ULTRASOUND IMAGING IN MIDWIFERY PRACTICE

AN EXPLORATION OF ONTARIO MIDWIVES' INTEREST IN ULTRASOUND IMAGING AND THEIR ATTITUDES TOWARD ADOPTING IT IN CLINICAL PRACTICE

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Lay Abstract

Accessing healthcare has been increasingly challenging in Canada. Allowing trained, non-physician practitioners to provide care beyond professional boundaries has been a suggested solution. In 2018, the College of Midwives of Ontario authorized Ontario midwives to perform ultrasounds on their clients. A survey was done to explore the degree of interest of midwives in doing ultrasounds and factors that may influence this interest and support for the new skill expansion. Both numbers and texts were analyzed. This study explores the perceived risks, benefits, enablers and barriers and the ultrasound examinations or tasks that are most appropriate within midwifery care. It was found that the interest and support were generally high. The interest was highest for specific limited examinations and tasks. Many believed the expansion in scope would improve access to care. However, many questions remain around payment, training, equipment and concerns around potential legal disputes.

Abstract

Long wait times in Canada have led to challenges in accessing timely care. Expanding the scopes of practice of non-physician health professionals may be a solution and has been implemented in Canada and abroad. In 2018, the College of Midwives of Ontario expanded the scope of practice of registered midwives to include obstetric ultrasound imaging. A mixed-methods study was conducted to investigate the interest of midwives in adopting ultrasound imaging in clinical practice and the factors that may influence their interest and support for the professional scope expansion. It investigated midwives' perceived risks, benefits, enablers and barriers in performing ultrasound imaging and the ultrasound examinations or tasks considered most appropriate for them to do. The data were analyzed using qualitative coding and thematic analysis as well as descriptive statistics and regression analysis. It was found that both interest and support were generally high. The interest was found to be highest for limited examinations and tasks with specific clinical indications. Many believed the practice would improve access to care. There were, however, still many questions around remuneration, training, equipment and concerns around potential liability issues.

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List of Abbreviations

AFI	Amniotic fluid index
AOM	Association of Ontario Midwives
BORN	Better Outcomes Registry & Network
BPP	Biophysical profile
ECV	External cephalic version
FHR	Fetal heart rate
IMPP	International Midwifery Pre-registration Program
LHIN	Local Health Integration Network
MW	Midwife/Midwifery
OB	Obstetric/Obstetrics/Obstetrician
OHIP	Ontario Health Insurance Plan
PACS	Picture Archiving and Communication System
PLEA	Prior Learning and Experience Assessment
POCUS	Point-of-Care Ultrasound
RHPA	Regulated Health Professions Act
SOGC	Society of Obstetricians and Gynecologists of Canada
UK	United Kingdom
US or U/S	Ultrasonography/Ultrasound(s)

1. Introduction

1.1 Background

Historically, the Canadian healthcare system has provided funded hospital and physician care primarily for acute and episodic needs (Bergevin et al., 2016; Lewis, 2015; Nelson et al., 2014). The system has remained greatly consistent for decades and is no longer able to meet the needs of Canadians (Bergevin et al., 2016; Nelson et al., 2014; Lewis, 2015; Taylor, 2012; van der Pol, 2010).The single most common cause leading to the unmet needs was found to be the long wait time for services, including consultation, diagnosis and treatment. (Eisen & Björnberg, 2010; Farrell et al., 2008; Sibley & Glazier, 2009; Taylor 2012). Compared to 10 other developed countries, Canadians reported to have greater trouble accessing timely care (Canadian Institute for Health Information [CIHI], 2017). Meanwhile, Canadian non-physician professionals were reported to be less engaged in the delivery of care (CIHI, 2017).

A transformation of the system is called upon by patients (CIHI, 2017) and professionals alike (Bergevin et al., 2016; Nelson et al., 2014; Lewis, 2015; Taylor, 2012). Considering the shortage of physicians in Canada, many have suggested the solution to mobilize existing health human resources with a focus on enhancing roles of non-physician health professionals and expanding their scopes of practice (Nelson et al., 2014; Oelke et al., 2008; Sibley & Glazier, 2009; Taylor, 2012; van der Pol, 2010). Likewise, in the Global Strategy on

Human Resources for Health 2030, the World Health Organization has also recommended utilizing non-physician health professionals, such as nursing staff and midwives, to fuller potentials to alleviate the shortage of health workforce worldwide (World Health Organization [WHO], 2016). This concept has been reviewed and implemented sporadically across Canada (Canadian Institute for Health Information [CIHI], 2011; Maier & Aiken, 2016; Nelson et al., 2014) and abroad (Maier & Aiken, 2016; Ruston, 2008) creating new roles and expanding scopes of practice in some health professions.

In rural and remote Canada where resources and skilled personnel are limited, many general practitioners, registered nurses and nurse practitioners have been cross-trained in multiple disciplines to provide coverage of care in primary, emergency and hospital settings (Miller et al., 2012). In the UK and Australia, new career designations have been created to reduce wait times by identifying discipline-specific, expanded skills and recognizing advanced qualification, competencies, and training (Ruston, 2008). A literature review done by Saxon, Gray & Oprescu in 2014 cited preliminary findings of improved efficiency with reduced wait times and comparable or better patient satisfaction with allied health professionals exercising their expanded skills while more robust data on patient outcomes are still pending.

An example of scope expansion aimed at facilitating access and reducing wait times is inclusion of point-of-care ultrasound (POCUS) in obstetric care. Ultrasound imaging has widely influenced the practice of obstetric care for many years (Demianczuk et al., 1999). Its examination findings often facilitate management decisions around prenatal, perinatal and neonatal medical and surgical plans that can reduce fetal mortality and maternal morbidity and mortality (Demianczuk et al., 1999; Demianczuk & Van den Hof, 2003; Le Ray & Morin, 2009). The diagnostic modality has been increasingly used in assessing women's and fetal health (Chalmers et al., 2008; You et al., 2010). In 2008, the Canadian Perinatal Surveillance System surveyed 6421 women with recent birth in 2007. They reported the usage of ultrasound imaging in nearly all cases (Chalmers et al., 2008). A growing proportion of pregnant women are having more than 3 ultrasound examinations per pregnancy (Chalmers et al., 2008; You et al., 2010). Nevertheless, according to a 2008 statement regarding wait times from the Society of Obstetricians and Gynecologists of Canada (SOGC), despite the fact that timing of obstetric services impacts standard of care and patient outcome, timely obstetric services including ultrasounds may not be available to all pregnant women in Canada (Farrell et al., 2008). The high number of obstetric ultrasounds being performed includes routine and non-routine examinations; some of which could probably have been done at point of care.

As there has not been a single, standardized definition of point-of-care ultrasound (POCUS), definition of Moore & Copel (2011) is adopted in this study and refers to "ultrasounds performed and interpreted by the clinician at the bedside (p. 749)." These ultrasounds tend, but do not have, to be limited and focus on specific clinical questions to facilitate care management.

In Ontario, primary obstetric care can be provided by an obstetrician, a family physician or a midwife (Farrell et al., 2008). While Ontario physicians have historically had the all-inclusive or near all-inclusive authority to perform all controlled acts regulated under the Regulated Health Professions Act, 1991 (RHPA) (Coburn, Torrance & Kaufert, 1983), other health professions such as midwives have had to expand their scopes of practice to be legislatively authorized to perform diagnostic medical ultrasound since it became a regulated form of energy. Until 2018, point-of-care ultrasound was not within the scope of midwifery care in Canada. Considering the high demand for obstetric ultrasounds, it stands to reason POCUS should be included also in midwifery care. In 2018, The College of Midwives of Ontario expanded the scope of midwifery to include ultrasound imaging to improve access to services for Ontarians. To further complicate the matter, there are other known barriers for scope expansion besides legislative authority (Lewis, 2015; Maier & Aiken, 2016; Nelson et al., 2014; Oelke et al., 2008). These barriers exist at multiple levels of the healthcare system, from the economic and educational structures to

individual practices, making it difficult to translate expanded skills and enhanced roles into clinical routine (Nelson et al., 2014).

1.2 Research Questions

Although the scope expansion to include POCUS is a recent change in Ontario, the idea of midwives performing ultrasound imaging is not novel around the world. Midwife-sonographers exist in countries of varied levels of development. However, the extent to which they exercise this skill differs.

In the United Kingdom (UK), obstetric ultrasound imaging is traditionally performed by radiographers, radiologists, and obstetricians. UK midwives have been legislatively and professionally entitled to this scope expansion since 1992 (Edwards, 2009). However, few midwives have adopted the expanded skill in clinical practice (Edwards, 2009). The commonly reported barriers include inadequate educational support due to staffing and funding, professional boundaries, the belief in non-medicalized pregnancy and birth, and the length and difficulty of accredited training programs (Edwards, 2009). The majority of those who do perform ultrasound imaging have taken on the practice for personal advancement and aimed to provide advanced patient care (Edwards, 2009).

In Sweden, obstetric ultrasound imaging is traditionally performed by trained midwives and obstetricians (Åhman et al., 2015). Swedish midwives found the modality valuable in managing and surveilling pregnancies

(Edvardsson et al., 2016). However, it created stress in cases of adverse findings, findings of indeterminate significance, technically difficult cases, and when mutual understandings of the purpose, capacity and limitation of the examinations could not be reached (Edvardsson et al., 2016). The authors of the Swedish study also raised questions as to the effort of widespread normalization of obstetric ultrasound imaging as other indications may have on the number of examinations (Edvardsson et al., 2016).

In Ireland, obstetric ultrasound imaging may be performed by midwife-sonographers, radiographers or obstetricians/fetal medicine specialists with midwife-sonographers performing the second trimester screening at 62% of all obstetric care facilities in 2016 (Hayes-Ryan et al., 2017). However, the types of obstetric ultrasound provided, the protocols employed in the examinations and the eligibility for the examinations, varied (Hayes-Ryan et al., 2017; Lalor, Devane & McParland, 2007). Only about half of the health professionals who provided obstetric ultrasound imaging were actually qualified to do so (Lalor et al., 2007). Both Lalor et al. (2007) and Hayes-Ryan et al. (2017) had indicated that the lack of standardized obstetric ultrasound protocols and regulated training requirements was problematic.

In Japan, obstetric ultrasound may be performed by trained midwives or obstetricians. Similar to the finding in the UK, less than half of the midwives surveyed in 2007 adopted the practice (Kabeyama, 2010). Of the group who

provided the service, 65% considered obstetric ultrasound imaging part of their job (Kabeyama, 2010). They also reported a few benefits of ultrasound imaging, including that it could improve communication with clients, effectively check for growth and abnormalities of fetuses, and promote bonding between the baby and the family (Kabeyama, 2010). The group that did not provide the service reported potential disagreement in diagnoses with obstetricians as a risk and increased workload as a barrier (Kabeyama, 2010).

Currently in Canada, the practice of midwives applying point-of-care ultrasound has not been well researched nor documented in the literature. The primary objective of this study is to investigate the support of Ontario midwives for this new scope expansion and their interest in adopting ultrasound imaging in their clinical practice. The secondary objective is to identify contextual or demographic factors that influence Ontario midwives in their support and their interest. The study also examines perceived risks and benefits and potential barriers and enablers of clinical scope expansion to include ultrasound imaging, and the particular ultrasound examinations or tasks most appropriate for midwifery practice. This original research is the first of its kind in Canada. I hope to expose current issues related to the introduction of ultrasound imaging into midwifery scope of practice in order to advise policy efforts, curriculum development and areas for further research.

2. Methodology

2.1 Study Design

An exploratory mixed-methods design was chosen since little research has been done on this topic, and there is value in studying both subjective and objective data that promote understanding of the context in which midwives work (McCusker & Gunaydin, 2015). Mixed methodology combines different methods enabling triangulation of findings contributing to rigor and trustworthiness (Mertens & Hesse-Biber, 2012; Thurmond, 2001). This approach aligns well with pragmatism which appreciates the relationship between ideas and practice and values the importance of contextual influences (McCusker & Gunaydin, 2015).

The survey questions were broadly divided into two sections (see Appendix 1). The first section asked about professional demographics, including years of experience, age, route of entry into the profession, patient population size, Local Health Integration Network (LHIN) of service area, and setting of practice, general support for the scope expansion and personal interest in clinical adoption of ultrasound imaging. Note that during the time of study design and data collection, the LHIN structure was still in place in Ontario and familiar to the participants of the study. The framework of Statistics Canada was adopted for the measurement of patient population size in area of service (Statistics Canada, 2011). A small center was defined to have a population of

less than 30,000, a medium center between 30,000 to 100,000, and a large center more than 100,000 (Statistics Canada, 2011). These definitions were explained to participants in the survey. Participants were also asked about their support for the scope expansion to include ultrasound imaging and their personal interest to adopt the skill in clinical practice with the options of answering yes, no, or unsure.

The second section of the survey asked about perceptions of midwives, including the general beliefs, the perceived benefits, risks, enablers and barriers regarding ultrasound imaging itself and/or the scope expansion to include it. In regard to the general beliefs about ultrasound imaging and/or the scope expansion, participants were asked to grade on a 5-point Likert Scale, their agreement or disagreement with each statement. Participants then ranked 5 items within the benefit group and 7 items in the risk group for their likelihood, and 6 items in the enabler group and 8 items in the barrier group for their importance.

Between the two sections, qualitative data were collected from 10 separate areas where the option of free-text answer was available.

The theoretical framework of Nelson et al. (2014) for optimal scopes of practice within collaborative care arrangements was used to organize and understand the data.

2.2 Recruitment and Participants

This study was designed as a census survey. The sample population and the target population were the same population. The only inclusion criterion required the participants to be registered midwives in the province of Ontario. Midwives who were not registered in the province of Ontario were excluded from the study. The aim was to try to reach as many registered Ontario midwives as possible. This included 749 registered midwives in Ontario at the time of data collection. Survey invitations and reminders were circulated through the Association of Ontario Midwives member weekly memo, email networks of the McMaster Midwifery Research Center and the preceptor group of McMaster Midwifery Education Program to reach all registered midwives in Ontario. Social media (Facebook and Twitter pages of Association of Ontario Midwives) were also utilized to promote survey visibility and participation. At the beginning of the survey, participants were asked to self-identify as a registered midwife in Ontario to proceed with participation.

2.3 Data Collection

A literature review was conducted to inform the survey questions. Health databases of CINAHL, EMBASE and PubMed were searched using combined keywords relevant or equivalent to “midwife” (or midwives or midwifery), “providing” (or practicing), and “ultrasound” (or sonography, ultrasonography or sonogram). The literature review was intended to be informative and not

exhaustive. Only literature from countries or regions where midwifery has been regulated and where ultrasound imaging has been routinely provided by midwives was included in the review. This restriction was intended to reduce variation across healthcare systems and standards of practice to promote transferability to the Canadian context. Based on experiences of these midwives, a survey was formulated (see Appendix 1).

Upon receiving ethical approval, this survey was launched on REDCap, a secure, web-based data capturing system, in the Department of Obstetrics and Gynecology, McMaster University. Two practicing Ontario midwives volunteered to test-run the survey to provide feedback and determine face validity of the questions. The survey was opened from September 10, 2018 to December 14, 2018 and data was collected during this period. Electronic consent was used at the beginning of the survey. Consent was implied with completion of the questions. The survey was anonymous, no personal identifiers such as name, email or IP address were collected. Information collected is stored with password protection on McMaster REDCap server and used solely for the purpose of scholarly research. The data are intended to be kept for a period of two years.

2.4 Data Analysis

Microsoft Excel was used to prepare professional demographic data for descriptive statistics. The Better Outcomes Registry & Network (2013)

framework for grouping of LHINs was adopted in data analysis to facilitate understanding. The 14 LHINs were grouped into 5 regions (Better Outcomes Registry & Network [BORN], 2013). These included ESC-SW (Erie St. Clair and South West), WW-HNHB (Waterloo Wellington and Hamilton Niagara Haldimand Brant), GTA (Central West, Mississauga Halton, Toronto Central, Central, and Central East), SEC (South East and Champlain), and North (North Simcoe-Muskoka, North East, and North West) regions (BORN, 2013). For the reporting purpose of the study, the general beliefs indicated on the 5-point Likert Scale, answers agree and strongly agree were grouped together; answer neutral stood alone; answers disagree and strongly disagree were grouped together. The enabler, barrier, risk and benefit were reported based on the percentage of participants ranking the particular item as the most likely or the most important.

IBM SPSS was used to perform logistic regression analysis on the two measurements: a) the support for the scope expansion to include ultrasound imaging and b) the personal interest in conducting ultrasound imaging in clinical practice. Because the support and the interest were both generally high, the answers to these two questions were coded into binary outcomes: the yes and the non-yes which includes answers no and unsure. The following variables were identified as potential predictors of the aforementioned outcome measures: years of experience (less than 5 years, between 5 to 10 years, or greater than 10 years of experience), age (between 20 to 29, 30 to 39, 40 to 49, 50 to 59, or

greater than 60 years of age), route of entry into the profession (Michener Pre-legislation Program, Prior Learning and Experience Assessment [PLEA], Midwifery Education Program, or International Midwifery Pre-registration Program [IMPP]), patient population size (small centers, medium centers, large centers, or varied weekly or monthly), LHIN region of service area (ESC-SW, WW-HNHB, GTA, SEC, North region, or others), and setting of practice (solo, group, or alternate practice arrangement). Note that the option others under the LHIN category included midwives who worked in more than one LHIN regions and those who did not answer the question. Multinomial logistic regression in SPSS was employed to calculate the relative risks. Both the p-values and the 95% confidence intervals were considered to determine the statistical significance.

The free-text responses were qualitatively analyzed by AL and AM with parallel coding for consistency in approach and to enhance trustworthiness. Manual coding was done to identify thematic patterns. A reflective journal was kept by AL as an audit trail to document the decision-making process and bracket personal biases to be consistent with qualitative research approaches (Mays & Pope, 2000).

2.5 Ethics

Ethical approval was obtained from the Hamilton Integrated Research Ethics Board (Reference: 2018-4393-GRA). There were no anticipated risks to

participants of this study. Participation was voluntary. Recipients of the questionnaire could choose not to participate or withdraw at any time of the research.

3. Results

3.1 Descriptive Statistics

At survey closure, a total of 245 entries were collected. Of these, 218 were valid entries completed by registered Ontario midwives, and these included 134 complete entries and 84 incomplete entries. Of the 218 valid entries, all participants completed the professional demographics section of the questions. The complete information can be found in Table 1. There was 1 missing value for the question patient population size. There were participants who reported working in more than one LHIN regions and participants who did not answer this question resulting in the total number of responses summing up to 221 instead of 218 for this demographic characteristic. Some demographic groups are known to have smaller sizes. These include those who were aged over 60 years, entered the profession through the Michener Pre-legislative or Prior Learning and Experience Assessment (PLEA) route, those who served varying-size population centers and midwives who worked at a solo or alternative practice. Overall, all groups, except the solo practice group, were represented by some, if not more, registered midwives.

Table 1. Demographic Characteristics of Respondents

Demographic Characteristics	n	%
Years of Experience		
0 to < 5 years	81	37%
5 to < 10 years	56	26%
> 10 years	81	37%
Age		
20-29	39	18%
30-39	77	35%
40-49	67	31%
50-59	27	12%
60+	8	4%
Route of Entry		
Michener Pre-legislation	3	1%
PLEA	10	5%
Midwifery Education	188	86%
IMPP	17	8%
Patient Population Size		
Small	24	11%
Medium	48	22%
Large	140	64%
Varies	5	2%
Missing Value	1	0%
LHIN		
ESC-SW	45	20%
WW-HNHB	80	36%
GTA	57	26%
SEC	20	9%
North	19	9%
* Multiple selections were allowed		
Setting of Practice		
Solo	0	0%
Group	214	98%
Alternate	4	2%
Total	218	

By professional demographics, the distributions of participants who supported the scope expansion and those who were personally interested in performing ultrasounds are shown in Table 2. Overall, the support for the scope expansion and the personal interest in ultrasound imaging were both high among midwives of all groups, at rates of 50% or higher. The two measurements, however, did not correspond exactly with each other. In most of the groups, the support for the scope expansion was generally higher than or equal to the personal interest. The exceptions included the respondents with 5 to 10 years of experience, at 30 to 39 years of age, or entered the profession through the IMPP route. The overall level of support for the scope expansion was lowest in the IMPP group. There was also a trend of decreasing personal interest with increased age. Respondents aged 60 years or above reported the lowest overall level of personal interest in doing ultrasound imaging.

Table 2. Support for Scope Expansion and Personal Interest in Ultrasound Imaging by Demographic Characteristics

Demographic Characteristics	Scope Expansion n (%)	Personal Interest n (%)
Years of Experience		
0 to < 5 years	72 (89%)	72 (89%)
5 to < 10 years	44 (79%)	47 (84%)
> 10 years	70 (86%)	63 (78%)
Age		
20-29	36 (92%)	35 (90%)
30-39	65 (84%)	66 (86%)
40-49	57 (85%)	56 (84%)
50-59	21 (78%)	21 (78%)
60+	7 (88%)	4 (50%)
Route of Entry		
Michener Pre-legislation	3 (100%)	3 (100%)
PLEA	8 (80%)	8 (80%)
Midwifery Education	163 (87%)	158 (84%)
IMPP	12 (71%)	13 (76%)
Patient Population Size		
Small	22 (92%)	22 (92%)
Medium	38 (79%)	38 (79%)
Large	121 (86%)	117 (84%)
Varies	4 (80%)	4 (80%)
Missing Value	1 (n/a)	1 (n/a)
LHIN		
ESC-SW	34 (76%)	34 (76%)
WW-HNHB	69 (86%)	68 (85%)
GTA	50 (88%)	49 (86%)
SEC	18 (90%)	18 (90%)
North	17 (89%)	15 (79%)
*Multiple selections were allowed		
Setting of Practice		
Solo	0 (n/a)	0 (n/a)
Group	183 (86%)	179 (84%)
Alternate	3 (75%)	3 (75%)

A total of 202 participants answered the question on general beliefs regarding ultrasound imaging and/or the scope expansion to include it. The distribution of agreement and disagreement for each statement can be found in Figure 1. Most of these midwives acknowledged the benefits (comprehensive care, self-advancement, and reduced anxiety and cost for patients) and risks (workload and potential medico-legal issues) of the scope expansion, the advantage of ultrasound imaging technology (real-time monitoring), and the need for investment in training and certification (time, money and/or energy). The opinions were less uniformed around the scope expansion as a potential source of extra income, current practice as a barrier, and improved confidence in ultrasound findings. Most of these 202 midwives did not see ultrasound imaging as against the value or belief of natural pregnancy and birth.

Figure 1. Respondents Beliefs Regarding the Potential Impact of Midwifery Scope Expansion to Include Ultrasound Imaging

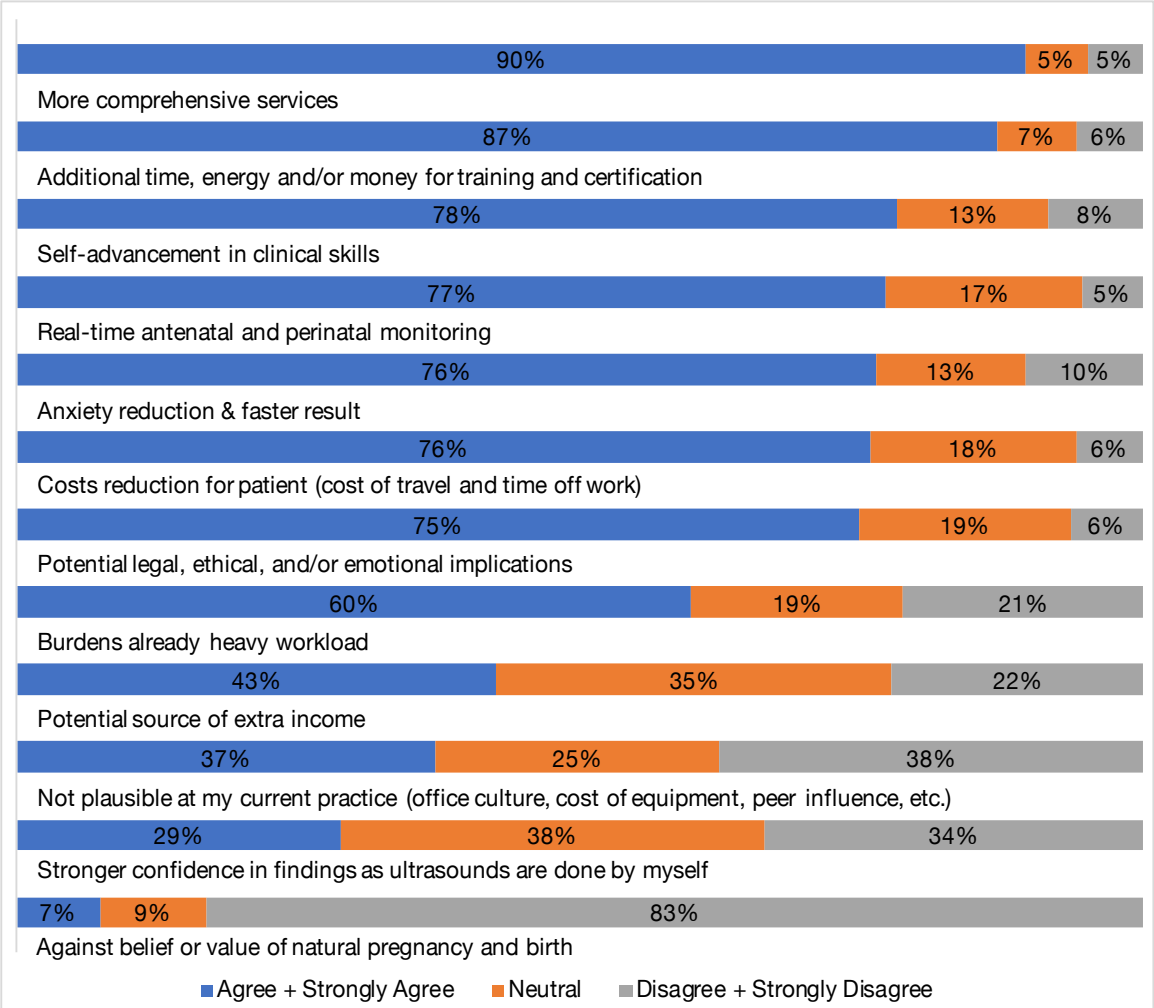

Table 3. reports the most likely enabler and barrier as well as the most important benefit and risk of the scope expansion to include ultrasound imaging in clinical practice. The degree of completion for each question ranged from 135 to 182 participants. There seemed to be stronger agreement on what the most likely enabler and most important benefit would be than on the barrier and the risk. The latter two groups had multiple competing items with similar votes.

Table 3. Most Likely Benefit and Risk as well as Most Important Enabler and Barrier Identified by Respondents

Benefit	**Risk**
Improved accessibility of healthcare services (52.4%)	Potential legal and/or ethical issues in cases of inconclusive, abnormal, or findings of undetermined significance (36.3%) Inconsistent quality of imaging and documentation among midwives who apply ultrasounds (31.0%)
Formalized expanded scope by College of Midwives of Ontario to include obstetric ultrasound imaging (45.0%)	Expense of technological installation and maintenance (22.1%) Lack of OHIP reimbursement (19.9%)
Enabler	**Barrier**

Table 4. shows the top 5 ultrasound examinations or tasks selected by 136 participants as being of interest to them personally or as being appropriate for midwives to perform. They were allowed to select as many items as they wished. Although not explicitly differentiated in the survey, by convention of radiology practices, more comprehensive imaging studies such as first trimester ultrasounds for dating or viability were considered full ultrasound examinations. Other solitary measures such as fetal heart rate or placental location were considered discrete ultrasound tasks in this study. The findings indicated that participating midwives were more interested in limited examinations or tasks for specific clinical indications than in routine screening ultrasounds.

Table 4. The top 5 Ultrasound Examinations/Tasks Identified by Respondents to be of Interest or Appropriate for Midwifery

Examinations or Tasks	n (%)
Fetal position and presentation	128 (94.1%)
Fetal heart rate detection	118 (86.8%)
First trimester ultrasound of threatened abortion for viability or such of incomplete abortion for retained product of conception	108 (79.4%)
Placental location	91 (66.9%)
First trimester dating ultrasound of uncertain last menstrual period	74 (54.4%)

3.2 Regression Analysis

Of the 218 valid survey entries, 217 were included in the regression analysis. One entry was automatically omitted by SPSS due to the one missing value in population size. Data were analyzed using SPSS multinomial regression to evaluate if any professional demographic variables were significantly associated with support for scope expansion or personal interest in adopting ultrasound imaging in clinical practice. Table 5 and Table 6 show the relative risk and the p value of each variable for the two measurements. The wide confidence intervals were likely attributed to the small sample size in some of the subgroups. Findings revealed no evidence of statistically significant association between years of experience, age, route of entry into the profession, patient population size, LHIN region of service area, or setting of practice with either of the two measurements. These are considered null findings and are therefore informative. With regard to scope expansion, although the Michener Pre-legislation group showed the highest rate of support for the scope expansion, and the IMPP group showed the lowest in descriptive statistics, their associations, positive and negative respectively, with the outcome measurement were insignificant. Personal interest was identified as the only variable that was significant to the support of the scope expansion and showed a positive relationship.

Table 5. Regression Analysis Examining the Association between Respondent Characteristics and Support for Scope Expansion

Demographic Characteristics	Rate of Respondents Supporting Scope Expansion N=185 n(%)	Relative Risk (95% Confidence Interval)	p Value
Personal Interest			
Yes	174 (94.1%)	142.1 (32.1, 629.6)	0.00
Non-yes	11 (5.9%)	* a	*
Years of Experience			
0 to < 5 years	71 (38.4%)	*	*
5 to < 10 years	44 (23.8%)	0.7 (0.1, 3.9)	0.67
> 10 years	70 (37.8%)	4.3 (0.5, 36.5)	0.18
Age			
20 - 29	36 (19.5%)	*	*
30 - 39	64 (34.6%)	0.2 (0.0, 2.6)	0.25
40 - 49	57 (30.8%)	0.2 (0.0, 2.6)	0.21
50 - 59	21 (11.4%)	0.1 (0.0, 2.8)	0.19
60 +	7 (3.8%)	2.8 (0.1, 135.0)	0.60
Route of Entry			
Michener Pre-legislation	3 (1.6%)	5960432.3	n/a
PLEA	8 (4.3%)	0.3 (0.0, 3.8)	0.32
Midwifery Education	162 (87.6%)	*	*
IMPP	12 (6.5%)	0.4 (0.0, 3.7)	0.42
Patient Population Size			
Small	22 (11.9%)	1.6 (0.1, 16.8)	0.71
Medium	38 (20.5%)	0.8 (0.2, 3.5)	0.79
Large	121 (65.4%)	*	*
Varies	4 (2.2%)	1.831 (0.0, 143.9)	0.79
LHIN			
ESC-SW	34 (18.4%)	0.4 (0.1, 2.6)	0.34
WW-HNHB	67 (36.2%)	1.4 (0.3, 7.5)	0.68
GTA	48 (25.9%)	*	*
SEC	16 (8.6%)	1.0 (0.1, 11.6)	0.97
North	16 (8.6%)	1.9 (0.2, 24.1)	0.61
Others	4 (2.2%)	1.1 (0.0, 157.2)	0.98
Setting of Practice			
Solo	0 (0%)	n/a	n/a
Group	182 (98.4%)	*	*
Alternate	3 (1.6%)	0.5 (0.0, 16.9)	0.68

a. * indicates reference group

With regard to personal interest, the Michener Pre-legislation group showed the highest rate of personal interest and a positive association with the measurement. The group aged 60 years or older showed the lowest rate and a negative association. Their associations with the outcome measurement were however insignificant. The support for the scope expansion was identified as the only variable that was significant to the personal interest in adopting ultrasound imaging and showed a positive relationship.

Based on the regression analysis, it was found that a) support for the scope expansion and b) personal interest in applying ultrasounds were the single most predictive factors of each other. When other demographic factors were also considered, the two variables did not correspond exactly.

Table 6. Regression Analysis Examining the Association between Respondent Characteristics and Personal Interest

Demographic Characteristics	Rate of Respondents with Personal Interest N=181 n(%)	Relative Risk (95% Confidence Interval)	p Value
Support for Expansion			
Yes	175 (96.7%)	132.6 (30.8, 571.6)	0.00
Non-yes	7 (3.9%)	* a	*
Years of Experience			
0 to < 5 years	71 (39.2%)	*	*
5 to < 10 years	47 (26.0%)	1.3 (0.2, 8.2)	0.79
> 10 years	63 (34.8%)	0.2 (0.0, 1.5)	0.11
Age			
20 - 29	35 (19.3%)	*	*
30 - 39	65 (35.9%)	2.3 (0.2, 22.1)	0.46
40 - 49	56 (30.9%)	2.1 (0.2, 25.7)	0.56
50 - 59	21 (11.6%)	1.8 (0.1, 35.6)	0.71
60 +	4 (2.2%)	0.2 (0.0, 4.5)	0.28
Route of Entry			
Michener Pre-legislation	3 (1.7%)	1.51E+08	n/a
PLEA	8 (4.4%)	11.7 (0.4, 378.8)	0.17
Midwifery Education	157 (86.7%)	*	*
IMPP	13 (7.2%)	1.6 (0.3, 9.6)	0.63
Patient Population Size			
Small	22 (12.2%)	4.8 (0.3, 67.1)	0.25
Medium	38 (21.0%)	1.3 (0.3, 5.1)	0.74
Large	117 (64.6%)	*	*
Varies	4 (2.2%)	0.5 (0.0, 40.1)	0.76
LHIN			
ESC-SW	34 (18.7%)	0.6 (0.1, 4.4)	0.65
WW-HNHB	66 (36.3%)	0.8 (0.2, 3.9)	0.79
GTA	47 (25.8%)	*	*
SEC	17 (9.3%)	1.2 (0.1, 20.3)	0.88
North	14 (7.7%)	0.4 (0.0, 4.2)	0.46
Others	4 (2.2%)	0.5 (0.0, 18.7)	0.70
Setting of Practice			
Solo	0 (0.0%)	n/a	n/a
Group	178 (98.3%)	*	*
Alternate	3 (1.7%)	0.6 (0.0, 54.1)	0.82

a. * indicates reference group

3.3 Qualitative Analysis

Qualitative data from the study composed of 135 entries of free-text answers provided by 76 participants. These answers were coded and organized. Four themes, twelve categories and eleven sub-categories emerged. These are summarized in Table 7

Table 7. Themes, Categories and Sub-categories from Qualitative Data

Themes	Categories	Subcategories
Community-based Demand	Improving Access	Rural/remote
		Amish/Mennonite
		Uninsured/unfunded
	No Immediate Need	Communities with access
System Burden Relief	Cost saving	
	Reducing unnecessary use of Radiology	
Comprehensive Care	Patient Care Management	Continuity of care
		Timely diagnoses
		Clinical decision-making
		Anxiety reduction
	Midwife Professional Identity	Self-sufficiency
		Professional image
		Clinical and ultrasound skills competition
Interest and Feasibility	Examination types	
	Caseload compared to ultrasound volume	
	Remuneration	
	Training and Competency	
	Equipment and Maintenance	
	Liability	

Community-based Demand:

From the qualitative data, it was found that the patient demand for midwives providing POCUS was community- or population-based. Some communities/populations experienced greater need, and some lesser. Therefore, the interest of a midwife in POCUS might not be completely personal, rather also professional. Specifically, two types of communities, thus two categories, were distinguished from each other in this theme: the ones that would benefit more from midwives providing ultrasound services due to improved access and the ones that did not have immediate need for the scope expansion due to existing readily-available ultrasound services. Three individual groups were further identified under the first category: rural/remote communities, Amish/Mennonite populations, and uninsured/unfunded clients. These were the groups with more barriers in accessing care mostly due to the timely availability of ultrasound services, the out-of-pocket cost for service and/or the implicit costs of commute and lost income to ultrasound appointments, etc. One supportive statement included:

> *We serve a large Amish population who declines u/s due to costs. Offering u/s as part of our scope of practice might help address this issue. Also, in our small community it is sometimes very inconvenient to access u/s as technicians are not in-house around the clock.*

Another participant described their work with uninsured patients:

> *This is something we are very interested in doing as our practice group cares for a large population of uninsured clients. It would*

significantly reduce costs for self-pay clients who do not access the uninsured funding from the AOM.

Participating midwives working in the second type of communities reported having less trouble accessing ultrasound services at radiology practices and did not feel the scope expansion would be as valuable in their communities as it would in others. One said:

Not sure if there would be much value in my community, where clinic and hospital US are fairly readily available […]

Nevertheless, some of these participants still supported the new midwifery scope expansion for other communities that may have stronger need for midwives providing ultrasound services than their own. For example, one midwife commented:

Though I don't think MW US would have much utility in my community, I strongly support expanding the scope of practice to include [POCUS] mainly because of [its] potential value in communities where access to US generally is more limited […]

This might explain why many demographic groups had higher support for the scope expansion than personal interest in adopting POCUS in clinical practice.

<u>System Burden Relief:</u>

For the purpose of the study, burden was not only defined in the financial terms but also in terms of human capitals as well as other resources. Considering the Ontario healthcare system as one unit, in which healthcare

providers collaborate and co-depend on each other to deliver health care to the entire patient population, relief to the system may come in the form of cost saving to health expenditure (such as in staffing of imaging specialists or running of an imaging program), and avoiding unnecessary trips to radiology practices (where non-obstetric patients also access care) if midwives are to provide POCUS.

The following quotes from participating midwives discussed the two forms of relief respectively.

> *[…] I think it would save health care dollars as midwives may be willing to do limited examinations, which I assume could be done quickly, and therefore the fee for the examination could be less.*
> *[*It would] [decrease] burden on our fetal assessment unit[.] [*There is] difficulty in our community [*to] book u/s fast enough.*

As there was no clear boundary between the two forms of relief, one midwife mentioned both ideas in the following statement:

> *[*It would help] [avoid] unnecessary trips to hospital with associated cost to the system for things like dating ultrasounds and positional U/S.*

One participating midwife provided an alternative view on the subject and expressed the concern that midwives who are incompetent or unconfident in their ultrasound skills might actually increase the system burden and lead to extra resources invested to rectify their cases. This concern coincides with the risk of having disagreements in diagnoses with imaging specialists.

*[*There is a] [risk] of doubling the burden on the healthcare system if midwives aren't trained well/confident in skills [i.e. If] something is [incidentally] seen and then the client gets sent to higher level US to rule out result.*

Comprehensive Care:

In the technical and conventional sense, the term comprehensive care was often used to mean the variety of services that midwives could provide. Nevertheless, it was found in the context of midwives providing POCUS that it could entail also how the expanded skill might fit into the clinical work as well as the professional identity of midwives to be an integral component. It spoke of not only what they could do and how they would do things, but also who they were. This theme has two categories. The first category is patient care management. It addresses how this scope expansion may impact the workflow and benefit the clients, and sometimes also the midwives. Many midwives reported that ultrasound skills might enable them to provide more comprehensive care by enabling continuity of care, facilitating clinical decision-making, and reducing anxiety with timely diagnoses.

The most frequently cited example for continuity of care was the application of ultrasound imaging in the care of first trimester loss and pregnancy termination, in which ultrasound imaging would be useful for dating, assessing viability, and ensuring process completion. The following provides an example of this perspective:

> *Helping to close the massive gaps in abortion support and care is one of the biggest reasons I would be interested in this. Conducting follow up ultrasounds to confirm passage of products of conception or confirm no FHR for example. I hate sending clients out into a terrible care system filled with insensitive providers for miscarriage care.*

In addition to continuity of care, many midwives believed point-of-care ultrasound would enable 1) timely diagnoses that could 2) facilitate clinical decisions and 3) reduce anxiety. These qualities of POCUS seemed to benefit both the midwife and the client. They were coded into three subcategories that represented interrelated yet distinctive ideas. A few participants cited how the new expanded skill might fit into and be of assistance in their clinical workflow. One participant said:

> *[*Ultrasound provides] timely results to help guide care management [,] less stress for clients and midwives [,] less (unnecessary) reliance on other [healthcare] providers.*

Another participant shared a personal experience:

> *[Minimizing] client anxiety and time delay in assessment is the biggest benefit [.] [Another] benefit is in care management. I have gone home and fretted about a breech only to find out it was vertex, etc. […]*

The timely diagnosis might also provide additional benefits to patients. As one participant commented:

> *I think if midwives could provide ultrasounds it would improve continuity and save clients time (booking u/s appointments, taking time off work and commuting to u/s appointments) and the stress of having to wait for the u/s results; they would know right away […]*

The second category of this theme is the midwife professional identity. It addresses how the scope expansion might impact the midwife profession. Under this category, there are three subcategories: self-sufficiency, professional image, and clinical and ultrasound skills competition. Many midwives reported that competency in POCUS could help them become more self-sufficient so that they would not have to rely on other health professionals to perform it nor to negotiate with their disciplinary protocols. One midwife explained the issue in the context of managing post-term pregnancies:

> *[…] Currently in my community, US [laboratories] refuse to assess amniotic fluid volume past [41weeks 3 days]. So, our only option is to have it done by an OB resident who believes (that) the community standard to induce at [41 weeks 3 days] at the latest is supported by evidence and going past [41 weeks 3 days] is dangerous [...]*

Another midwife discussed the issue in the context of making ultrasound referral to answer specific clinical question.

> *[…] In my experience, [third trimester] US to confirm presentation often leads to other concerns being identified as we are unable to get an US that confirms presentation only […]*

In both cases mentioned above, patient decisions were sometimes affected while care plans were altered as a result of added professional opinions from these imaging specialists.

Although no open conflicts with other health professionals were evident in the free-text answers, there was a general sense that midwives might become more self-sufficient with the new scope expansion. As one midwife said:

> *Being able to offer this service as part of an assessment would be so useful as we wouldn't be dependent of hospital staff and resources thus improving patient care.*

Some midwives felt that the scope expansion could improve professional image or reputation relative to other primary obstetric care providers who have been providing the service or have had this skill under their scopes of practice.

> *[…] By expanding our skills and scope to better match other OB [healthcare] providers, as well as meet the expectations of what clients expect from their appointments, I hope we can enhance credibility of midwives in Ontario.*

While the change in professional image could be generally positive, a few worried that if midwives were established as ultrasound imaging providers, some clients might expect the procedure whether clinically warranted or not.

> *Client [*may] [expect] midwives to provide ultrasounds in situations where midwives may prefer not to […] There may be an expectation that if we are providing ultrasounds in some situations, we should provide them in all situations.*

Meanwhile, several midwives expressed the concern regarding potentially losing traditional clinical skills such as the skill of palpation to the convenience of the imaging technology. That is, the new expanded skill of ultrasound might compete with the clinical skill of palpation. One midwife explained:

*[…] Palpation skills of midwives [*may] [deteriorate] over time as it is easier to do a quick scan than to develop excellent palpation skills.*

Interest and Feasibility:

The fourth theme that emerged from the qualitative data was the interest and feasibility theme. This theme addresses the fact that the high interest may not be supported by equally high feasibility to implement the new scope in clinical practice. Several factors were identified by participating midwives as being influential in determining the feasibility and thus their support for the scope expansion and their personal interest in doing ultrasounds. These factors included examination types, midwifery caseload compared to ultrasound volume, remuneration, training and competency, equipment and maintenance, and liability. Each stood as a distinct category that was worth mentioning and discussing.

Examination types refer to the particular ultrasound examinations or tasks that midwives are interested in conducting thus are likely to conduct. Most midwives expressed interest only in limited ultrasound examinations and tasks for specific clinical indications.

I would only be interested in using POCUS for specific clinical questions or indications - presentation, FHR assessments in early pregnancy, etc. Assessments requiring further details and information (measurements, placental location, BPP, etc.) would be better left to technicians and radiologists.

Only a few midwives were interested in a full ultrasound skill expansion that would include routine screening ultrasounds.

> *I am open to any ultrasound exam in pregnancy and would also add postpartum scan for potential retained products of conception.*

Finding the fine balance between existing caseload and ultrasound volume could also be a delicate task as the two compete for time and energy of midwives to provide the services and develop the skills. As one midwife expressed:

> *I think it's asking a lot to add into practice when the schedule is already straining and filled […]*

Remuneration refers to the financial compensation that midwives may receive for performing ultrasounds. Most midwives would like the service to be compensated. An example can be seen in the following quote.

> *I would only offer this if it provided additional income stream. [*I am] not interested in more work with no income added.*

Various remuneration schemes were proposed. Some would like an increased pay with reduced caseload if they were to provide POCUS to clients. One example can be found in the following quote:

> *[…] I could envision larger practices having one or two midwives with this skill who work a reduced caseload and augment their income by providing limited US services to the clients of the practice […]*

Some suggested financial compensation in the form of training and/or equipment funding. As one midwife mentioned:

> *Funding for training and equipment is the most important to me.*

Some preferred an increase in overall pay without billing OHIP for a fee per service. As can be seen in the quote below:

> *I would see us providing ultrasound as part of our course of care (at increased pay overall) similar to ECVs.*

Some felt remuneration was not required if they were only to provide limited ultrasound examinations as an integral part of midwifery care. They related POCUS to an element of comprehensive care. As one participant said:

> *For the scope of POCUS, I would prefer brief bedside US, not detailed scan, I don't believe financial remuneration is necessary, as it would be another part to our routine care.*

One midwife expressed similar thought and felt that all midwifery services should continue to be free to all clients.

> *Having OHIP reimbursement sounds great for practices that have [OHIP] clients, but I feel strongly that midwifery care should continue to be free for everyone. Once we start asking clients to pay out of pocket for certain aspects of care that midwives do, it gets messy, burdens the relationship and results in poorer care [...]*

The training and competency refer to the requirements to attain competency in the new skill and the investments to ensure volume of ultrasound cases to maintain competency. Together, they seemed to play a role in determining midwives' interest in adopting ultrasound imaging. Many midwives felt it would be a huge undertaking to become proficient in ultrasound skill. As one participant commented:

> *It would be helpful in offering; however, it seems like large commitment for training […]*

The comment below also seemed to indicate that there needed to be an ongoing incentive to sustain a lasting interest and maintain proficiency in the ultrasound skill.

> *My [workload] is great, this new skill would need to be billable to be sustainable. Volume should be there to be able to [bill the service] and maintain skills […]*

Equipment and maintenance refer mainly to the costs to acquire, install and service ultrasound machines and sometimes also the archiving system. Similar to the continuing nature of training requirements, keeping a functional machine requires ongoing maintenance and calibration in addition to the initial acquisition cost. Many midwives expressed concerns regarding the cost as well as other technical issues related to using the imaging technology. One participant explained all these factors in a quote:

> *The biggest barrier will be how to store the images, affording and maintaining equipment and getting the training. We already have a [hand-held] unit given to us by our [Maternal-Fetal Medicine] specialist and use it for position, but we don't [store images], etc. Big cost.*

Liability category addresses the extra responsibility and risk of medico-legal disputes arisen from providing obstetric POCUS. POCUS differs from regular ultrasound imaging in that interpretation and clinical decisions are made at point of care by the healthcare providers who perform the procedure as opposed to separately by healthcare providers who specialize in imaging,

diagnosing, and/or caring. Many midwives felt that the multiplication of roles associated with doing POCUS would likely contract greater responsibilities and increased risks of liability issues. As one midwife commented:

> *[…] I feel like doing BPPs, anatomy scans would add extra pressure on [*the] midwife if [*there is a] bad outcome and not a formal [ultrasound] report from radiology.*

4. Discussion

4.1 Community-based Needs

Despite the growing availability of midwifery services, the shortage of obstetric care professionals remains a challenge to accessing timely obstetric care (Sutherns & Bourgeault, 2008). In a 2008 statement on wait times, the SOGC expressed concern related to long wait times that delay access to services and impact Canadian women's health (Farrell et al., 2008). The shortage has been more evident in rural and remote Canada (Peterson et al., 2007; Sutherns, 2004; Sutherns & Bourgeault, 2008). Lack of obstetric care, allied health and auxiliary personnel and resources has directly affected the sustainability of maternity services and programs forcing patients to travel long distances to larger centers for both routine and emergency services (Dooley et al., 2009; Miller et al., 2012, Sutherns & Bourgeault, 2008).

Results from this study indicate that the need for the new midwifery scope expansion depends on the ease of access to ultrasound imaging in each community or population. Specifically, smaller rural/remote and Amish/Mennonite communities and uninsured/unfunded pregnant people have been identified as the likely beneficiaries of the scope expansion. The survey in this study did not ask about the specific communities or populations that participating midwives were serving. Yet, since rural/remote and Amish/Mennonite communities tend to be smaller, and participants serving

smaller communities showed the highest rates of support and interest compared to their peers serving areas of medium or large population sizes, findings from this study seem to support the literature. With midwives providing ultrasound imaging to these identified groups of patients, it is hoped that their access to care and wait times to obstetric ultrasounds will improve.

4.2 System Burden Relief

Midwifery care has long been considered a cost-effective alternative to physician-led obstetric care, and this has contributed to the regulation of the profession in multiple provinces in Canada (Benoit et al., 2005). While data are still lacking in Ontario, cost analyses from Alberta (O'Brien et al., 2010) and British Columbia (Janssen, Mitton & Aghajanian, 2015) support cost efficiency of midwifery care for low-risk pregnancy in those respective provinces. As the remuneration scheme and clinical uptake of ultrasound imaging skill is not yet clear in Ontario, the extent of the economic impact on the healthcare system by midwives providing POCUS cannot be estimated for the time being. Future research in this area is required.

4.3 Comprehensive Care

4.3.1 Patient Care Management

Several midwives mentioned about using their new ultrasound skill in the abortion care. Abortion care is another area of service that has shown disparity in access in Ontario (Norman et al., 2016). Midwifery scope expansion to include

abortion care has been examined and is considered a strategy to address this barrier (Norman et al., 2016). By standard, abortions in Canada are currently provided by physicians (Norman et al., 2016). Clients under midwifery care often have to go through several health professionals, who are not familiar with the clients and provide only part of care, to conclude the abortion process. Continuity of care and informed choice are philosophical tenets of Canadian midwifery care. Although data on abortion provider preference are predominantly absent in Canada, supporting continuity of care honors patients' decisions and choices of care.

Besides continuity of care, there are also other advantages of employing ultrasound imaging in obstetric care. Swedish and Australian midwives who performed ultrasound imaging found it to be valuable in the management and surveillance of pregnancy and desired by pregnant people. (Edvardsson et al., 2015; Edvardsson et al.,2016). Although the midwifery scope expansion to include ultrasound imaging is still new, the majority of the participating midwives in the study anticipated that readily available ultrasound could reduce client anxiety and facilitate care management with real-time results. These findings are limited to the perceptions of care providers, however, a study from the United Kingdom has investigated patient perspectives (Lumsden et al., 2018). The authors studied diagnostic ultrasound as an expanded scope in physiotherapy (Lumsden et al., 2018). They found that when the examination findings were

discussed immediately as a part of care plan, the majority of patients believed they better understood their clinical problem, felt reassured, and believed they were better able to manage it (Lumsden et al., 2018). Based on these findings and literature review, it is believed that the inclusion of POCUS in midwifery care may be welcomed similarly by midwifery clients in Ontario.

4.3.2 Midwife Professional Identity

Earlier in the discussion regarding the community-based need, it was realized that the high support for the scope expansion and the high interest in ultrasound imaging should not be attributed only to the personal preference of individual midwife but also to the professional concerns of the midwifery profession. While the concept was not conceived in the literature review to be properly incorporated into the survey questions, free-text answers provided by participating midwives have given more insights into these professional concerns. In addition to acting in response to the demand of their clients, specifically that of the communities and populations that have experienced barriers in accessing timely care, the support and the interest also seemed to relate to the professional identity of midwives and how or where they think they fit among other healthcare professionals in Ontario. Many midwives expressed the desire to be less dependent on others to operate the imaging modality and to be able to measure up to other primary obstetric care providers in Ontario. These desires may have motivated the vast majority of participants to provide

more comprehensive care and to self-advance in clinical skills as can be seen in the quantitative data. I was inquisitive to explore the basis of these desires and found that the developmental history of the profession in Canada might have been relevant.

Becoming a regulated health profession is directly related to having legislative authority to perform medical procedures known as the controlled acts. Historically, Ontario midwives had engaged in the legislative struggle as the profession became recognized and regulated. Despite being one of the oldest professions in the human history, Canadian midwives fought for the privilege of providing maternity care after the regulation of medical profession in the 19th century. Many faced litigations for practicing as “unqualified” practitioners because they had no formal medical training nor memberships in a regulatory body (Bourgeault, 2000; Coburn, Torrance & Kaufert, 1983). After a period of declined activity, Canadian midwifery resurged in the 1970s in the wave of social movements that advocated for the rights of minorities including those of women (Biggs, 2004; Bourgeault, 2000; Macdonald, 2006).). It was not until the 1990s that the profession acquired legislative protection and professional recognition in Ontario, formalized the training, and received public funding for their services (Bourgeault, 2000; Macdonald, 2006). Midwifery care has since been publicly funded for all Ontario residents, including uninsured patients, with the intention of improving care access (Darling et al., 2019).

Association of Ontario Midwives has also continued to advocate for uninsured clients so they can access relevant health services without financial burden while under midwifery care (Darling et al., 2019). Understanding the history seems to help conceptualize the high support and interest and the motives behind them.

The much-desired change in professional image relevant to other primary obstetric care providers is not without risk. Some midwives expressed concern that if ultrasound becomes the norm in midwifery care, clients will expect imaging, perhaps without justification. Swedish obstetricians and midwives as well as Australian midwives have also shared a similar concern that this normalization of obstetric intervention may encourage unnecessary ultrasound imaging (Åhman et al., 2015; Edvardsson et al., 2015; Edvardsson et al.,2016). They have realized that sometimes patients did not understand the purpose, capacity and limitation of imaging examinations (Edvardsson et al., 2015; Edvardsson et al., 2016).

Interestingly, strong opposition to this new scope expansion on the basis of professional philosophy is not evident in this study. Unlike research from the UK (Edwards, 2009) and Australia (Edvardsson et al., 2015), no evidence exists in this study to suggest that Ontario midwives feel ultrasound imaging medicalizes pregnancy. In fact, opposition from within the community of midwives was ranked the least likely barrier by participants, and the majority of participants disagreed that doing ultrasounds would conflict with the belief or

value of natural pregnancy and birth. A few participants mentioned that ultrasound imaging done at radiology practices would often lead to additional assessments and thus undesired interventions, which might be considered medicalizing pregnancies, but they believed that the scope expansion would allow them to be more self-sufficient and autonomous from the disciplinary protocols of other health professionals and thus avoid the situation. These findings add new perspectives to existing literature.

Other than who would or who wanted to expand the clinical scope to conduct POCUS, few participants commented on who should. One midwife recommended imposing restriction on the scope expansion to include ultrasound imaging:

> *[…] I would suggest this expansion of scope should only be available to midwives with 5 years of full caseload experience. […]*

This comment might partially elucidate the discrepancy between the support for the scope expansion and the personal interest seen in the statistical data. Specifically, it seems to coincide with the group of midwives with 5 to 10 years of experience that showed higher personal interest in doing ultrasound imaging than their support for the scope expansion. While it is unclear from the free-text answer whether this recommendation was rooted in the concern regarding the competition between ultrasound skills and clinical skills, I have considered this possibility and searched the literature but was not able to find quality studies that evaluate diagnostic technologies and clinical skills to this effect. According

to the position statements from the Canadian Association of Radiologists and the World Federation for Ultrasound in Medicine & Biology, POCUS, by definition and when used appropriately, enhances the clinical examination (Canadian Association of Radiologists [CAR], 2013; Dietrich et al., 2017). That is, POCUS does not, and should not, replace clinical examination. At the time of the writing of this thesis, the College of Midwives of Ontario had not defined the eligibility for the scope expansion, nor the precise ultrasound scope in midwifery practice. The College has, nonetheless, required that midwives who use the technology to demonstrate accountability, competence, knowledge, and skills to exercise appropriate judgement and actions (College of Midwives of Ontario [CMO], 2018).

Overall, this study has found that there is a professional element to the support for the new scope expansion and the interest of adopting ultrasound imaging in clinical practice. This professional element may have stemmed from the developmental history of the midwifery profession in Canada and in Ontario, and it differs from the professional stances of midwives from other countries that have been reviewed in the literature.

4.4 Interest and Feasibility

Inclusion of ultrasound in the midwifery scope of practice is new in Ontario. Faced with stark uncertainties during this transition phase, many midwives reported that their support for the scope expansion and/or personal

interest in performing ultrasound imaging might be conditional on several factors. These factors are often convoluted indicating the multifaceted nature of implementational barriers.

A key finding from this study is that most of the participating midwives are only interested in limited ultrasound examinations and tasks. One implication of this finding is that Ontario midwives are unlikely to follow the professional midwife-sonographer model in other countries, such as that in the United Kingdom, Sweden, Ireland or Japan, where midwife-sonographers expand their scope to provide a full range of obstetric ultrasounds including routine screening examinations. The majority of participating midwives in this study are more interested in point-of-care ultrasound (POCUS) that can be done quickly at bedside to answer specific clinical questions. The rationale has been discussed on the grounds of heavy clinical workload and training requirements for ultrasound skills. While there have been accounts of midwife-sonographers describing the challenge of balancing the demand of both practices in the UK (Edwards, 2009), this does not appear to be applicable to Ontario midwives. A difference in career designation also exists between Canada and these countries. Although diagnostic medical sonography only recently became a regulated health profession in Ontario, it has been an established career designation since 1970s in the United States (Craig, 2013) where many Canadians sonographers have received their credentials. Many midwives cannot

envision themselves “taking over” the role of another health profession. Diagnostic medical sonography, however, does not exist as an independent profession in many of these countries being reviewed. There is no existing literature addressing on how POCUS impacts the workload of clinicians. There is also a lack of outcome data to recommend the volume requirements to attain and maintain ultrasound competency (Arntfield et al., 2014; Hertzberg et al., 2000). It is, however, broadly agreeable that low ultrasound volume can contribute to difficulty in maintaining competency in ultrasound skills if Ontario midwives do not perform POCUS often enough.

Much of the discussions captured in free-text answers centered around how midwives might be, if at all, compensated for the extra service they are to provide with the scope expansion. Most participants would like to be compensated additionally for performing ultrasound imaging. Presently, Ontario midwives have no access to OHIP fee-for-service funding. The lack of OHIP reimbursement was ranked the second greatest barrier in adopting ultrasound imaging in clinical practice. Unlike other primary obstetric care providers in Ontario, the obstetricians and family physicians, who are compensated by OHIP on the fee-for-service basis, Ontario midwives are remunerated on a salary model based on their caseload as provided in the 1993 Ontario Midwifery Funding Framework (Association of Ontario Midwives [AOM], 2013). Nevertheless, fee-for-service cost of ultrasound services can be a major barrier

for many uninsured clients including Amish and Mennonite people who have opted out from the OHIP, as it is when ultrasound imaging is performed at radiology practices. One rationale for the new midwifery scope expansion is to improve access to care for these groups of patients. From 2012 to 2015, about 7% of clients under midwifery care in Ontario were uninsured, and the number of uninsured pregnant people in Ontario is growing (Darling et al., 2019). If this extra service is funded through OHIP, uninsured clients will continue to experience cost as a barrier in accessing care defeating the goal of the new scope expansion to improve access.

Like other clinical skills, ultrasound knowledge and skills require practice and continuing medical education to stay current. The vast majority of midwives in this study understood that the training and practice to attain and maintain obstetric ultrasound competency could be a huge undertaking. Quantitative data in the study have also suggested that it was of minority opinion that midwives would feel more confident in the ultrasound findings had they been the ultrasound operators themselves. Across disciplines, education and training has been considered one of the major barriers in translating expanded skills into clinical practice (Nelson et al., 2014). Health professionals who are new to ultrasound imaging through expanded scope of practice desire quality ultrasound training (Ailon, 2016; Edwards, 2009; McKiernan, Chiarelli & Warren-Forward, 2011)

The cost of equipment has been identified in this study as the greatest barrier in implementing ultrasound imaging in practice. Other allied health professionals with an expanded scope that includes ultrasound imaging also experience the same challenge. It has been found in a study that few Australian physiotherapists actually owned a personal machine, and some only had access to one at their workplace (McKiernan et al., 2011). Some Australian physiotherapists and offices reported having purchased used machines through radiology practices (McKiernan et al., 2011). Existence of such a channel should be relayed to and considered by midwifery practices planning on acquiring one. Furthermore, the price of ultrasound equipment is partly influenced by the imaging capabilities required for the tasks to be performed. In retrospective, knowing that Ontario midwives are more interested in POCUS for limited examinations and tasks, a portable or a handheld device at lower price range than a full ultrasound machine may already suffice.

Obstetric services are prone to medico-legal disputes. Participants in this study ranked potential legal and/or ethical issues, such as those that could arise from inconclusive or abnormal findings, to be the greatest risk of conducting ultrasounds. The fear of litigation has bound some UK and Australian midwives from fully exercising their expanded skill (Edwards, 2009; Edvardsson et al., 2015). Australian and Swedish midwives also found obstetric ultrasound imaging to be stressful especially when intervention or termination were considered, and

when mutual understanding on the purpose, capacity and limitation of the examination could not be established (Edvardsson et al., 2015; Edvardsson et al., 2016). The possibility of inconsistent imaging quality and documentation among midwives was ranked the second greatest risk in this study. Considering POCUS is performed by clinicians to assist in immediate care arrangement, it differs from traditional ultrasound done by sonographers, stored in picture archiving and communication system (PACS), and interpreted by radiologists (Arntfield et al., 2014; Moore & Copel. 2011). Storage of POCUS images and videos is not always considered nor feasible. It is unclear in this study or in the literature whether midwives' fear of litigation is related to the litigation-prone nature of obstetric services or the decision-focused manner of POCUS. Recently, some professional organizations have started to advocate for POCUS image archiving. Position statements of the Canadian Association of Emergency Physicians (Lewis et al., 2018) and the Society of Hospital Medicine (Soni et al., 2019) recommend image archiving for documentation, training, quality assurance, research and legal purposes.

Findings from the study have revealed contextual and demographic variables regarding the scope expansion to include ultrasound imaging. They may be context-specific and influenced by the population makeup of the communities midwives serve, the structure or funding scheme of the healthcare system, and/or regulations of health professions in the system. Some of the

concerns raised by participants have been shared by midwives and other health professionals within or outside of Canada who have recently started using POCUS. While many problems have remained unsolved, lessons learned from these contexts included those related to alternative means to acquire equipment and storage of images to address some of these concerns. Ultimately, the decision needs to be made in context within which midwives are practicing. As circumstances vary for each midwife, and each of these factors may affect midwives to a different extent, it is felt that the new scope expansion to conduct ultrasound imaging in clinical practice should be left to individual decision. This will likely create uncertainty in the overall clinical uptake of the expanded skill among midwives in Ontario.

4.5 Limitations

Despite the efforts to recruit as many registered Ontario midwives as possible, only about 30% of the study population participated. While the response rate is comparable with that of past Ontario midwifery surveys, I acknowledge the risk of nonresponse bias of the results. Additionally, the survey in this study contained several ranking questions. Several participants expressed difficulty in ranking and prioritizing items. This appeared to contribute to the numbers of incomplete survey entries. The rationale of the design to not permit equal ranking for these questions was to prioritize future legislative, educational

and research efforts. However, future research could limit these options to enhance completion.

4.6 Recommendations

In reference to the framework developed by Nelson et al. (2014) for optimal scopes of practice within collaborative care arrangements, this study has revealed that much of the discussion on midwifery scope expansion to include ultrasound imaging currently centers around barriers at the macro level. These barriers included remuneration and funding, education and competencies, and professional liabilities (Nelson et al., 2014). Additional barriers at the meso level, including quality assurance and evidence of investment return, and at the micro level, including job protectionism and inter-professional communication, were not frequently cited nor profoundly discussed by participants of this study. These barriers may surface and become more appreciable as the clinical scope expansion takes its course. Exploration into these factors is recommended.

Future regulatory and educational efforts should seek interdisciplinary collaboration with the sonography, radiology and obstetrics communities to devise a common language and means of quality assurance for obstetric ultrasound imaging. This will address some of the concerns among midwives with interest in providing POCUS. A well-defined language and an established standard with coordinated service provision among various health professions is essential in providing timely and quality care that is attentive to public safety.

A cost-effectiveness analysis should also be performed, once the remuneration and funding schemes are determined, to evaluate the effects of the scope expansion.

4.7 Conclusions

Ontario midwives' interest in ultrasound imaging is high, especially for limited examinations and tasks for specific clinical indications. Examples of these clinical indications include fetal position and presentation, fetal heart rate, first trimester ultrasound for viability or retained product, placental location, and first trimester dating ultrasound. The support for scope expansion and the personal interest in conducting ultrasound imaging are the single most predictive factor of each other.

The most important enabler for clinical adoption of the practice is the formalized scope expansion by the College of Midwives of Ontario. The most important barriers are the cost of the equipment and maintenance as well as the lack of OHIP funding. Resolution of these barriers will require engagement of Ontario Ministry of Health and Long-Term Care for funding. In terms of benefits and risks, participating midwives identified the improved access to care as the most likely benefit of the scope expansion, and the potential liability issues as well as inconsistent imaging quality and documentation as the most likely risks. Regulators, policy makers, advocates, educators should consider these factors in curriculum development and implementation of expanded scope of practice

that includes POCUS. Key findings from this study have informed the development of a POCUS training program for primary obstetric care providers at McMaster University. Evaluation of this program and other continuing educational materials for midwives is anticipated.

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Appendix 1

Point of Care Ultrasound (POCUS) in Midwifery Practice Survey

Thank you for your interest in participating in this study.

Access to timely and quality care has been identified as an area of insufficiency within the Canadian healthcare system. As an ongoing effort to address the issue, new roles and expanded scopes have been created in several healthcare professions. Effective January 2018, midwives in Ontario are legally and professionally authorized to order and apply soundwave for the purpose of obstetric and pelvic ultrasound imaging. Midwifery and obstetrical ultrasound imaging are both in high demand. Expanding scope of midwifery to include ultrasound imaging at point of care may help meet obstetric imaging needs but interest among membership in doing so has yet to be determined.

This study uses a questionnaire to explore the interest of actively practicing midwives in Ontario in performing ultrasound imaging in their point of care practice. Participants will be asked questions including their professional demographics, their general interest in performing ultrasound imaging, as well as their perceptions about the benefits, risks, enablers, and barriers in such expansion of the scope of practice. You will have an opportunity to provide free text to share any information you feel may reinforce your opinions or may be helpful as we attempt to understand interest in including ultrasound in expanded scope of practice.

This study is supervised by Dr. Anne Malott, an associate professor of Midwifery Education Program, and co-investigated by Master student, An Ling, from

Health Sciences Education Program at McMaster University. This study is not sponsored. The findings from this study will be shared with the scientific community at a provincial or national level conference and a peer- reviewed journal for publication.

There are no anticipated risks to participants of this study. The survey is anonymous, no personal identifiers such as name, email or IP address will be collected. Information collected will be stored on a secure, encrypted McMaster University REDCap server for a period of 2 years and used solely for the purpose of scholarly research.

Participation is voluntary, and you may discontinue the survey at any time by simply closing the browser window. Completion of the survey implies consent. To withdraw completely and permanently from the study, you may send an email to the student co-investigator at linga5@mcmaster.ca to request and confirm the removal of survey answers. You will otherwise not be contacted in any way following completion of this survey.

For more information regarding the study, please do not hesitate to contact Anne Malott, the principal investigator at malotta@mcmaster.ca

By proceeding with the survey questions, you are giving consent to collection and use of your answers for this study. Scroll down to continue, otherwise close the browser window to exit the survey.

Thank you for your participation.

General Demographics

1. Are you a registered midwife in Ontario (not eligible to proceed with survey if no)?
   - Yes
   - No
2. How long have you practiced in Ontario as a registered midwife?
   - 0 to < 5 years
   - 5 to < 10 years
   - 10 years
3. What is your age?
   - 20 - 29
   - 30 - 39
   - 40 - 49
   - 50 - 59
   - 60 and above
4. What is your route of entry to the profession?
   - Michener pre-legislation program
   - Prior learning and experience assessment program
   - Midwifery Education Program
   - International Midwifery Pre-registration Program
5. What is the population size of the area(s) that you serve and spend most of your working hours every week? (Statistics Canada, 2011)
   - Small population centers (29,999 and below)
   - Medium population centers (30, 000 to 99,999)
   - Large population centers (100,000 and above)
   - Varies from week to week/ month to month
6. What LHIN(s) do you work in?
   - Erie St. Clair
   - South West

- Waterloo Wellington
- Hamilton Niagara Haldimand Brant
- Central West
- Mississauga Halton
- Toronto Central
- Central
- Central East
- South East
- Champlain
- North Simcoe Muskoka
- North East
- North West

7. What is the setting of your professional practice?
    - Solo midwifery practice
    - Group midwifery practice
    - Alternate practice arrangement (e.g. multi-professional clinic, hospital, or community center) * Free text

General Interest

8. Do you think application of obstetric ultrasound imaging should be included in expanded scope of practice of Ontario midwives?
    - Yes
    - No
    - Not sure * Free text

9. Are you personally interested in applying obstetric ultrasound imaging to your patients at your practice?
    - Yes
    - No

- Not sure * Free text

10. Indicate your level of agreement with the following statements (Strongly agree, moderately agree, neutral, moderately disagree or strongly disagree)
    - Enables me to provide more comprehensive services
    - Does not fit my belief or value of natural pregnancy and birth
    - Reduces cost for my patients (cost of travel and time off work to appointments)
    - Burdens already heavy workload of existing tasks
    - Reduces my patients' anxiety and result turnaround time
    - Requires additional time, energy and/or money consumption for training and certification
    - Gives me stronger confidence in the finding as ultrasounds are done by myself
    - Has potential legal, ethical, and/or emotional implications for care
    - Enables real-time antenatal and perinatal monitoring
    - Is something I want to do in the future but not plausible at my current practice (office culture, cost for the technology, peer influence etc.)
    - Is a part of self-advancement in clinical skills
    - Provides a potential source of extra income

Please feel free to suggest other factors that may affect your interest in adopting and applying ultrasound to your patients.

- *Free text

Starting next page, there will be a few ranking questions that look similar to the image below *Image not included*. Please read through each question stem and all its corresponding items carefully before you answer. No two items can receive the same ranking. Each number can be used only once.

11. What do you think may be the potential benefits of the scope of practice expansion to include diagnostic ultrasound imaging? Please rank them from 1, the most likely, to 5, the least likely. (Please read through the items and use each ranking number only once.)

- Improved accessibility of healthcare services
- Better integration of healthcare services
- Enhanced midwife-patient interaction and relationship
- Tending to the psychological and holistic wellbeing of patients and their families
- Tending to the physical health of patients and babies

Please feel free to suggest other potential benefits that we may have missed.

- *Free text

12. What do you think may be the potential risks of the scope of practice expansion to include diagnostic ultrasound imaging? Please rank them from 1, the most likely, to 7, the least likely. (Please read through the items and use each ranking number only once.)

- Enhanced societal bias against babies with disabilities
- Alteration of professional images of midwives
- Medicalizing pregnancy and/or birth
- Inconsistent quality of imaging and documentation among midwives who apply ultrasounds
- Potential legal and/or ethical issues in cases of inconclusive, abnormal, or findings of undetermined significance
- Mismatched expectations of ultrasound imaging between midwives and patients
- Abuse or misuse of obstetric ultrasound imaging by midwives or patients

Please feel free to suggest other potential risks that we may have missed.

- *Free text

13. Please rank the following potential enablers to scope of practice expansion to include diagnostic ultrasound imaging in order of highest (1) to lowest (6) importance. (Please read through the items and use each ranking number only once.)

- Formalized expanded scope by College of Midwives of Ontario to include obstetric ultrasound imaging
- OHIP reimbursement for obstetric ultrasound imaging services
- Financial support for training, education, and/or licensing
- Established, well-structured training curricula
- Tax-incentive for technical upgrade
- Grant funding for equipment purchase

Please feel free to suggest other potential enablers that we may have missed.

- *Free text

14. Please rank the following potential barriers to scope of practice expansion to include diagnostic ultrasound imaging in order of highest (1) to lowest (8) importance. (Please read through the items and use each ranking number only once.)

- Opposition from within the community of midwives
- Opposition from other healthcare professional communities
- Lack of OHIP reimbursement
- Legal and regulatory issues
- Ethical concerns
- Lack of educational support and training curricula
- Expense of technological installation and maintenance
- Certification or licensing costs

Please feel free to suggest other potential barriers that we may have missed.

- *Free text

15. What specific ultrasound exams or tasks will you be the most interested in applying to your patients? If you are not personally interested in applying ultrasound to your patients, which ultrasound exams or tasks, if any, do you believe would be appropriate for midwives to conduct? (Select all the apply)

- First trimester dating ultrasound of uncertain last menstrual period
- First trimester ultrasound of threatened abortion for viability or such of incomplete abortion for retained product of conception
- First trimester ultrasound before pregnancy termination
- First trimester ultrasound for suspected multiple gestation
- First trimester ultrasound for suspected ectopic pregnancy, molar pregnancy or pelvic masses
- First trimester nuchal translucency ultrasound as a part of fetal genetic screening
- Routine second trimester anatomy survey
- Third trimester ultrasound for fetal well-being (e.g. biophysical profile and fetal Doppler)
- Ultrasound assessment of preterm labor or pre-labor rupture of membrane
- Ultrasound assessment of post-term pregnancy
- Any trimester real-time guidance during diagnostic or therapeutic interventions
- Any trimester fetal growth surveillance including for size/date discrepancies
- Any trimester monitoring of multiple gestations
- Any trimester investigation of suspected congenital anomalies
- Dating with crump-rump length measurement
- Fetal heart rate detection
- Cervical length measurement

- Fetal position and presentation
- Placental location
- Amniotic fluid index
- Growth
- Biophysical profile

Please feel free to suggest other (combination of) ultrasound exams or tasks that we may have missed.

- *Free text

16. Do you have any other comments?
    - *Free text