participate on a first come, first served basis. These interviews will be conducted at approximately six months after the course as it allows participants to reflect upon what they have learned in the course and have had the opportunity to integrate POCUS within their practice. Interviews will be scheduled at a date and time that is convenient for the participant. The interviews will be audio recorded with consent. It is anticipated that interviews will last for 30 – 60 minutes.

#### *Data Analysis*

Audio recordings of the interviews will be transcribed verbatim and analyzed. Data analysis will follow the principles of grounded theory and will begin with open coding, followed by axial coding and then finally selective coding. In keeping with grounded theory, data analysis will begin at the same time as data collection to make use of the iterative process of constant comparison. This constant comparison will ensure the

interview questions evolve during data collection, so we can build and refine the emerging theory. NVivo 12 software will be used to organize the data.

### iii) Prospective Cohort Study

Following successful completion of the participants clinical practicum, we will compare two cohorts of participants in their skill development using the Philips Lumify portable ultrasound during their clinical practice prospectively. Participants will be taught how to use these units by 3<sup>rd</sup> year sonography students. The sonography students will have received extensive instruction on the Lumify by the Philips team, thereby being classified as "Super Users". These "Super Users" will help the participants with ensuring proper techniques for sonography.

#### *Population*

Via email, we will recruit up to 15 participants to enroll in the prospective cohort study. Five of which will be in the intervention group. The remaining participants will be in the control group. We have over sampled the number of participants in the control group to mitigate any challenges with participant drop out. In order to be eligible for the Lumify cohort, participants must complete their clinical practicum by December 31<sup>st</sup> 2019. Five participants will be given a Lumify handheld ultrasound device to use within their clinical setting for 3-6 months. There will be ten controls that will not be given a Lumify device to take back to their practice. This will allow comparison between the Lumify group and the control group of skill development using the Lumify device.

#### *Data Collection*

- i) All participants will be asked to complete a logbook describing the number and type of scans they conduct in practice. Ten images from the logbook scans will be submitted for review by faculty in the Mohawk McMaster Medical Radiation Sciences program, and credentialed sonographers working in an instructor role. Evaluators will work from a standard image critique rubric and feedback will be given directly to the participant.
- ii) Real time feedback: Utilizing the Lumify React Collaborative platform tele/ultrasound application, (<https://www.youtube.com/watch?v=m-RY-IV284>) we will address the sonographic skill development in a real time capacity. Allowing for the scanning participant to have a mentor while building their skill set. Participants will be guided in only the skill of scanning leaving the responsibility for the sonographic findings and use of that information in the hands of the participant midwife on the basis of client's care plan.

iii) OSCE assessment: All 10 participants will take part in an OSCE assessment of their skill development using ScanTrainer 6 months after the course. A standard rubric will be used to assess competency.

iv) Data Analysis: logbook assessment rubric scores, OSCE assessment scores will be compared between the two cohorts using tests of statistical significance.

**3.0 Research Plan:**

The research plan is highlighted below.

Months	June 2019- Aug 2019	Sept 2019- Dec 2019	Jan 2020- April 2020	May 2020- Aug 2020	Sept 2020- Dec 2020	Jan 2021- May 2021
<b>1. Developmental Phase</b>						
Research Proposal						
HIREB Application						
Literature Review						
<b>2. Course Administration</b>						
POCUS Course						
Pre-course survey						
Post-course survey						
Preliminary Survey Analysis						
Post 6-months Survey						
Post One Year Survey						
Interviews						
Lumify						
Survey and Interview Analysis						
<b>3. Dissemination of Findings</b>						
Scholarly publications, presentations						
Writing up of findings						

**4.0 Team Expertise**

Our team has drawn together leaders in midwifery and ultrasound education and is the first to build a curriculum and deliver a comprehensive course to meet the needs of midwives within our community. Our state-of-the-art facilities paired with knowledge and expertise of the faculty will meet the need to set a standard for training and implementation of point of care ultrasound in practice. Education research such as this

has been conducted by the team before within their respected specialties.

### **5.0 Implications:**

The findings of this project will have a direct and meaningful impact on all future participants who enroll in the POCUS course as we will be able to refine the course based on participant feedback. It is also anticipated that our findings will highlight the importance of POCUS within midwifery and aid in the development of future courses, such as an advanced level ultrasound course for midwives. Further, we will also have a better understanding of how midwives are integrating POCUS into their practice for the betterment of their clients. This represents an important contribution to the body of knowledge for midwives in Ontario. Finally, beyond Ontario, the development and evaluation of the course will also highlight educational methods that can be applied to effectively teach POCUS and could be applicable to other settings where midwives are taking on this additional skill.

## Appendix C: Participant Consent Forms

### Pre-Course, Post Course, 4-Months Post Course Survey Consent Forms:



#### Point of Care Ultrasound for Maternity Care: Study Information

**Investigators: Bronte Johnston, Beth Murray-Davis, Carol Bernacci, Laura Thomas**

#### **Local Principal Investigator:**

Dr. Beth Murray Davis  
Department of: Obstetrics and Gynecology  
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#### **Purpose of the Study**

It is essential that midwives are properly educated to perform POCUS as well as competently analyze the data presented from the sonographic images. We are inviting registrants of the Point of Care Ultrasound for Primary Maternity Care of Fall 2019 to participate in this study. The aim of this project is to a) implement a POCUS curriculum for midwives and b) evaluate learner skill acquisition and application to practice. The purpose of the surveys are to establish a baseline of the knowledge you know regarding Point of Care Ultrasound and to gain a deeper understanding to how you have translated the information from the course into your practice as well as how you have maintained your sonographic skills.

#### **Procedures involved in the Research**

To be an eligible participant for this study, you are required to be a registered midwife, and must be registered to complete the Point of Care Ultrasound for Primary Maternity Care at McMaster University in Fall 2019. Three surveys will be required for you to complete, each survey will take approximately ten minutes to complete. The three

surveys will be administered: pre-course survey, a post-course survey, and six-months post survey.

Before completion of any course materials, you are required to complete a 'pre-course survey'. This survey will take approximately ten minutes to complete.

**Potential Harms, Risks or Discomforts:**

This project will involve very minimal risk, however, if you feel any discomfort answering certain questions, please let the investigators know and accommodations can be made. Your participation is voluntary; therefore, and you can withdraw at any time.

**Potential Benefits**

The research will not directly benefit you. However, you will have the opportunity to learn more about Point of Care Ultrasound and how you can integrate it within your practice. Additionally, this research is essential to further understand how midwives are able to properly learn point of care ultrasound, maintain competency, and integrate diagnostic imaging throughout their practice.

**Confidentiality**

All surveys and interviews will be anonymized to protect your confidentiality and privacy. The information you provide will be kept on a computer that is password protected, databases will also be password protected, and will only be accessed by investigators. Upon study completion, the study data will be destroyed.

**Participation and Withdrawal**

Participation within this study is completely voluntary. You are not required to answer every question within the surveys and interviews. You can withdraw from the study at any time before January 2020 as this is when data analysis will start to occur. If you chose to withdraw from the study, all data pertaining to you will be removed unless otherwise specified.

**Information about the Study Results**

The results of this study are expected to be completed by Spring 2021. Study participants are more than welcome to receive a summary of these results by e-mail.

**Questions about the Study**

If you have any questions regarding the study, please contact Dr. Beth Murray Davis  
Bmurray@mcmaster.ca 905-525-9140 ext. 21596

This study has been reviewed by the Hamilton Integrated Research Ethics Board (HiREB). The HiREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HiREB, at 905.521.2100 x 42013.

**Point of Care Ultrasound for Maternity Care: Consent Form**

**Investigators: Bronte Johnston, Beth Murray-Davis, Carol Bernacci, Laura Thomas**

I have read the information presented in the information letter about a study being conducted by Dr. Beth Murray Davis, of McMaster University.

I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested.

I understand that if I agree to participate in this study, I may withdraw from the study at any time.

I will be given a signed copy of this form. I agree to participate in the study.

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Name of Participant (Printed)	Signature	Date
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Consent form explained in person by:

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Name and Role (Printed)	Signature	Date
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**One Year Post-Course Survey Consent Form to Be Entered on RedCap:**



**Point of Care Ultrasound for Maternity Care: Study Information**

**Investigators: Bronte Johnston, Beth Murray-Davis, Carol Bernacci, Laura Thomas**

**Local Principal Investigator:**

Dr. Beth Murray Davis  
Department of: Obstetrics and Gynecology  
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**Graduate Student Investigator:**

Bronte Johnston  
Department of Health Sciences Education  
McMaster University  
Hamilton, ON, Canada  
**(905)-359-5349**  
E-mail: [johnsb11@mcmaster.ca](mailto:johnsb11@mcmaster.ca)

**Purpose of the Study**

It is essential that midwives are properly educated to perform POCUS as well as competently analyze the data presented from the sonographic images. We are inviting registrants of the Point of Care Ultrasound for Primary Maternity Care of Fall 2019 to participate in this study. The aim of this project is to a) implement a POCUS curriculum for midwives and b) evaluate learner skill acquisition and application to practice. The purpose of the surveys are to establish a baseline of the knowledge you know regarding Point of Care Ultrasound and to gain a deeper understanding to how you have translated the information from the course into your practice as well as how you have maintained your sonographic skills.

**Procedures involved in the Research**

To be an eligible participant for this study, you are required to be a registered midwife, and must be registered to complete the Point of Care Ultrasound for Primary Maternity Care at McMaster University in Fall 2019. A one-year post course survey will be required for you to complete, it will take approximately ten minutes to complete.

**Potential Harms, Risks or Discomforts:**

This project will involve very minimal risk, however, if you feel any discomfort answering certain questions, please let the investigators know and accommodations can be made. Your participation is voluntary; therefore, and you can withdraw at any time.

**Potential Benefits**

The research will not directly benefit you. However, you will have the opportunity to learn more about Point of Care Ultrasound and how you can integrate it within your practice. Additionally, this research is essential to further understand how midwives are able to properly learn point of care ultrasound, maintain competency, and integrate diagnostic imaging throughout their practice.

**Confidentiality**

All surveys and interviews will be anonymized to protect your confidentiality and privacy. The information you provide will be kept on a computer that is password protected, databases will also be password protected, and will only be accessed by investigators. Upon study completion, the study data will be destroyed.

**Participation and Withdrawal**

Participation within this study is completely voluntary. You are not required to answer every question within the surveys and interviews. You can withdraw from the study at any time before January 2020 as this is when data analysis will start to occur. If you chose to withdraw from the study, all data pertaining to you will be removed unless otherwise specified.

**Information about the Study Results**

The results of this study are expected to be completed by Spring 2021. Study participants are more than welcome to receive a summary of these results by e-mail.

**Questions about the Study**

If you have any questions regarding the study, please contact Dr. Beth Murray Davis Bmurray@mcmaster.ca 905-525-9140 ext. 21596

This study has been reviewed by the Hamilton Integrated Research Ethics Board (HiREB). The HiREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HiREB, at 905.521.2100 x 42013.

**Point of Care Ultrasound for Maternity Care: Consent Form**

**Investigators: Bronte Johnston, Beth Murray-Davis, Carol Bernacci, Laura Thomas**

I have read the information presented in the information letter about a study being conducted by Dr. Beth Murray Davis, of McMaster University.

I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested.

I understand that if I agree to participate in this study, I may withdraw from the study at any time.

I agree to participate in the study.

Yes (survey questions appear)

No (survey questions do not appear, survey ends)

**Interview Consent Form:**



**Point of Care Ultrasound for Maternity Care: Study Information**

**Investigators: Bronte Johnston, Beth Murray-Davis, Carol Bernacci, Laura Thomas**

**Local Principal Investigator:**

Dr. Beth Murray Davis  
Department of: Obstetrics and Gynecology  
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**Purpose of the Study**

It is essential that midwives are properly educated to perform POCUS as well as competently analyze the data presented from the sonographic images. We are inviting registrants of the Point of Care Ultrasound for Primary Maternity Care of Fall 2019 to participate in this study. The aim of this project is to a) implement a POCUS curriculum for midwives and b) evaluate learner skill acquisition and application to practice. The purpose of the interview is to further evaluate how you feel about the course and how well you have been able to integrate POCUS within your practice as well as maintain sonography skills.

**Procedures involved in the Research**

You are required to have completed the Point of Care Ultrasound for Primary Maternity Care at McMaster University Fall 2019 for approximately six months. You are required to complete either a telephone or in-person semi-structured interview. The interviews will take approximately 30-60 minutes to complete and will be recorded for further analysis.

**Potential Harms, Risks or Discomforts:**

This project will involve very minimal risk, however, if you feel any discomfort answering certain questions, please let the investigators know and accommodations can be made. Your participation is voluntary; therefore, and you can withdraw at any time.

**Potential Benefits**

The research will not directly benefit you. However, you will have the opportunity to learn more about Point of Care Ultrasound and how you can integrate it within your practice. Additionally, this research is essential to further understand how midwives are able to properly learn point of care ultrasound, maintain competency, and integrate diagnostic imaging throughout their practice.

**Confidentiality**

All surveys and interviews will be anonymized to protect your confidentiality and privacy. The information you provide will be kept on a computer that is password protected, databases will also be password protected, and will only be accessed by investigators. Upon study completion, the study data will be destroyed.

**Participation and Withdrawal**

Participation within this study is completely voluntary. You are not required to answer every question within the surveys and interviews. You can withdraw from the study at any time before January 2020 as this is when data analysis will start to occur. If you chose to withdraw from the study, all data pertaining to you will be removed unless otherwise specified.

**Information about the Study Results**

The results of this study are expected to be completed by Spring 2021. Study participants are more than welcome to receive a summary of these results through e-mail.

**Questions about the Study**

If you have any questions regarding the study, please contact Dr. Beth Murray Davis Bmurray@mcmaster.ca 905-525-9140 ext. 21596

This study has been reviewed by the Hamilton Integrated Research Ethics Board (HiREB). The HiREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HiREB, at 905.521.2100 x 42013.

**Investigators: Bronte Johnston, Beth Murray-Davis, Carol Bernacci, Laura Thomas**

I have read the information presented in the information letter about a study being conducted by Dr. Beth Murray Davis, of McMaster University.

I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested.

I understand that if I agree to participate in this study, I may withdraw from the study at any time.

I will be given a signed copy of this form. I agree to participate in the study.

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Name of Participant (Printed)	Signature	Date
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Consent form explained in person by:

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Name and Role (Printed)	Signature	Date
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## Appendix D: E-Mail Correspondence

### **Initial General Recruitment E-mail**

Dear Midwife:

On January 1<sup>st</sup>, 2018, the College of Midwives of Ontario expanded the scope of practice for registered midwives to now perform ultrasounds for clients to enhance maternal care during pregnancy, birth and postpartum. It is essential that midwives are properly educated to perform ultrasounds as well as able to competently analyze the data presented from the sonographic images. The aim of this project is to a) develop and implement a POCUS curriculum for midwives and b) evaluate learner skill acquisition and application to practice.

As registrants in this course for Fall 2019, you are invited to participate in this study if you wish. As a participant of this study, you will be asked to complete 3 surveys (pre course, immediately upon completion, and 6-months post course) and to participate in a semi-structured interview.

If you have any questions, please do not hesitate to contact any of the researchers.

Thank you for your time and consideration,

### **Pre-course Survey:**

Dear Participants:

Welcome to the Point of Care Ultrasound for Primary Maternity Care course for Fall 2019! Thank you so much again for participating in this course, your time and effort are greatly appreciated to help further develop a POCUS curriculum for midwives as well as evaluate learner skill acquisition and application to practice.

Before you start the course, we ask that you complete a survey (link below) to identify your current knowledge and experience with point of care ultrasound. Please note that if you are uncomfortable answering certain questions within the survey you are not required to answer.

Survey Link:

If you have any questions, please do not hesitate to contact the researchers.

Thank you for your time and consideration,

## Appendix E: Survey Questions

### **Part 1: (pre-course, post-course, 4-months post-course, 1-year post-course)**

1. How frequently is point of care ultrasound used in your clinical practice to assist in clinical decision making? (performed by you or another health care provider)

(5-point Likert)

Never/Once in 6 months/Once a month/Once a week/Daily

2. How comfortable do you feel conducting ultrasound scans? (5-point Likert)

Not comfortable -1/2/3/4/5- Very comfortable

3. How comfortable do you feel conducting ultrasound scans for each of the following applications? (5-point Likert)

Not comfortable -1/2/3/4/5- Very comfortable

Confirming viability in the first trimester

Normal pregnancy dating

Ectopic pregnancy

Fetal presentation

Confirming viability in the second trimester

Biophysical Profiles

Placental location

4. Please rank the following applications in order of how likely you feel you are to use each of them, with 1 being most likely and 7 being least

likely. Please leave applications blank if you feel you would never use them

Confirming viability in the first trimester

Normal pregnancy dating

Ectopic pregnancy

Fetal presentation

Confirming viability in the second trimester

Biophysical Profiles

Placental location

5. How often would you use point of care ultrasound per day if you had the training? (5-point Likert)

Once in 6 months/Once a month/Once a week/Daily/Multiple times per day

6. How frequently do you use point of care ultrasound for each of the following applications? (5-point Likert for each modality)

Once in 6 months/Once a month/Once a week/Daily/Multiple times per day

Confirming viability in the first trimester



Normal pregnancy dating

Ectopic pregnancy

Fetal presentation

Confirming viability in the second trimester

Biophysical Profiles

Placental location

**Part 2: Pre-course survey questions only**

1. How did you hear about the Point of Care Ultrasound for Primary Maternity Care course?
  - a) MEP preceptor newsletter
  - b) From a colleague
  - c) Through McMaster Continuing Education
  - d) AOM biweekly memo
2. How many practitioners in your clinic currently utilize point of care ultrasound as a component of their clinical assessment?
  - a) 0
  - b) 1-2
  - c) 3-4
  - d) 5+
3. Have you participated in any other formal/informal point of care ultrasound training program beyond the Mohawk-McMaster program? If yes, please provide details of the program, ie. didactic/hands-on
  - a) Yes. Explanation \_\_\_\_\_
  - b) No
4. Do you have access to a dedicated ultrasound unit in your current practice?
  - a) Yes
  - b) No
5. Why were you interested in taking this course?
6. How do you plan to use POCUS within your practice?
7. May investigators contact you for future research
  - Yes
  - No

**Part 3: Post-course (immediate) survey questions only**

1. Would you be interested in participating in further POCUS training at a more advanced level?

a) Yes

b) No

Additional Comments:

2. Would you recommend this course to a colleague?

a) Yes

b) No

If not, why?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
<b>Question:</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
3. The implementation of POCUS has changed my care management					
4. The implementation of POCUS in my practice has reduced client anxiety					
5. Conducting POCUS is beneficial to the client experience					
6. The implementation of POCUS in my practice provides better client care					
7. POCUS provides more accurate and faster diagnosis to my clients					
8. I am confident in performing POCUS following completion of this course					
9. I am comfortable with the equipment and technology involved in POCUS					
10. I understand the limitations of POCUS					
11. I am integrating POCUS within my daily clinical care routine.					
<b>Additional Comments:</b>					

**Part 4: Post-course (four months) survey questions only**

1. Would you be interested in participating in further POCUS training at a more advanced level?
  - a) Yes
  - b) No
2. Would you recommend this course to a colleague?
  - a) Yes
  - b) No
    - If no, why?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
<b>Question:</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
3. The implementation of POCUS has changed my care management					
4. The implementation of POCUS in my practice has reduced client anxiety					
5. Conducting POCUS is beneficial to the client experience					
6. The implementation of POCUS in my practice provides better client care					
7. POCUS provides more accurate and faster diagnosis to my clients					
8. I am confident in performing POCUS following completion of this course					
9. I am comfortable with the equipment and technology involved in POCUS					
10. I understand the limitations of POCUS					
11. I am integrating POCUS within my daily clinical care routine.					
12. I am competent to perform POCUS					
13. I will continue to use POCUS within my practice					
<b>Additional Comments:</b>					

14. Has anything significantly changed in your practice over the last six months?

a) Yes

i. Please Explain: \_\_\_\_\_

b) No

15. How has your level of POCUS integration changed since completion of the course?

a) Increased

b) Stayed the Same

c) Decreased

d) Not used

**Part 5: Post-course (one year) survey questions only**

1. I have read the information presented in the information letter about a study being conducted by Dr. Beth Murray Davis, of McMaster University.

I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested.

I understand that if I agree to participate in this study, I may withdraw from the study at any time. I agree to participate in the study.

Yes (survey questions appear)

No (survey questions do not appear, survey ends)

2. How frequently is point of care ultrasound used in your clinical practice to assist in clinical decision making? (performed by you or another health care provider)

(5-point Likert)

Never/Once in 6 months/Once a month/Once a week/Daily

3. How comfortable do you feel conducting ultrasound scans? (5-point Likert)

Not comfortable -1/2/3/4/5- Very comfortable

4. How comfortable do you feel conducting ultrasound scans for each of the following applications? (5-point Likert)

Not comfortable -1/2/3/4/5- Very comfortable

Confirming viability in the first trimester

Normal pregnancy dating

Ectopic pregnancy

Fetal presentation

Confirming viability in the second trimester

Biophysical Profiles

Placental location

5. Please rank the following applications in order of how likely you feel you are to use each of them, with 1 being most likely and 7 being least likely. Please leave applications blank if you feel you would never use them

Confirming viability in the first trimester

Normal pregnancy dating

Ectopic pregnancy

Fetal presentation

Confirming viability in the second trimester

Biophysical Profiles

Placental location

6. How often would you use point of care ultrasound per day if you had the training? (5-point Likert)

Once in 6 months/Once a month/Once a week/Daily/Multiple times per day

7. How frequently do you use point of care ultrasound for each of the following applications? (5-point Likert for each modality) Please leave blank if you feel you would never use them.

Once in 6 months/Once a month/Once a week/Daily/Multiple times per day

Confirming viability in the first trimester

Normal pregnancy dating

Ectopic pregnancy

Fetal presentation

Confirming viability in the second trimester

Biophysical Profiles

Placental location

8. Would you be interested in participating in further POCUS training at a more advanced level?

c) Yes

d) No

9. Would you recommend this course to a colleague?

c) Yes

d) No

a. If no, why?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
<b>Question:</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1. The implementation of POCUS has changed my care management					
2. The implementation of POCUS in my practice has reduced client anxiety					
3. Conducting POCUS is beneficial to the client experience					
4. The implementation of POCUS in my practice provides better client care					
5. POCUS provides more accurate and faster diagnosis to my clients					
6. I am confident in performing POCUS following completion of this course					
7. I am comfortable with the equipment and technology involved in POCUS					
8. I understand the limitations of POCUS					
9. I am integrating POCUS within my daily clinical care routine.					
10. I am competent to perform POCUS					
11. I will continue to use POCUS within my practice					
<b>Additional Comments:</b>					

10. Has anything significantly changed in your practice over the last six months?

c) Yes

i. Please Explain: \_\_\_\_\_

d) No

11. How has your level of POCUS integration changed since completion of the course?

a. Increased

b. Stayed the Same

c. Decreased

d. Not used

## Appendix F: The Semi Structured Interview Guide

**Opening Statement:** Take the time to thank the participants, remind them that our conversation will be recorded and transcribed for analysis. Also, remind participants that the purpose of the interview is to further understand the participants perspectives of the course, confidence with POCUS, and how they have integrated POCUS within their practice.

**Questions:**

1. How would you describe your experiences with the POCUS course?
  - a. What did you enjoy?
  - b. What could be improved?
2. How did you find the course structure and educational methodologies used in the course?
  - a. Online component? Evaluations? Clinical Practicum? Hands-on workshop?
  - b. How clearly was the course material presented?
  - c. What were the takeaways from the course?
3. Can you describe in detail how you have integrated POCUS throughout your practice?
  - a. What types of scans are you performing?
  - b. How often are you performing diagnostic imaging?
4. How have your clients responded to you conducting POCUS?
  - a. Do they respond positively or negatively?
  - b. Are they asking for more imaging?
5. How are you maintaining competency?
  - a. Are you reviewing course material? Going to additional courses?
  - b. How do you think the College of Midwives can ensure competency?
6. How will POCUS impact the field of midwifery in general from your perspective?
7. Is there anything you would like to discuss today that has not been previously mentioned?

## Appendix G: Quantitative Results Data Tables

*How frequently do you use point of care ultrasound for each of the following applications?*

1, Once in 6 months 2, Once a month 3, Once a week 4, Daily 5, Multiple times per day

Never- Once-6-months: Infrequently, Monthly-Multiple Times Daily: Frequently

<u>POCUS Application:</u>	<u>Pre-Course Responses</u>		<u>Post-Course Responses</u>		<u>4-Months Post-Course Responses</u>		<u>1-Year Post-Course Responses</u>	
	<u>Infrequently</u>	<u>Frequently</u>	<u>Infrequently</u>	<u>Frequently</u>	<u>Infrequently</u>	<u>Frequently</u>	<u>Infrequently</u>	<u>Frequently</u>
Confirming Viability-First Trimester	78% (n=14)	22% (n=4)	50% (n=9)	50% (n=9)	45% (n=5)	55% (n=6)	60% (n=6)	40% (n=4)
Pregnancy Dating	78% (n=14)	22% (n=4)	61% (n=11)	39% (n=7)	55% (n=6)	45% (n=5)	80% (n=8)	20% (n=2)
Ectopic Pregnancy	100% (n=18)	0% (n=0)	100% (n=18)	0% (n=0)	64% (n=7)	36% (n=4)	90% (n=9)	10% (n=1)
Fetal Presentation	78% (n=14)	22% (n=4)	44% (n=8)	56% (n=10)	36% (n=4)	64% (n=7)	40% (n=4)	60% (n=6)
Confirming Viability- Second Trimester	94% (n=17)	6% (n=1)	67% (n=12)	33% (n=6)	55% (n=6)	45% (n=5)	50% (n=5)	50% (n=5)
Biophysical Profile	83% (n=15)	17% (n=3)	67% (n=12)	33% (n=6)	64% (n=7)	36% (n=4)	70% (n=7)	30% (n=3)
Placental Location	83% (n=15)	17% (n=3)	78% (n=14)	22% (n=4)	55% (n=6)	45% (n=5)	80% (n=8)	20% (n=2)

*How comfortable do you feel conducting ultrasound scans?*

1, Not Comfortable 2, Minimal Comfort 3, Neither 4, Comfortable 5, Very Comfortable

<u>Pre-Course Responses</u>			<u>Post-Course Responses</u>			<u>4-Months Post-Course Responses</u>			<u>1-Year Post-Course Responses</u>		
<u>Not Comfortable</u>	<u>Neither</u>	<u>Comfortable</u>	<u>Not Comfortable</u>	<u>Neither</u>	<u>Comfortable</u>	<u>Not Comfortable</u>	<u>Neither</u>	<u>Comfortable</u>	<u>Not Comfortable</u>	<u>Neither</u>	<u>Comfortable</u>
89% (n=16)	0% (n=0)	11% (n=2)	39% (n=7)	11% (n=2)	50% (n=9)	55% (n=6)	0% (n=0)	45% (n=5)	40% (n=4)	10% (n=1)	50% (n=5)



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**How comfortable do you feel conducting ultrasound scans for each of the following:**

1, Not Comfortable 2, Minimal Comfort 3, Neither 4, Comfortable, 5, Very Comfortable

<u>POCUS Application:</u>	<u>Pre-Course</u>			<u>Post-Course</u>			<u>4-Months Post-Course</u>			<u>1-Year Post-Course</u>		
	Not Comfortable	Neither	Comfortable	Not Comfortable	Neither	Comfortable	Not Comfortable	Neither	Comfortable	Not Comfortable	Neither	Comfortable
Confirming Viability- First Trimester	89% (n=16)	0% (n=0)	11% (n=2)	16% (n=2)	6% (n=1)	78% (n=15)	54% (n=6)	10% (n=1)	36% (n=4)	40% (n=4)	0% (n=0)	60% (n=6)
Normal Pregnancy Dating	83% (n=15)	0% (n=0)	17% (n=3)	39% (n=7)	17% (n=3)	44% (n=8)	54% (n=6)	10% (n=1)	36% (n=4)	80% (n=8)	0% (n=0)	20% (n=2)
Ectopic Pregnancy	83% (n=15)	0% (n=0)	17% (n=3)	83% (n=15)	11% (n=2)	6% (n=1)	70% (n=7)	0% (n=0)	30% (n=3)	80% (n=8)	10% (n=1)	10% (n=1)
Fetal Presentation	72% (n=13)	6% (n=1)	22% (n=4)	0% (n=0)	0% (n=0)	100% (n=18)	27% (n=3)	9% (n=1)	64% (n=7)	10% (n=1)	0% (n=0)	90% (n=9)
Confirming Viability- Second Trimester	89% (n=16)	0% (n=0)	11% (n=2)	0% (n=0)	11% (n=2)	89% (n=16)	36% (n=4)	9% (n=1)	55% (n=6)	20% (n=2)	10% (n=1)	70% (n=7)
Biophysical Profile	89% (n=16)	0% (n=0)	11% (n=2)	39% (n=7)	28% (n=5)	33% (n=6)	55% (n=6)	0% (n=0)	45% (n=5)	80% (n=8)	0% (n=0)	20% (n=2)
Placental Location	89% (n=16)	0% (n=0)	11% (n=2)	39% (n=7)	28% (n=5)	33% (n=6)	64% (n=7)	0% (n=0)	36% (n=4)	78% (n=7)	0% (n=0)	22% (n=2)

**Likely Use POCUS Applications:**

1, Most Likely 2, Moderately Likely 3, Slightly Likely 4, Neutral 5, Slightly Unlikely 6, Moderately Unlikely 7, Least Likely, Blank Never

<u>POCUS Application:</u>	<u>Pre-Course</u>			<u>Post-Course</u>			<u>4-Months Post-Course</u>			<u>1-Year Post-Course</u>		
	Likely	Neutral	Unlikely	Likely	Neutral	Unlikely	Likely	Neutral	Unlikely	Likely	Neutral	Unlikely
Confirming Viability- First Trimester	89% (n=16)	5.5% (n=1)	5.5% (n=1)	89% (n=16)	0% (n=0)	11% (n=2)	73% (n=8)	9% (n=1)	18% (n=2)	60% (n=6)	10% (n=1)	30% (n=3)
Ectopic Pregnancy	44% (n=8)	22% (n=4)	33% (n=6)	28% (n=5)	17% (n=3)	55% (n=10)	36% (n=4)	0% (n=0)	64% (n=7)	30% (n=3)	10% (n=1)	60% (n=6)
Fetal Presentation	89% (n=16)	5.5% (n=1)	5.5% (n=1)	100% (n=18)	0% (n=0)	0% (n=0)	100% (n=11)	0% (n=0)	0% (n=0)	100% (n=10)	0% (n=0)	0% (n=0)
Confirming Viability- Second Trimester	67% (n=12)	11% (n=2)	22% (n=4)	89% (n=16)	0% (n=0)	11% (n=2)	45% (n=5)	10% (n=1)	45% (n=5)	60% (n=6)	10% (n=1)	30% (n=3)
Biophysical Profile	44% (n=8)	11% (n=2)	44% (n=8)	56% (n=10)	0% (n=0)	44% (n=8)	45% (n=5)	0% (n=0)	55% (n=6)	40% (n=4)	0% (n=0)	60% (n=6)
Placental Location	39% (n=7)	22% (n=4)	39% (n=7)	44% (n=8)	6% (n=1)	50% (n=9)	36% (n=4)	18% (n=2)	45% (n=5)	50% (n=5)	0% (n=0)	50% (n=5)

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**Please Answer the Following Questions:**

1, Strongly Disagree, 2, Disagree, 3, Neither Agree nor Disagree, 4, Agree, 5, Strongly Agree

POCUS Application:	Post-Course			4-Months Post-Course			1-Year Post-Course		
	Disagree	Neither	Agree	Disagree	Neither	Agree	Disagree	Neither	Agree
The implementation of POCUS has changed my care management	13% (n=2)	25% (n=4)	62% (n=10)	50% (n=5)	10% (n=1)	40% (n=4)	20% (n=2)	40% (n=4)	40% (n=4)
The implementation of POCUS in my practice has reduced client anxiety	7% (n=1)	60% (n=9)	33% (n=5)	44% (n=4)	11% (n=1)	44% (n=4)	30% (n=3)	20% (n=2)	50% (n=5)
Conducting POCUS is beneficial to the client experience	7% (n=1)	26% (n=4)	67% (n=10)	22% (n=2)	11% (n=1)	67% (n=6)	0% (n=0)	30% (n=3)	70% (n=7)
The implementation of POCUS in my practice provides better client care	6% (n=1)	38% (n=6)	56% (n=9)	22% (n=2)	33% (n=3)	44% (n=4)	0% (n=0)	33% (n=3)	67% (n=6)
POCUS provides more accurate and faster diagnosis to my clients	6% (n=1)	50% (n=8)	44% (n=7)	30% (n=3)	20% (n=2)	50% (n=5)	0% (n=0)	33% (n=3)	67% (n=6)
I am confident in performing POCUS following completion of this course	25% (n=4)	6% (n=1)	69% (n=11)	50% (n=5)	10% (n=1)	40% (n=4)	22% (n=2)	33% (n=3)	44% (n=4)
I am comfortable with the equipment and technology involved in POCUS	20% (n=3)	7% (n=1)	73% (n=11)	50% (n=5)	10% (n=1)	40% (n=4)	11% (n=1)	22% (n=2)	67% (n=6)
I understand the limitations of POCUS	6% (n=1)	0% (n=0)	94% (n=15)	9% (n=1)	0% (n=0)	91% (n=10)	0% (n=0)	0% (n=0)	100% (n=9)
I am integrating POCUS within my daily clinical care routine	21% (n=3)	36% (n=5)	43% (n=6)	40% (n=4)	10% (n=1)	50% (n=5)	44% (n=4)	0% (n=0)	56% (n=5)
I will continue to use POCUS within my practice				30% (n=3)	20% (n=2)	50% (n=5)	0% (n=0)	22% (n=2)	78% (n=7)
I am competent to perform POCUS				30% (n=3)	20% (n=2)	50% (n=5)	33% (n=3)	22% (n=2)	44% (n=4)

## Appendix H: Qualitative Data Codes

Learning a Skill & Facilitating Learning	Improving Care	Refining the Role of the Midwife	Serving Community	Achieving Personal Competency
<ul style="list-style-type: none"> <li>• Ultrasound Understanding                             <ul style="list-style-type: none"> <li>• Ultrasound device</li> <li>• Technology advancements</li> <li>• Ultrasound Unfamiliarity</li> </ul> </li> <li>• Course Components                             <ul style="list-style-type: none"> <li>• Asynchronous learning</li> <li>• Course materials</li> <li>• Course practicum</li> <li>• Hands on weekend</li> </ul> </li> <li>• Course Challenges                             <ul style="list-style-type: none"> <li>• No POCUS Use                                     <ul style="list-style-type: none"> <li>• Low comfort</li> <li>• No access</li> <li>• No ultrasound device</li> </ul> </li> </ul> </li> <li>• Post Course Education                             <ul style="list-style-type: none"> <li>• Refresher course</li> <li>• Review materials</li> </ul> </li> <li>• Real Tummies</li> <li>• Learning Challenges</li> <li>• Course Improvements                             <ul style="list-style-type: none"> <li>• Criticism</li> <li>• First iteration</li> <li>• Improve practicum</li> <li>• Lack of support</li> <li>• Course restructure</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive Care</li> <li>• Potential Problems                             <ul style="list-style-type: none"> <li>• POCUS appropriateness</li> <li>• POCUS overuse</li> <li>• Unnecessary scans</li> <li>• Hinder practice</li> <li>• Liability</li> <li>• Over rely on technology</li> <li>• Pregnancy complications</li> </ul> </li> <li>• POCUS Organizational Care Barriers                             <ul style="list-style-type: none"> <li>• Cost</li> <li>• Experience</li> <li>• Practicum challenges and organization</li> <li>• Motivation</li> <li>• Time</li> </ul> </li> <li>• POCUS Benefits</li> <li>• Improvements to POCUS                             <ul style="list-style-type: none"> <li>• Improve access</li> <li>• Improving skills</li> </ul> </li> <li>• Personal Care Barriers                             <ul style="list-style-type: none"> <li>• Minimal confidence and use</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Accreditation                             <ul style="list-style-type: none"> <li>• Letter of completion</li> <li>• Required certification</li> <li>• Skill acknowledgment</li> </ul> </li> <li>• College of Midwives</li> <li>• Midwifery Career                             <ul style="list-style-type: none"> <li>• Future plans</li> <li>• Midwifery integration</li> </ul> </li> <li>• Midwifery Organizational Challenges                             <ul style="list-style-type: none"> <li>• Overcoming criticism</li> <li>• Short staffed</li> <li>• Midwifery gaps</li> <li>• Midwives overburdened</li> <li>• Midwives underutilized</li> </ul> </li> <li>• Personal Role Barriers                             <ul style="list-style-type: none"> <li>• Past experiences</li> </ul> </li> <li>• Personal Feelings                             <ul style="list-style-type: none"> <li>• Clinical learning</li> <li>• Education interest</li> <li>• POCUS motivation</li> <li>• POCUS demand</li> <li>• Personal determination</li> <li>• Ultrasound desire</li> </ul> </li> <li>• Expanding Scope of Midwifery                             <ul style="list-style-type: none"> <li>• POCUS' impact on midwifery</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Client Perspective                             <ul style="list-style-type: none"> <li>• Changed perspectives</li> <li>• Client choice</li> <li>• Client preference</li> <li>• Client support</li> </ul> </li> <li>• Low Resources</li> <li>• Additional Tool                             <ul style="list-style-type: none"> <li>• No additional training</li> </ul> </li> <li>• Other Health Professionals                             <ul style="list-style-type: none"> <li>• Comparisons</li> <li>• Diagnostic imaging consultation</li> </ul> </li> <li>• Interprofessional comparisons</li> <li>• POCUS Applications                             <ul style="list-style-type: none"> <li>• Integration</li> <li>• Resource allocation</li> </ul> </li> <li>• POCUS Pushback from Other Health Professionals</li> <li>• Urban Communities</li> <li>• POCUS Frequency</li> </ul>	<ul style="list-style-type: none"> <li>• Confidence                             <ul style="list-style-type: none"> <li>• POCUS comfort</li> <li>• Continued usage</li> </ul> </li> <li>• Determining Competency                             <ul style="list-style-type: none"> <li>• Personal competency</li> </ul> </li> <li>• Maintaining skills</li> </ul>

## Appendix I: Bar Graph Study Figures

Figure 7 Participants' POCUS Comfort Level Over Time

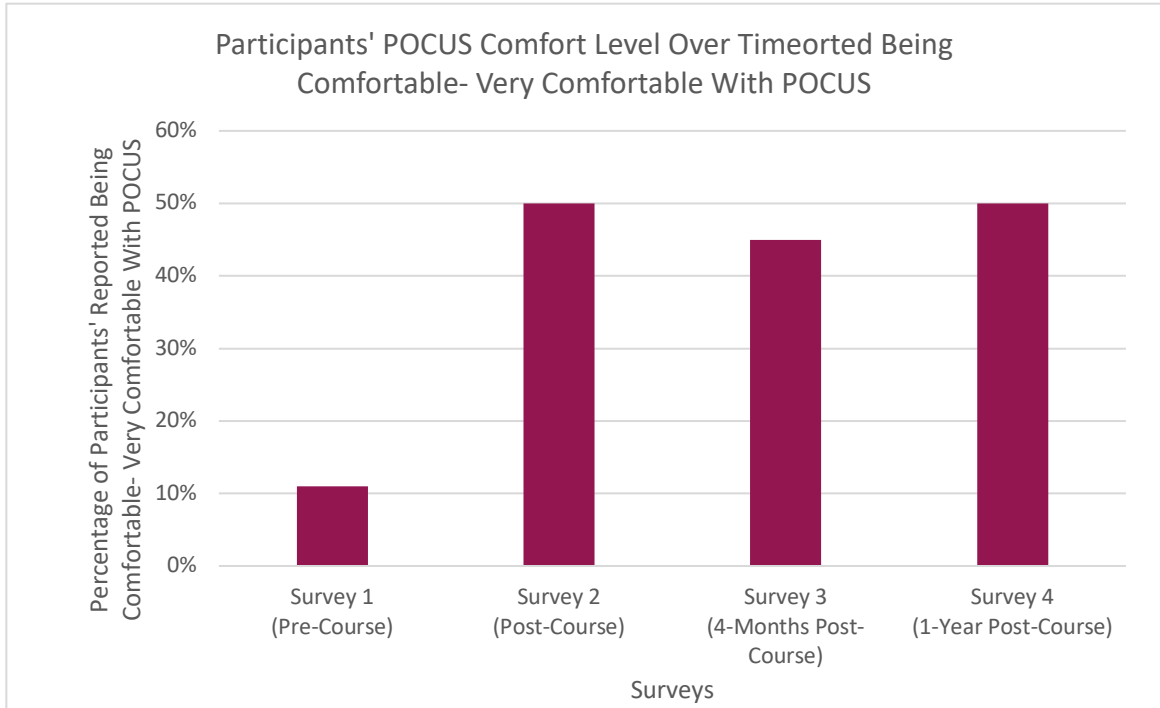


Figure 8 POCUS Comfort Level by Indication Throughout the Study

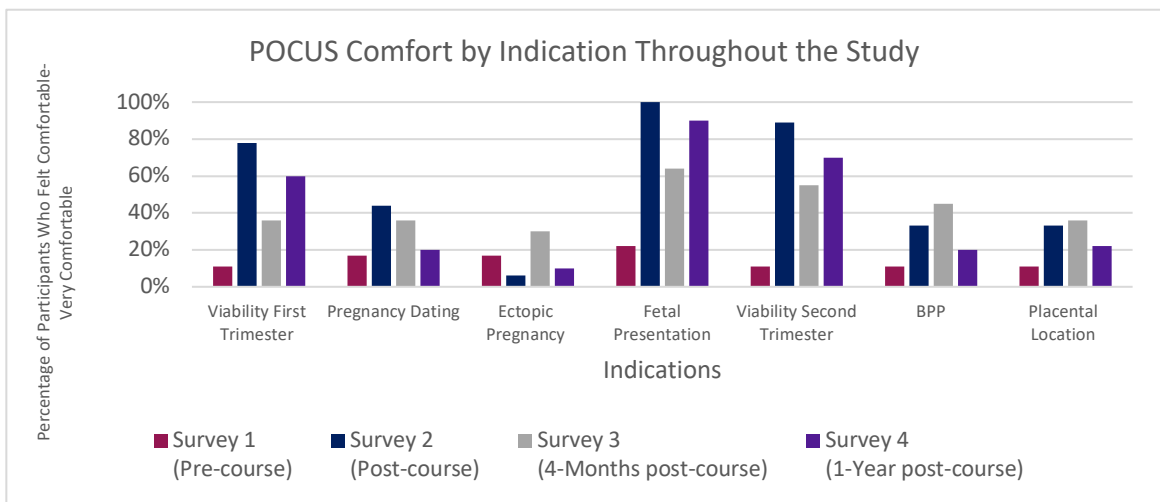


Figure 9 Percentage of Participants Interested in Further Training

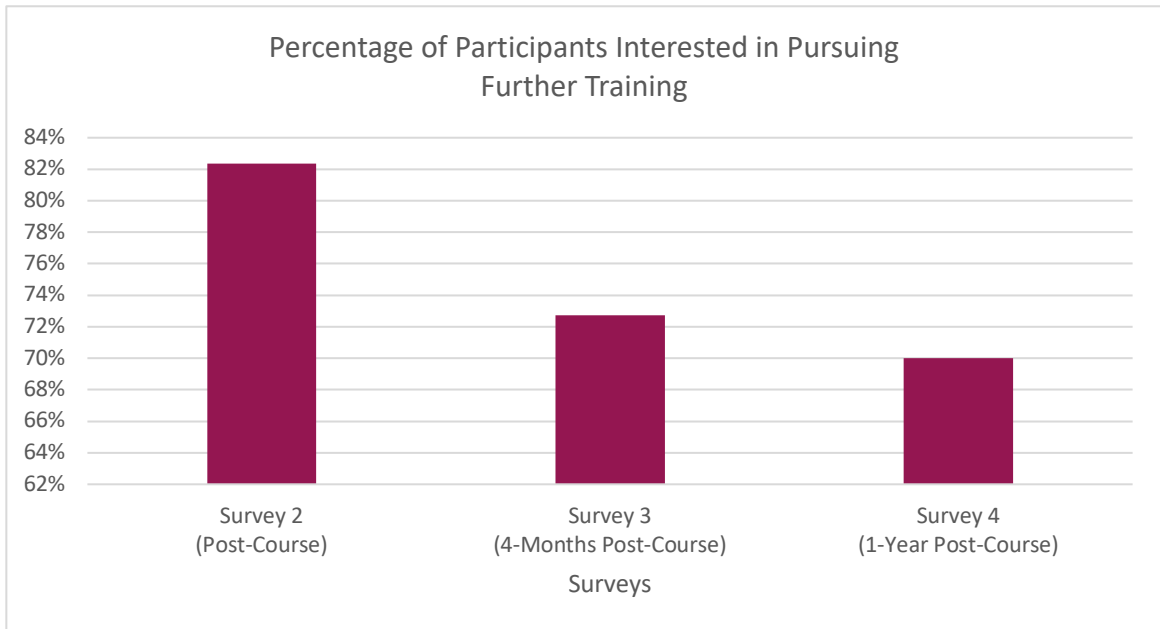


Figure 10 Participant Likely Use of POCUS by Indication Over Time

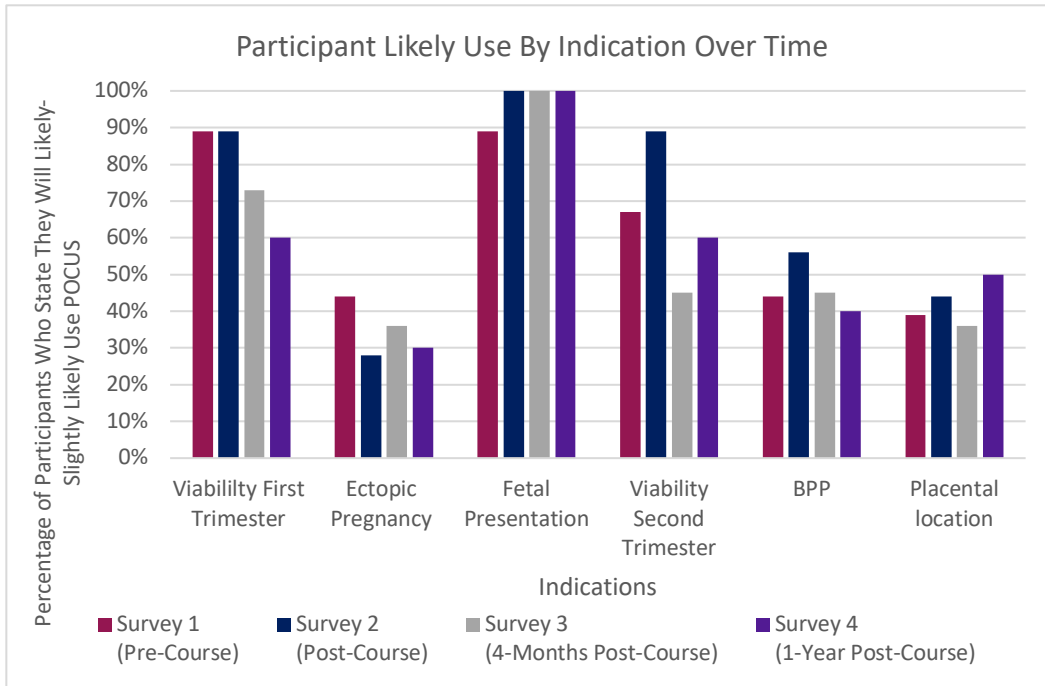


Figure 11 Participants' POCUS Frequency Over Time

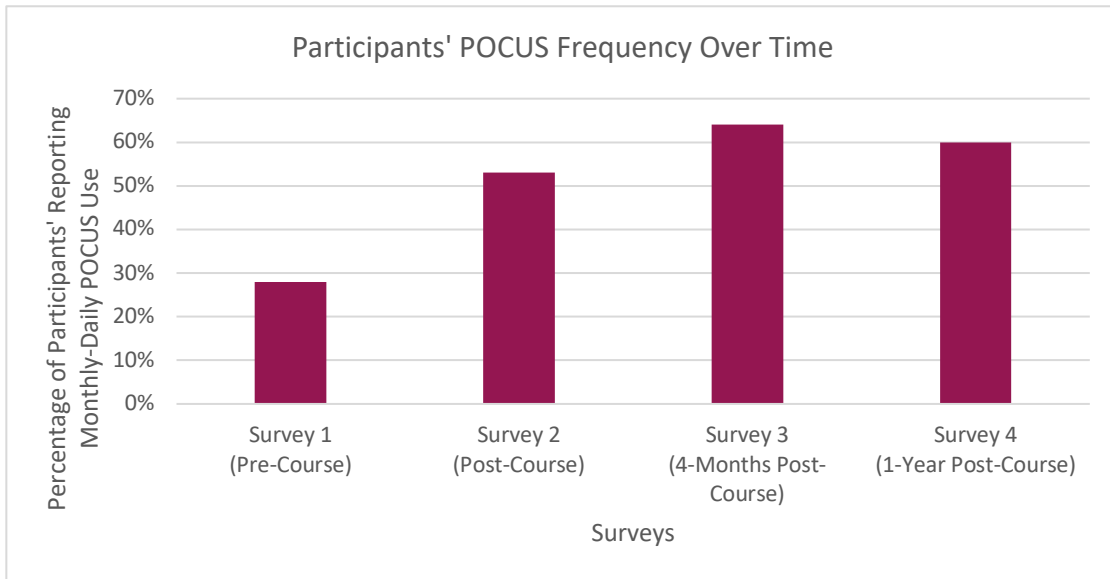


Figure 12 POCUS Use by Indication for Participants Over Time

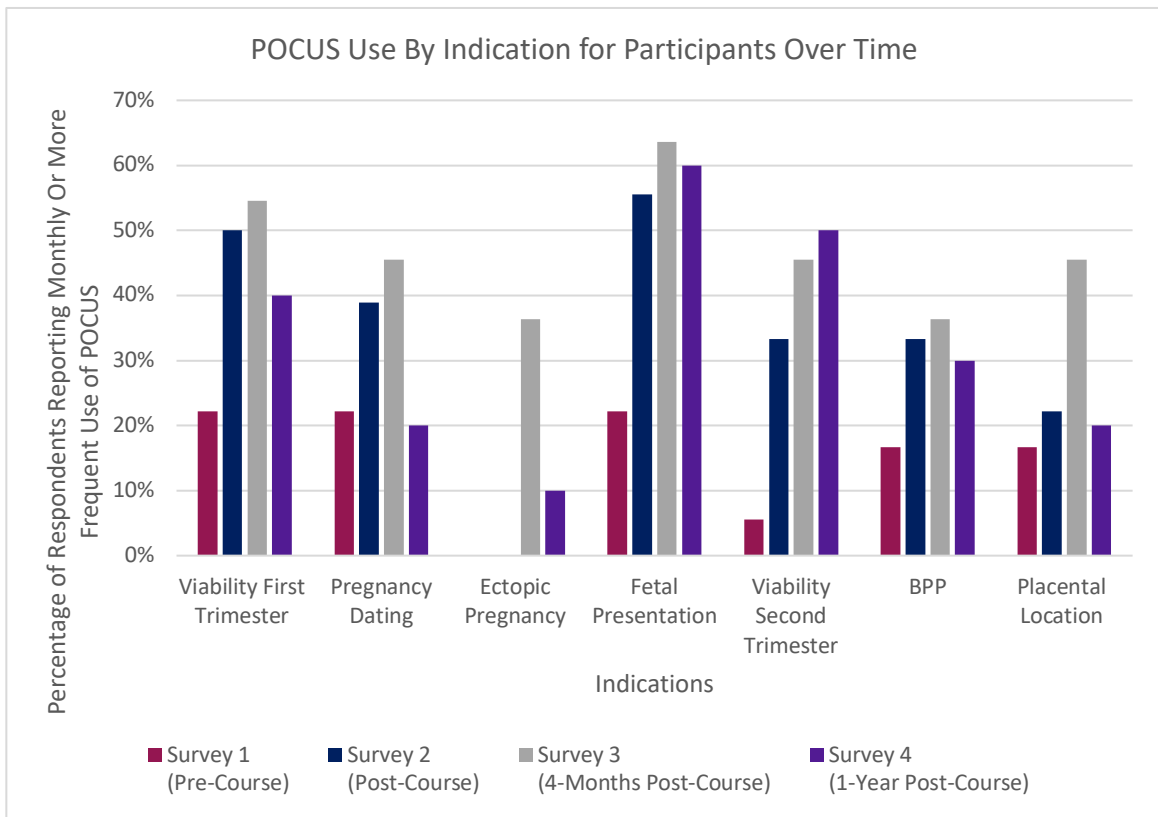


Figure 13 POCUS Implementation Agreement Sentiments

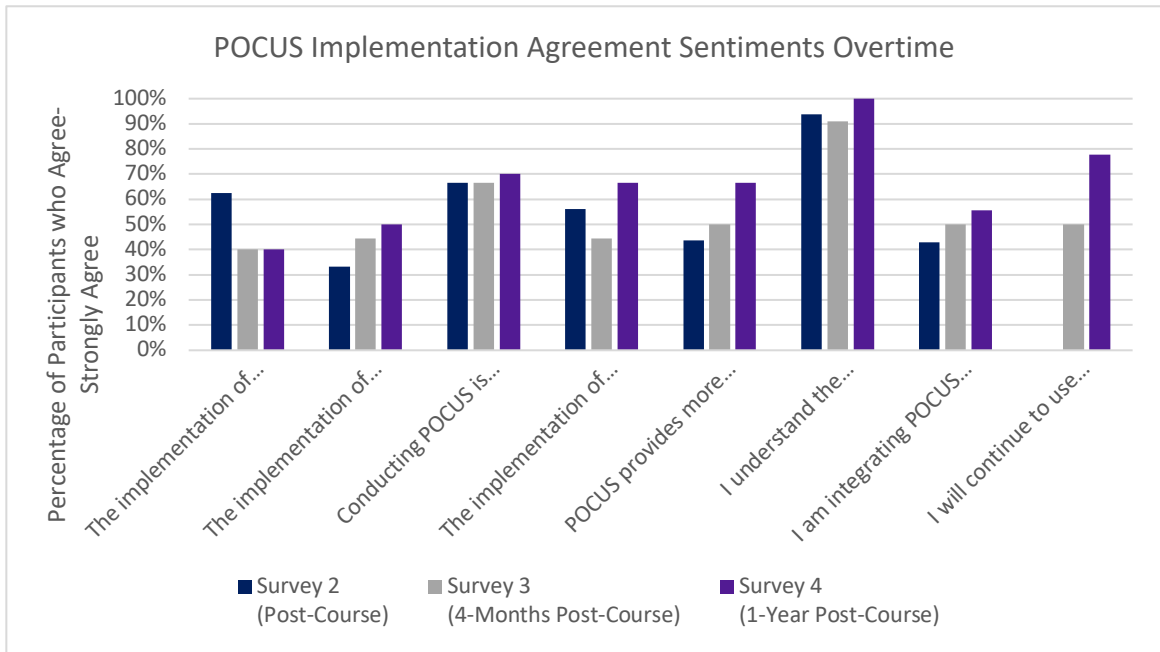
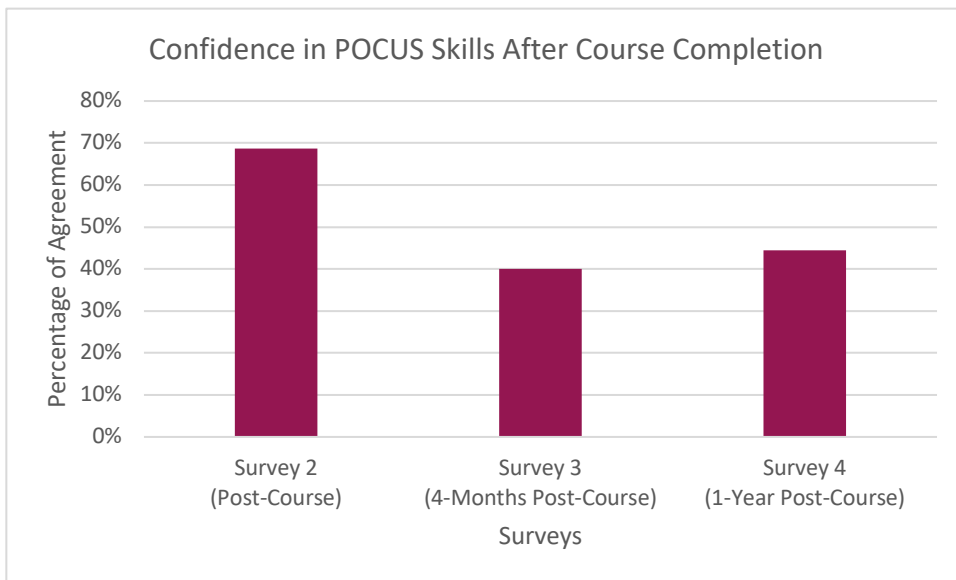


Figure 14 Confidence in POCUS Skills After Course Completion



*“Science, for me, gives a partial explanation for life. In so far as it goes, it is based on fact, experience and experiment.” -Dr. Rosalind Franklin*