

# The State of Point of Care Ultrasound Certification in South Africa. Why are so Few Providers Completing the Certification Process?

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## **Declaration**

I, Franz Gustav Lemke, hereby declare that the work contained in this assignment is my original work and that I have not previously submitted it, in its entirety or in part, at any university for a degree.

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## **Abstract**

### **The State of Point of Care Ultrasound Certification in South Africa. Why are so few Providers Completing the Process?**

#### **Introduction**

Point of Care Ultrasound (POCUS) is widely used in clinical practice. Although relatively new to South Africa, the POCUS introductory course received wide interest with many clinicians attending. However, many clinicians are failing to complete the requirements to become certified POCUS providers. The study's aim was to identify the outcomes of clinicians entering the training program via the introductory course and the obstacles they faced in achieving POCUS provider certification.

#### **Methods**

The Cape Town faculty kept an electronic database of all clinicians who attended their introductory course since inception in 2007. After mining the database, an electronic cross sectional survey was emailed to all clinicians who attended the introductory POCUS courses in Cape Town. This group represents more than half of the national total. The questionnaire polled clinicians regarding obstacles faced in their effort to obtain certification. Outcomes were compared between the certified and non-certified groups.

#### **Results**

A total of 90 out of 218 (41, 3 %) course attendees completed the questionnaire of which 23/43 (53%) represented the certified group and 63/175 (36 %) the non-certified group. Four incomplete surveys were excluded (n = 86). The most common obstacle identified by the certified group, 15/23 (62.5 %), was scarcity of pathology (positive scan findings) resulting in difficulty gathering prerequisite scans. Time constraints were identified as both the most common 49/63 (77.8 %) and the top rated obstacle 27/63 (42.9 %) by the non-certified group and the top obstacle by the certified group, 9/23 (39.1 %). Of the non-certified respondents, 44 (69.8 %) still aim to complete the certification process. However, 33/63 (52.4 %) of non-certified providers utilise POCUS more than three times a week in their clinical practice.

#### **Conclusion**

The majority of non-certified clinicians wish to complete the certification process. Both groups identified time constraints and limited access to scans with pathology as their largest obstacles.

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## Abbreviations and Terms

AAA:	Abdominal Aorta Aneurism
ACEM:	Australasian College for Emergency Medicine
ACEP:	American College of Emergency Physicians
ATLS:	Advanced Trauma Life Support
CEM SA:	College of Emergency Medicine of South Africa
CME:	Continued Medical Education
CMSA:	College of Medicine of South Africa
CPD:	Continuing Professional Development
CT:	Computed Tomography
CVC:	Central Venous Catheter
DOPS:	Direct Observation of Procedural Skills
DVT:	Deep Venous Thrombosis
ECG:	Electrocardiogram
ED:	Emergency Department
EUS:	Emergency Ultrasound
E-FAST:	Extended Focused Assessment with Sonography for Trauma
ELS:	Echocardiography in Life Support
EM:	Emergency Medicine
EMSSA:	Emergency Medicine Society of South Africa
EP:	Emergency Physician
FAST:	Focused Assessment with Sonography for Trauma
FCEM:	Fellowship in the College of Emergency Medicine
FEER:	Focused Echocardiographic Evaluation in Resuscitation
IJV:	Internal Jugular Vein
POCUS:	Point of Care Ultrasound
US:	Ultrasound
USA:	United States of America

## Chapter 1: INTRODUCTION

The portable (handheld) ultrasound has been described as “*the new stethoscope in the Emergency Department*” and its use is growing from strength to strength<sup>1</sup>.

The modern ultrasound has come a long way from its modest beginning in the early nineteenth century. Jean-Daniel Colladon and Charles Sturm pioneered research in the investigation of sound and the way that sound waves are transmitted. The Curie brothers, Pierre and Jacques, discovered the piezoelectricity phenomenon which led to the modern ultrasound transducer containing piezoelectric crystals. During the war years in the early twentieth century, ultrasound was further refined and utilised as SONAR (Sound, Navigation and Ranging) underwater and in searching for flaws in the metal incorporated in ship hulls. It was first utilised in the medical field by Karl Theodore and Friederich Dussik in the late 1930’s. The brothers used a 1.5 MHz transmitter to scan the human brain in search of brain tumours. With the development of transrectal and transvaginal transducers by John Julian Wild in the 1950’s ultrasound started to get more clinical exposure<sup>2</sup>. Jehle et al published a landmark article in 1989 in the American Journal of Emergency Medicine<sup>3</sup>. In this retrospective review, the authors found that Emergency Physicians (EP) were able to accurately perform ultrasound and that the results influenced the diagnosis and treatment of patients in the Emergency Department (ED). They recommended that the utilisation of Emergency Point of Care Ultrasound (POCUS) in the ED should become the standard of care<sup>3</sup>.

Emergency Point of Care Ultrasound is an adjunct to the clinician’s physical examination and should enhance their clinical examination without replacing it. In emergency medicine, the tool should be used to answer binary questions, for example, is there free fluid in the abdomen<sup>4</sup>? The answer should positively influence the management of the patient. In the emergency setting, the main advantages of POCUS are that it is compact, portable and can thus be performed at the bedside. The ultrasound machine is cheap to maintain once purchased, the investigations are repeatable and results are conjured in real time data<sup>4,5</sup>. POCUS should not be seen as a competitor nor replacement for formal radiology or speciality ultrasound scans. There are a few distinct differences in the respective approaches between POCUS and formal ultrasonography<sup>6</sup>:

1. POCUS should be seen as an extension of the patient's examination, and not as a separate, distinct investigation. It is utilised by the primary treating physician and not by a consultant. It should be seen as more akin to the acquiring and interpretation of an Electrocardiogram (ECG) or speculum examination rather than to Computed Tomography (CT).
2. It is a focused examination that should be used to answer binary questions. Speciality done ultrasounds usually utilises a broad based approach to organs or systems, where the EP approach is to seek a yes/no approach to questions, for example, is there an abdominal aorta aneurism (AAA) that could explain the patient's hypovolemia?
3. POCUS investigation is brief and to the point. Where formal duplex-doppler deep vein thrombosis (DVT) scans may take up to 30 minutes to complete, the POCUS compression scan takes less than 5 minutes. The binary question of is there a DVT, yes/no is answered rather than why is the patients leg swollen (lymphoedema, ruptured Baker cyst, cellulitis etc)?<sup>6</sup>

The main drawback to POCUS is that the validity of the result is operator dependant. As in general medicine, the skill level varies between experienced operators with formal training and novice users influencing the results of the investigation. There is the factor of inter-operator variability. The patient's condition may be seen as a limitation as some patients might be very difficult to assess, for example in morbid obesity<sup>5</sup>.

The usage of the POCUS is legion. According to the 2009 American College of Emergency Physician Emergency (ACEP) ultrasound guidelines, emergency ultrasound can be classified into the following functional clinical categories<sup>7</sup>.

Functional category	Definition	Example
Resuscitative	Ultrasound use as directly related to an acute resuscitation	FEER, E-FAST scans
Diagnostic	Ultrasound utilised in an emergent diagnostic imaging capacity	DVT scans
Symptom or sign-based	Ultrasound used in a clinical pathway based upon the patient's symptom or sign	DVT, AAA scans
Procedure guidance	Ultrasound used as an aid to guide a procedure	Central line placement
Therapeutic and monitoring	Ultrasound use in therapeutics or in physiological monitoring	IVC monitoring

**Table 1 Functional categories for POCUS according to ACEP 2009 policy statement<sup>7</sup>**

Thus, its use varies widely, from use in resuscitation for instance the Focused Echocardiographic Evaluation in Resuscitation (FEER) exam to assess for cardiac motion and pericardial effusions in the cardiac-arrest patient, to the diagnostic application in diagnosing a DVT. In trauma and critically ill patients the Extended Focused Assessment with Sonography for Trauma (E-FAST) is a rapid, effective screening tool. As stated by Rippey<sup>5</sup>, the ultrasound can “*assist in identifying immediate life threats, in directing and prioritizing interventions and in guiding resuscitation*”<sup>5</sup>. Ultrasound can assist with procedural guidance when inserting a central line, and in therapeutic monitoring utilizing the caval index in order to assess the intravascular fluid status<sup>4</sup>. It can be used to assess for raised intracranial pressure by measuring of the optic nerves and for identifying intra-ocular foreign bodies. POCUS is therefore an extremely useful tool in assessing a wide variety of pathology and more importantly it can guide your further management decisions. It has been demonstrated that using a protocol incorporating POCUS decreases the time to operation for patients with chest trauma by 64 % and decreases the use of CT scans. Furthermore it was shown to decrease both the hospital stay and the complication rate<sup>8</sup>. The updated Advanced Trauma Life Support (ATLS) run by the American College of Surgeons, has incorporated the Focused Assessment with Sonography for Trauma (FAST) exam into the practical part of the course<sup>9</sup>.

In trained and experienced hands POCUS is very accurate. In a retrospective analysis of 2576 ultrasound exams done in an American Trauma Unit for blunt abdominal trauma, ultrasound was found to have a sensitivity of 86 % and a specificity of 98 %<sup>10</sup>. A South African study evaluating the FAST exam as performed by clinicians was done in Ngwelezane Hospital, KwaZulu-Natal. The FAST was found to have a 100 % specificity and sensitivity of 81.3 % for blunt abdominal trauma<sup>11</sup>. When POCUS was compared to conventional chest radiography in the detection of hemothoraces post chest trauma (both blunt and penetrating), POCUS was found to have comparable accuracy to the initial chest x-ray, with both modalities having a sensitivity of 96.2 % and a specificity of 100 %<sup>12</sup>. The widespread utilisation of POCUS would thus have wide ranging positive effects especially in under-resourced countries or areas where there is a limited radiology service, for example the Day Hospitals in the Western Cape Metropole - there are no Radiology services after 16h00.

## Chapter 2: LITERATURE REVIEW

Training in POCUS has become commonplace in the developed world. In the USA, the ultrasound has been used in the Emergency Department for decades<sup>3</sup>. By 2001 it was found that 95 % of emergency medicine residency programs were teaching point of care ultrasound during their training. 89 % of these departments had access to a dedicated ultrasound machine<sup>13</sup>. In a study published in the American College of Radiology in 2011, they found that emergency physicians were performing POCUS in 92 % of the institutions surveyed. The most commonly performed examinations were the FAST (92 %), basic cardiac echocardiography (54 %) and pelvic ultrasound (51%)<sup>14</sup>.

Following the revised 2009 ACEP policy guidelines for emergency ultrasound<sup>7</sup>, there are two pathways for completion of the training for basic emergency ultrasound in the United States. The first option is residency based. Residents are taught throughout their training and become proficient in the use of POCUS while doing their specialist training. ACEP recommends that they start with an initial one day course relating to “knobology” and instrumentation and the physics behind ultrasound. They should spend a minimum of two weeks in a dedicated emergency ultrasound rotation while completing their training, preferably within the first year of their training rotation. The training should entail both practical and theoretical components and should be run under the supervision of a faculty member acting as the Emergency Ultrasound Director. There is an exit examination at the end to assess operator competency. The second pathway is a practice-based pathway entailing an initial 16 – 24 hour introductory course. This is followed by didactic and practical training focusing on repetitive scanning. In order to become competent via this pathway, a minimum of 150 emergency ultrasound examinations are required<sup>7</sup>. In an American Critical Care study regarding ultrasound training, it was found that 81 % of program directors were interested in providing POCUS training, but multiple obstacles exist. Findings include high fellow turnover (84.1 %) necessitating ongoing training of ultrasound novices, lack of adequately trained and credentialed faculty (40 %) and financial constraints. A lack of dedicated ultrasound machines was noted as an obstacle in 13 % of the units<sup>15</sup>.

The Australasian College for Emergency Medicine (ACEM) POCUS certification process entails that the candidate attend an instructional workshop, perform and log a predetermined amount of POCUS scans under supervision, and then pass an exit examination<sup>16</sup>. The instructional workshop

covers ultrasound physics, instrumentation, E-FAST, AAA, Echocardiography in Life Support (ELS) and an introduction to procedural ultrasound<sup>17</sup>. For the E-FAST module, candidates are required to perform a minimum of 25 accurate POCUS scans. At least 50 % of these scans should be clinically indicated and at least five should be positive. Regarding the AAA module, at least 50% should be clinically indicated and five should be positive<sup>16</sup>. For the ELS module, candidates are required to perform 25 examinations. Five should be clinically indicated and at least five should be under direct supervision of a sonologist. They should interpret 25 more examinations, either of their own or recorded scans. Of the total 50 scans, there should be at least two cases each of cardiac tamponade, right heart failure or massive pulmonary embolus, hypovolemia and left ventricular failure<sup>18</sup>. Regarding the exit examination, an emergency medicine sonologist or qualified sonographer will evaluate the candidate regarding the ability to create adequate ultrasound images of all the appropriate anatomical structures. Lastly, candidates are required to perform 25 EFAST, 25 ELS and 15 AAA scans annually to remain current. To maintain his/her credentials, the candidate must undertake at least three hours of ultrasound training per year and perform 25 EFAST examinations for the EFAST module and 15 aorta scans per year for the AAA scan module. For the ELS module, candidates are required to perform 25 examinations annually and undertake at least four hours of continuing professional development (CPD) per year related to basic echo. If the candidates are unable to fulfil the requirements, they are required to attend a refresher course<sup>16,18</sup>. A recent study in Australia, surveying all emergency physicians and emergency medicine registrars, found that only 18.4 % (91/494) were certified in FAST and AAA scans. 21.5 % (106/494) were undergoing certification and 60.1 % (297/494) were uncertified<sup>19</sup>.

In the United Kingdom, the College of Emergency Medicine Ultrasound Sub-committee has drawn up guidelines for certification<sup>20,21</sup>. The training entails both a theoretical and practical curriculum. The theory consists of anatomy, physics and instrumentation, ultrasound techniques and administration. The practical training is gained under the guidance of a named supervisor who is ultrasound trained. This should be within an ultrasound training department. The trainer should be a level two practitioner or a level one practitioner with at least six months experience at level one. The training entails regular scans (approximately five scans per week under supervision). The outcome of the training is competency “*rather than adherence to a fixed number of training scans*”<sup>20</sup>. The scans focus on trauma, AAA and vascular access modules. Once a candidate has been assessed as competent, he is required to continue performing ultrasound

regularly. If periods of three months pass without the trainee doing any scans, he/she is to be re-assessed by a trainer by Direct Observation of Procedural Skills (DOPS). Practitioners are required to attend regular ultrasound and multi-disciplinary meetings. They should keep up to date with ultrasound literature and regularly audit their practice<sup>20</sup>.

The certification process in South Africa currently falls under the auspices of the Emergency Medicine Society of South Africa (EMSSA) and is accredited by the College of Emergency Medicine of South Africa (CEM (SA))<sup>22</sup>. The CEM (SA) recommends that emergency physicians be proficient in EFAST, AAA, DVT, FEER scans and central venous line placement<sup>23</sup>. The process entails the completion of a formal one day introductory course, followed by the logging of 65 scans under either direct supervision of an accredited POCUS trainer, or signed-off on digitally recorded or printed copies of scans, followed by the successful completion of a practical examination in order to achieve competency. (Appendix I) The required 65 scans comprise the following as set out in table 2 below:

Scan	Positive	Negative	Total
E-FAST	10	10	20
AAA	5	10	15
DVT	5	5	10
IJV/Central line	0	5	5
FEER	15	0	15

Table 2. Positive and negative scans required for introductory POCUS course (South Africa)

According to the CEM (SA) Ultrasound policy document, “of the required at least 50 % of these scans should be clinically indicated and at least ten scans should have abnormal findings (five must demonstrate intra-peritoneal, pleural or pericardial fluid and five abdominal scans should demonstrate an aneurysm). At least half of these scans must be proctored (supervised) examinations under the direct supervision of a proctor approved by the CEM (SA). A proctor may be a specialist Radiologist or an Emergency Physician experienced in EUS”<sup>23</sup>. For the provider to maintain currency and certification in emergency ultrasound, he/she should perform at least 50 ultrasounds per year (25 E-FAST, ten AAA, ten DVT and five CVC). The provider should complete three hours of ultrasound training per year.

A short note regarding competence, credentialing, certification and accreditation: The Oxford dictionary defines competence as “*the ability to do something successfully or efficiently*”<sup>24</sup>. Competence is therefore an acquired, individual skill. Credentialing is granted by an institution in recognition of competence in a specific skill. The problem is that since credentialing may be hospital specific, it is not always transferable between institutions. Certification is an official document granted by a formal, academic body or institution as evidence of achieving a certain level of training. This certification is thus transferrable and is linked to the individual and not the institution where the individual is practising. Accreditation is conferred when recognised standards have been met. For example, this could be by a national body conferring accreditation to a department or hospital<sup>25</sup>. The South African POCUS course certifies individual providers in Point of Care Emergency Ultrasound, and is internationally recognised.

The Cape Town ultrasound faculty keeps a formal database of all trainees who completed the POCUS introductory course in Cape Town since its inception in 2009. According to the mined data, only 43 out of 228 providers (18, 9%) who attended the introductory course completed and passed the final POCUS certification. This poor outcome results in the waste of scarce resources. The low return of time and monetary investment committed results in less credentialed POCUS providers available to train the next generation of clinicians.

There is a large discrepancy relating to the initial number of providers attending the introductory course and the final number of providers completing the credentialing process. It is unknown why there is such a big discrepancy. The motivation for this study is to establish the reasons why this discrepancy exists.

The investigators wanted to sample a relatively large population from across the country in a short period of time and therefore elected to utilise an internet based survey program, SurveyMonkey©.

In the year 2000, Cook et al performed a meta-analysis of the response rates in web- or internet based surveys<sup>26</sup>. They found that out of the 68 surveys reported in 49 studies, the mean response rate was 39.6 % ( $SD = 19.6\%$ ). The most important factors influencing the response rate to a survey were the following:

### *1. Contacts*

When no email follow-up is done, a response rate of 25-30 % can be expected. Sending more reminders does not have a large effect on the rate of return. This might be attributed to the fact that individuals get saturated by too many email messages, and may become resistant to being reminded multiple times about a survey<sup>27</sup>. However, personalizing the correspondence is associated with an increase in the survey response rate.

### *2. Salience*

The more relevant and prominent a subject is to the sample population, the more responses can be expected.

### *3. Incentives*

Surveys with added incentives had a lower response rate, possibly due to people with long or tedious surveys recognizing the need for providing a reward for completion of the survey<sup>26</sup>.

## **Conclusion**

Emergency Point of Care Ultrasound is here to stay. In the developed world it has reached the tipping point where utilisation of ultrasound is the standard of care. Although there is general acceptance of the need for ultrasound training, there are still multiple issues with certifying. The issues of which POCUS scans to teach, how many scans are enough for competence and how to best assess candidates are still not satisfactorily answered.

The objective of this study is to assess why clinicians, who deem ultrasound as a necessary skill, are being left behind and not certifying. Identifying the obstacles providers face is the next step to making the ultrasound as ubiquitous as the stethoscope in South Africa.

## Chapter 3: METHODOLOGY

### Ethical approval

Ethical approval was obtained from the University of Stellenbosch Health Research Ethics Committee (reference number: **Copyright** Refer to Appendix II.

### Research question

Why are providers not completing the certification process after completion of their introductory emergency point of care ultrasound course?

### Aim

To establish the obstacles providers face preventing them from certification following completion of their introductory emergency point of care ultrasound course.

### Objectives

- a. Identify the proportion of POCUS candidates who fail to certify after completion of the introductory course.
- b. Compare failure rates between different specialties.
- c. Compare failure rate between different experience levels.
- d. Survey unsuccessful POCUS candidates who did not certify to identify obstacles.
- e. Survey certified POCUS providers to identify obstacles and compare the results to the non-certified candidates.
- f. Identify if certified POCUS providers use ultrasound regularly in their daily clinical practice and vice versa.

### Study design

The study is a descriptive, observational study consisting of two components:

1. Analyses of the certification database regarding all POCUS trainees who attended the Cape Town introductory course since its inception in 2009.

2. A cross-sectional survey of trainees who certified and those who failed similar courses presented since POCUS training started in Cape Town in 2009.

### **Study population**

The study population included all POCUS trainees who attended the accredited (CEMSA/EMSSA) introductory courses in South Africa since course inception.

### **Sampling and inclusion criteria**

There are three training centres currently offering the POCUS introductory course in South Africa, namely Cape Town, Durban and Johannesburg. Cape Town is responsible for more than 60 % of the national total. Unfortunately the other two centres never kept a certification database which could have been included in this study. Therefore the investigators only sampled the Cape Town database.

The inclusion criterion was all providers who attended the introduction to point of care ultrasound course in Cape Town since its inception in 2009. The exclusion criteria used was incomplete questionnaires and non-responders.

### **Data collection and management**

An analysis was performed by the investigator using the Cape Town database. The goal of the analysis was to identify the drop out prevalence, stratified between different specialties, experience levels and work environment. An electronic questionnaire (refer to Appendix III) was compiled by the investigator and entailed responding to questions regarding the providers' field of medicine, experience and geographical location. The first nine questions were relevant to both groups, followed by questions specific to each group. There were an extra three questions for the certified group and four for the non-certified group. The initial three questions were the same for both groups. The fourth was for the non-certified group and related to whether the candidate would wish to complete the certification process in the future.

The database was interrogated by the primary investigator to identify all trainees who attended the POCUS introductory course in Cape Town since its inception in 2009. The database contained the names and email addresses of all candidates and yielded the names of all the people who have completed the certification process. This information made it possible for the researchers to create two groups of candidates, namely a certified and a non-certified group. A questionnaire was created and finalised by the investigator. An account was opened with SurveyMonkey®, a commonly used online survey tool.

The researcher utilised SurveyMonkey® to distribute the questionnaire to all candidates in the database. The relevant information was copied and pasted from the database to SurveyMonkey® and then manually checked to confirm that no errors were made regarding relevant contact details. Providers received an invitation from the researcher in their email to complete the questionnaire via SurveyMonkey®. (Appendix IV) The initial invitation to participate was sent on Tuesday the 28<sup>th</sup> May 2013. The email invitation was resent after one week (4 June 2013), again at two weeks (11 June 2013) and a final reminder was sent on the 25<sup>th</sup> of June 2013 to non-responders in order to decrease responder bias and increase response rate. The data was collected and analyzed. All information was kept confidential.

The following variables were collected within the electronic questionnaire (Refer to Appendix III). Firstly, the investigators wanted to know more regarding the background of the provider. We asked what the highest academic qualification, job title, clinical discipline and clinical experience was at the time of the course and at the time of completing the questionnaire. The response were applied to compare failure rates and outcomes between the different specialities based on years of clinical experience. The hypothesis is that the older physicians will probably be less inclined to complete the certification process.

Secondly we wanted to know in what type of facility and geographical area the provider is working. Presumably the general practitioner working in a primary health care facility would have less exposure and use for POCUS than the registrar working in a tertiary, level one trauma centre like Groote Schuur Hospital. Likewise, working in a small rural community vs. urban centre would probably make it more difficult to certify due to limited access to ultrasound machines and trainers and issues with scarcity of pathology.

Thirdly we wanted to know what obstacles were faced by providers. The investigators compiled a list of seven perceived obstacles, ranging from personal issues, “I never planned to complete the ultrasound certification process” and time constraints to logistical and physical restraints i.e. no or limited access to ultrasound machines or certified providers to sign-off on logged scans or not able to save and log scans. Difficulty to gather certain pre-requisite scans e.g. five abdominal aorta aneurism scans were an option, the hypothesis being that working in a small rural setting it would be much more difficult to gather than in a tertiary institution with vascular surgical facilities. Providers were asked to add any perceived obstacles that were not mentioned on the list in an open ended format (Refer to Box 1 later in the manuscript for these suggestions).

We asked the non-certified group whether they were planning to complete the certification process in the future, to be able to ascertain whether attempting to ameliorate the obstacles would result in more people certifying.

The last question was directed at both groups and aimed to ascertain how often POCUS is utilised in daily clinical practice by providers.

The investigator inserted the data into an electronic spreadsheet (Microsoft Excel®, Microsoft Corporation, Redmond, WA). The electronic spreadsheet is password protected to ensure the integrity of the data. The data was collected in such a way as to protect participant confidentiality. No personal or identifying information was collected or used in the results. The data spreadsheet was modified for analysis after consultation with a statistician, and then submitted for statistical analysis.

### **Statistical analysis**

The primary aim of the statistical analysis is to compare the demography differences between the two groups and compare their perception of obstacles deterring trainees from credentialing. For this purpose, data was collated in a Microsoft Excel® spreadsheet using pivot tables. Summary statistics were used to describe all measured variables. Distributions of variables were presented with histograms and frequency tables.

**Ethical considerations****Autonomy**

All prospective participants to the study were adequately informed of the aims and objectives of the study. There were no personal risks or benefits involved to participate in the study. The investigator implied informed consent, whereby completion of the on-line survey, confirmed that the participant has given his/her consent. Participants could decide to withdraw from the study at any stage. They would need to notify the principal investigator of their decision and their survey would be discarded.

All data were collected anonymously. No personal or identifying details were collected. All the data collected were entered into an electronic spread sheet (Microsoft Excel®, Microsoft Corporation, Redmond, WA). The electronic spread sheet was only accessible on a password protected work computer situated in the offices of the Division of Emergency Medicine, Faculty of Health Science building, Stellenbosch University. Access to this information was restricted to senior members of the research team.

**Beneficence**

Outcomes of the on-line survey will benefit all future ultrasound trainees who embark on the training programme and wish to successfully complete the course. The survey will provide us with data to minimise the impact of the obstacles currently preventing trainees from certifying.

**Justice**

There will be equitable selection of study participants across all sectors of the community. There will be no unfair coercing of certain vulnerable population groups to participate in the study. The benefits of the study will be equal and apply to all population groups in our community who entered the POCUS training programme since 2009.

## Chapter 4: RESULTS

The percentage of providers completing the certification process after the introductory course was 18.9 % (43/228). In total, 218 surveys were sent to all Cape Town introductory course attendees. Ten surveys could not be delivered, either due to a wrong address entered into the database when captured initially or due to the email address not in use. The bounced email addresses were cross-checked against the database and no administrative/clerking error was noted. After a 3<sup>rd</sup> and final reminder the total responses were 90 out of 218 (41.3 %). Unfortunately, six candidates incorrectly completed the crucial question (number ten) relevant to obstacles faced by the candidate. Four candidates rated two or more options and two candidates did not assign a number one to any obstacle. After consultation between the investigators, a new email was sent to these six candidates consisting solely of question ten and once again explaining how to correctly answer the question. Five out of the six candidates replied and corrected their initial mistake. One candidate did not reply and the survey was subsequently excluded.

Three more surveys were excluded initially as they were missing more than one question/answer. The approach and outcome of the data collection is summarised in diagram, figure 1.

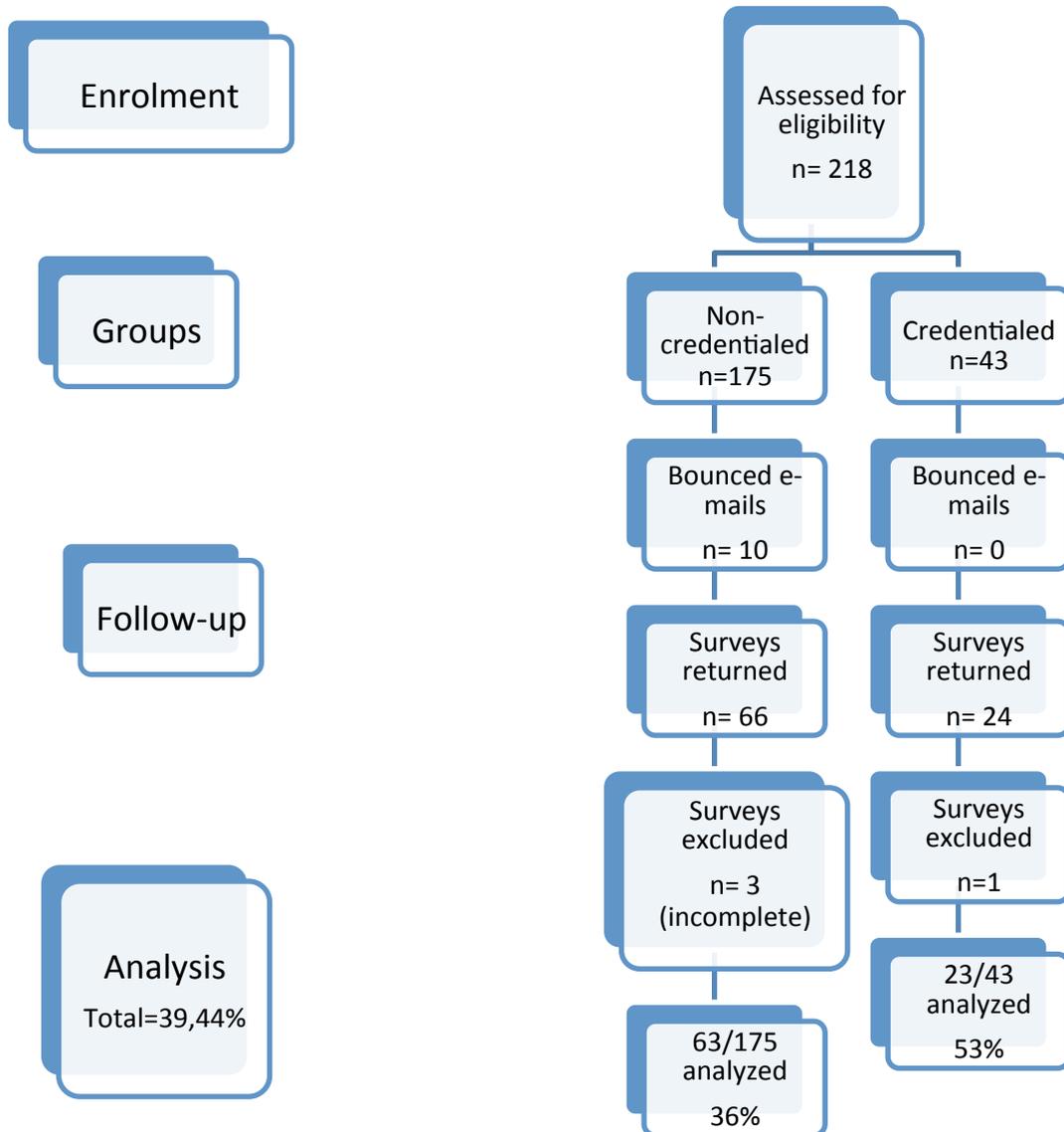


Figure 1 Consort statement flow diagram<sup>28</sup>

The bulk of the POCUS introductory course was made up of emergency physicians with 68.6 % (59/86). Refer to figure 2 below for a breakdown of the specialities that completed the survey. In figure 3, the certification prevalence was stratified by speciality, and clear shows that only emergency physicians have been completing the certification process. None of the other disciplines have completed the POCUS certification.

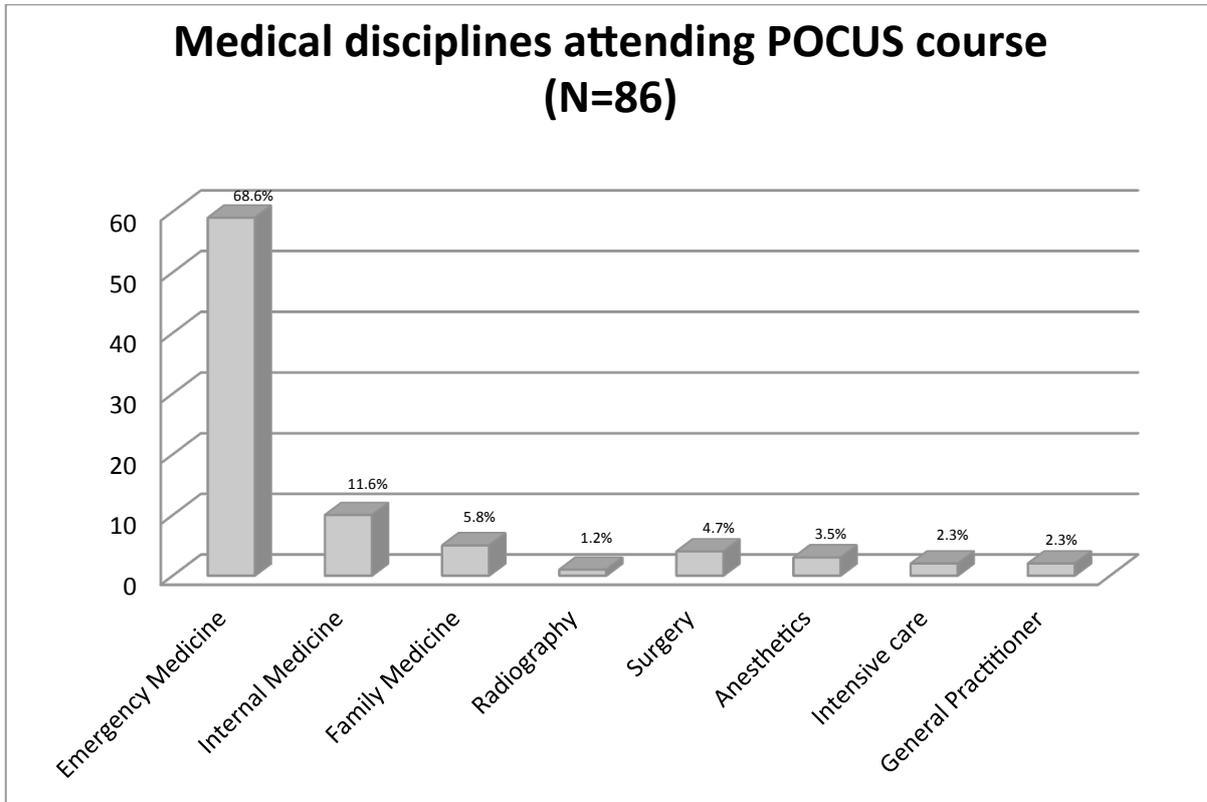


Figure 2. Graphic representation of various medical disciplines attending POCUS courses

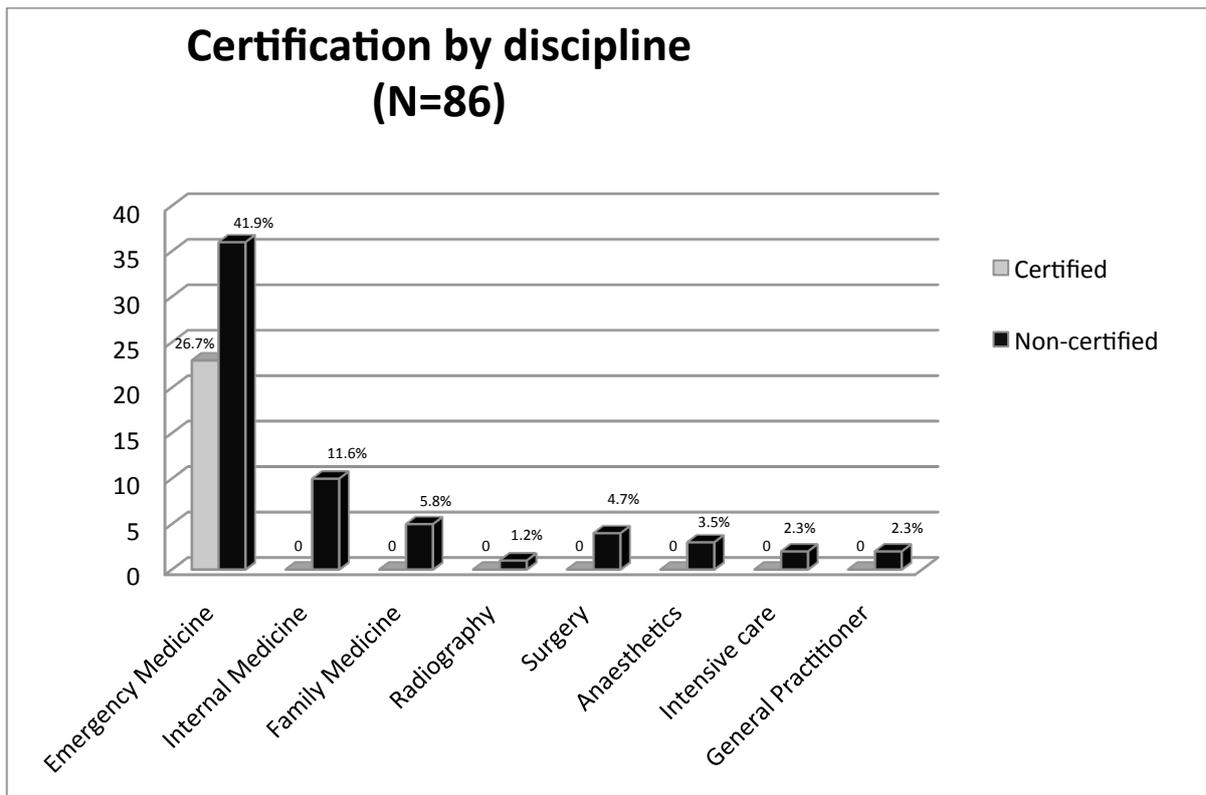


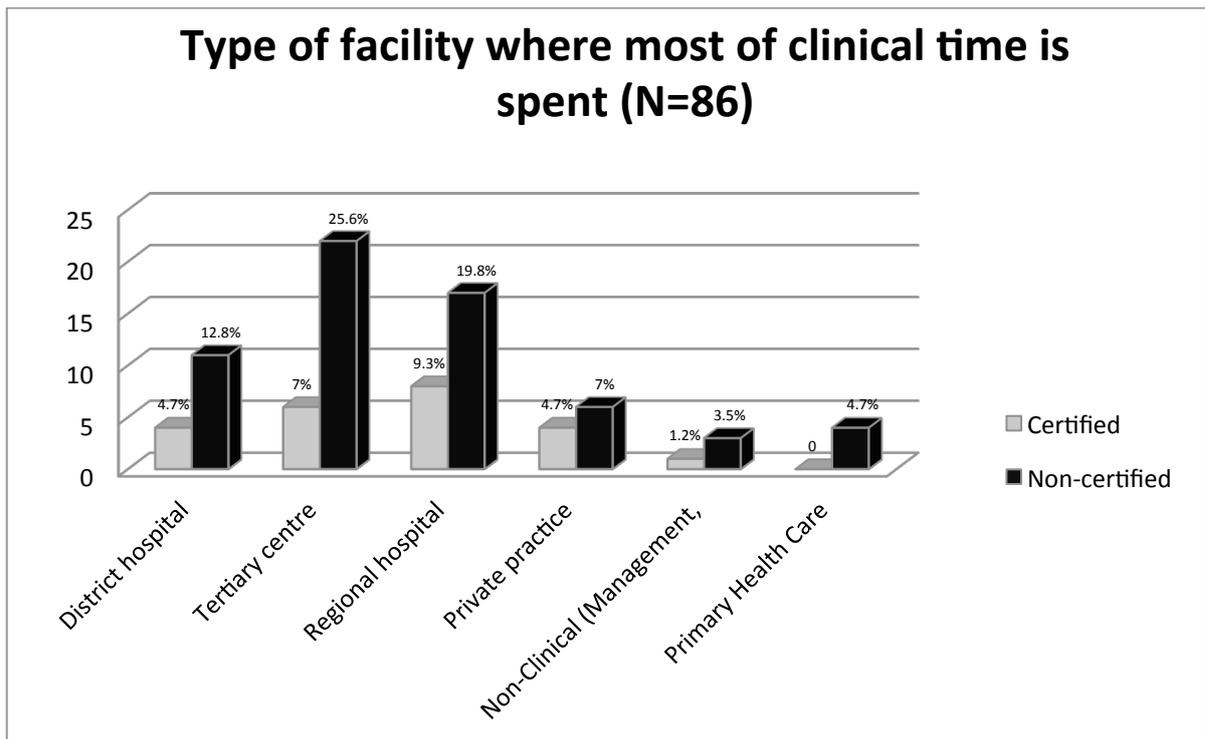
Figure 3. Graphic representation of certification by discipline

Referring to the experience levels of the providers (refer to Figure 4) we can see that it is mostly registrars (specialist trainees) who completed their certification, 23.3 % (20/86). We know that this group of registrars consist solely of emergency medicine registrars. The largest group to attend and respond to the survey is the medical officers (SHO), with 27.9 % of the total. Only one medical officer completed the credentialing process (1.2 %) and that provider is employed in the discipline of Emergency Medicine.



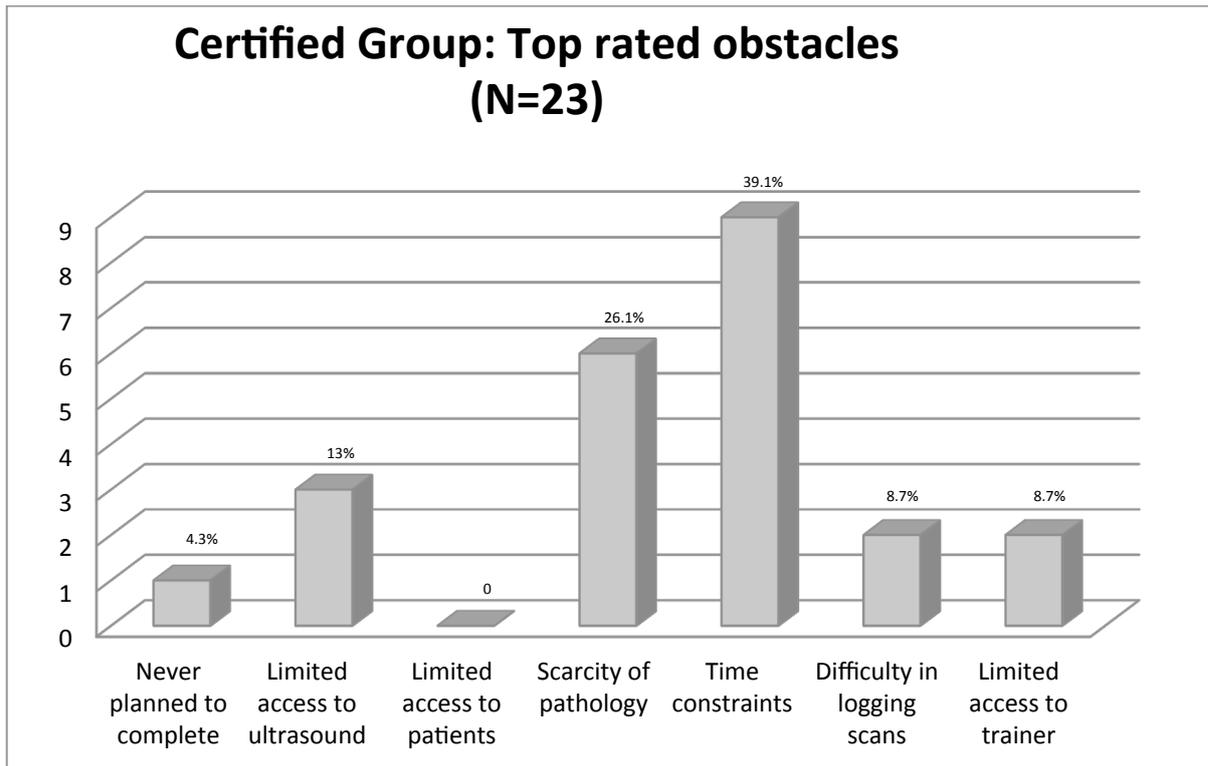
**Figure 4. Graphic presentation of certification by level of provider experience**

Most of the providers who attended the introductory course (33.6 %) were from a tertiary institution (refer to Figure 5).

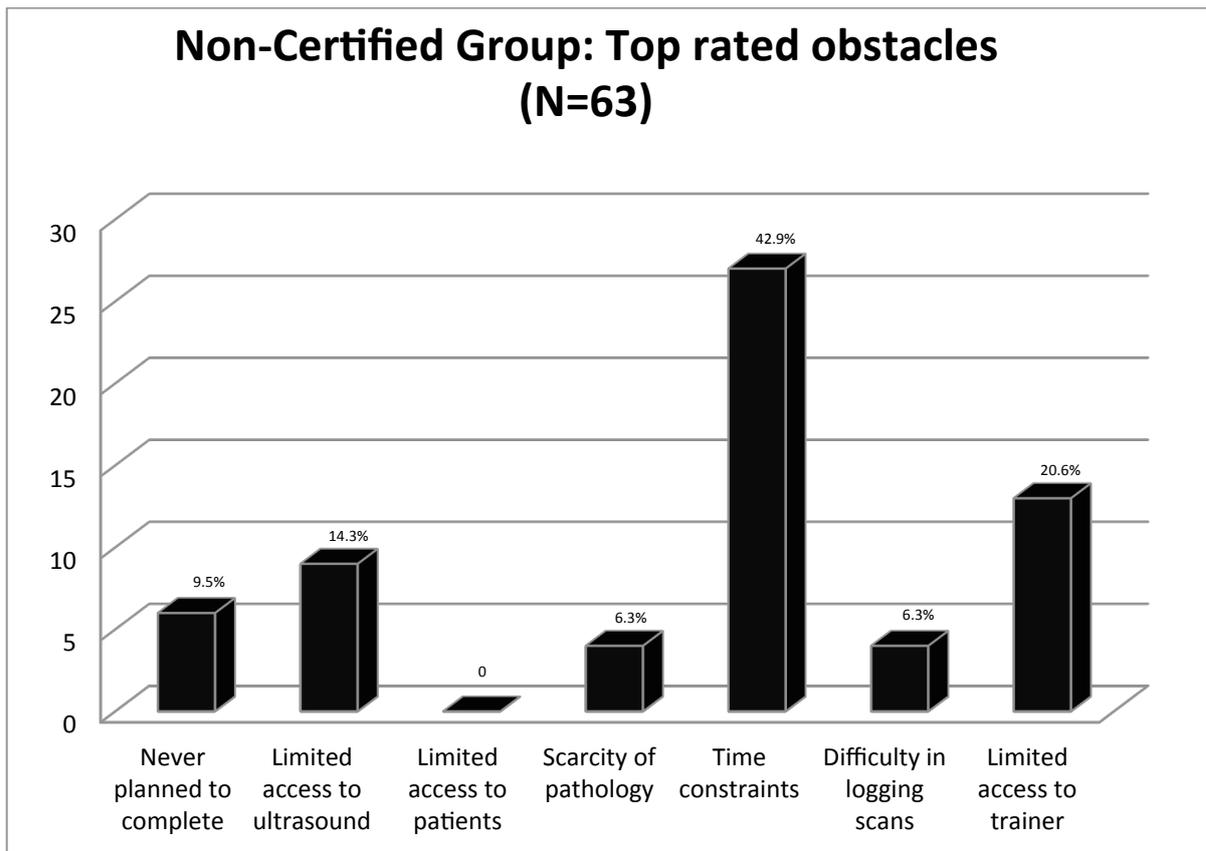


**Figure 5** Type of facility where most of clinical time is spent

When analyzing the results, the investigator looked at both the common obstacles and the top rated obstacles faced by providers. The most common obstacle was the obstacle that most providers identified in the survey (rated anywhere from one to seven), but not necessarily the top rated. The top rated obstacle is the obstacle that most providers rated as the number one obstacle they faced. The groups were stratified into certified and non-certified groups. The certified group identified time constraints, 39.1 % (9/23) and secondly lack of pathology, 26.1 % (6/23) as the two top rated obstacles (refer to Figure 6). The non-certified group identified time constraints, 42.9 % (27/63) and limited access to a certified trainer, 20.6 % (13/63) as the top rated obstacles faced (refer to figure 7).

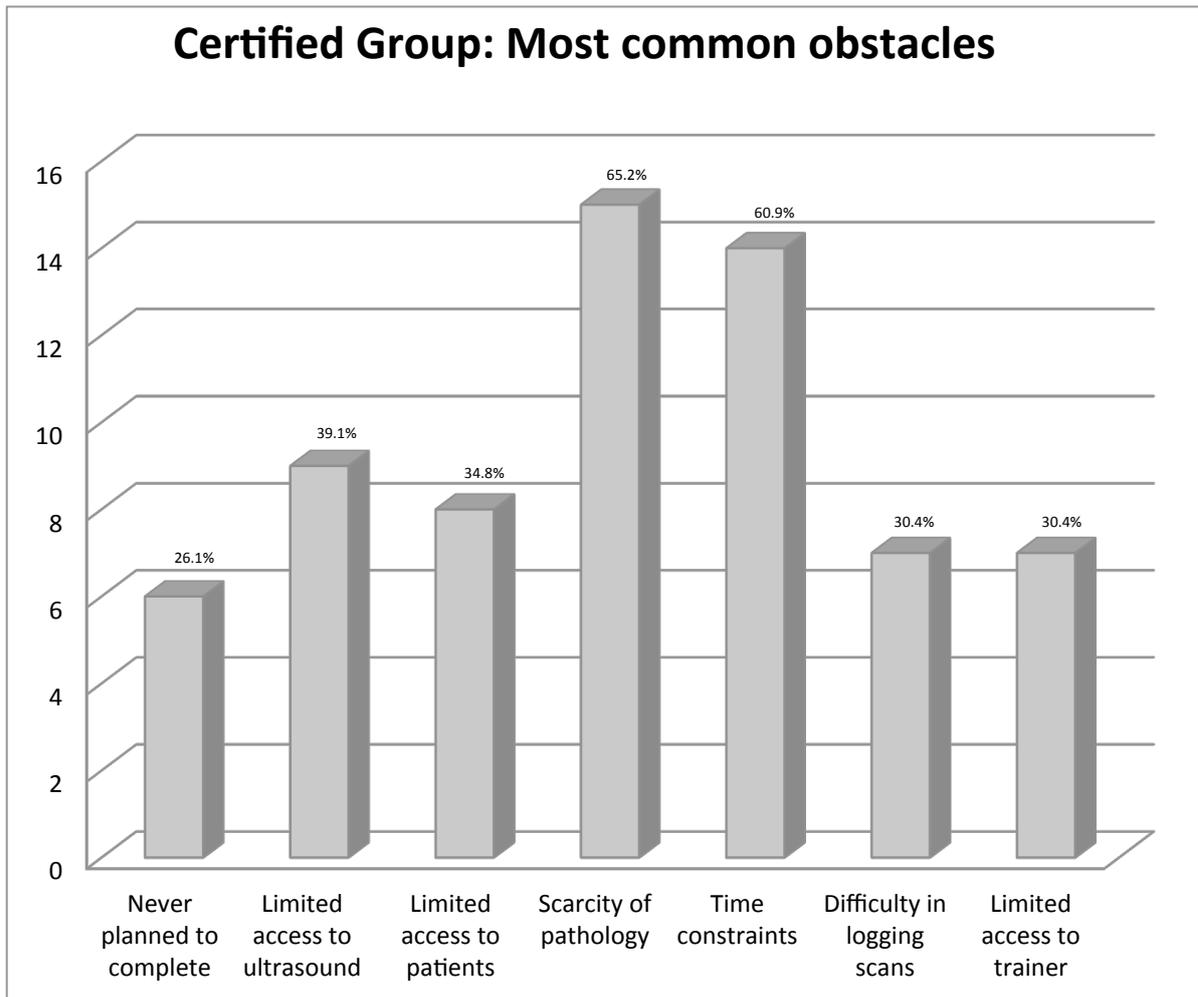


**Figure 6** Top rated obstacles faced by the certified group

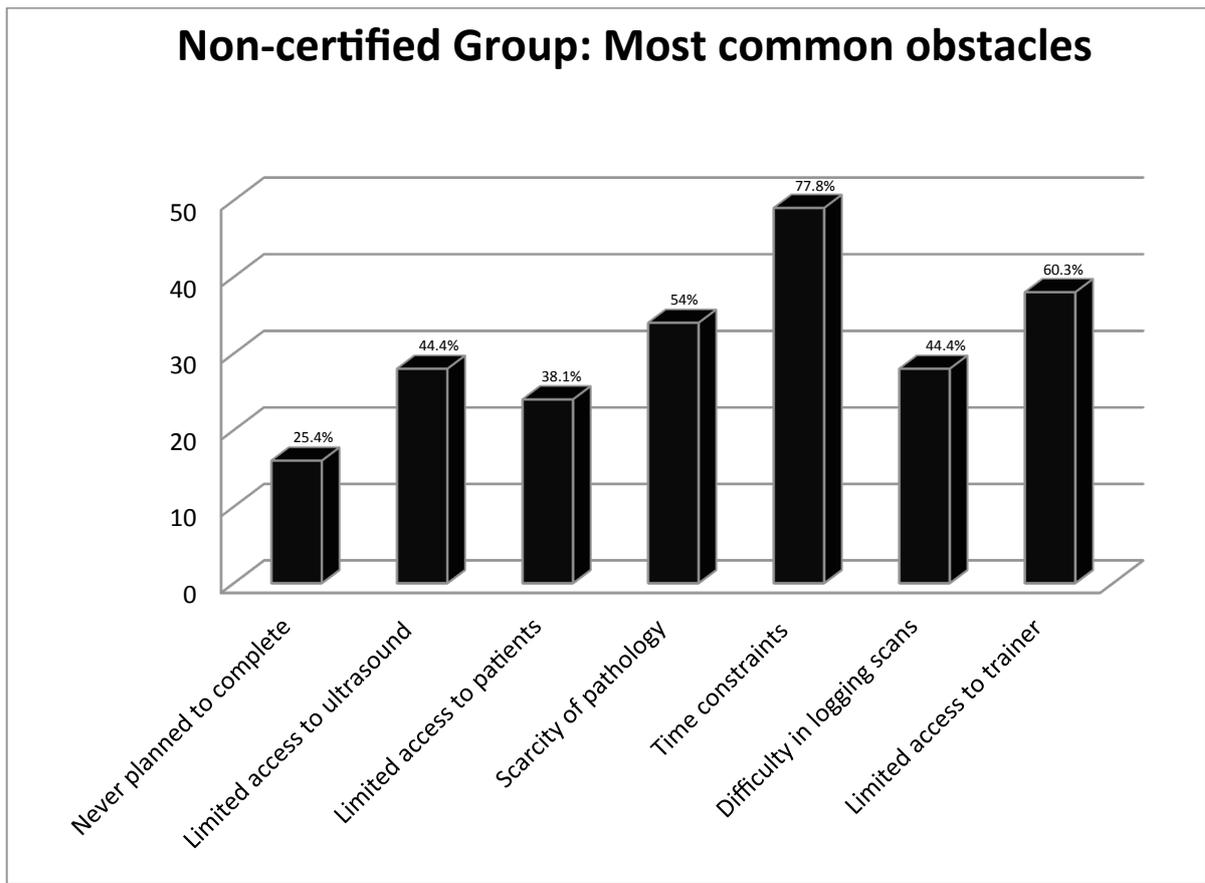


**Figure 7 Top rated obstacles faced by the non-certified group**

When comparing the most common obstacles faced by the two groups, (refer to Figures 8 and 9), time constraints once again featured as the most common obstacle in the non-certified group 77.8 % (49/63) and the second most common in the certified group 60.9 % (14/23). The most common obstacle in the certified group was scarcity of pathology, 15/23 (65.2 %). Limited access to trainers, 60.3 % (38/63) and scarcity of pathology, 54 % (34/63) was the second and third most common obstacles faced by the non-certified group.

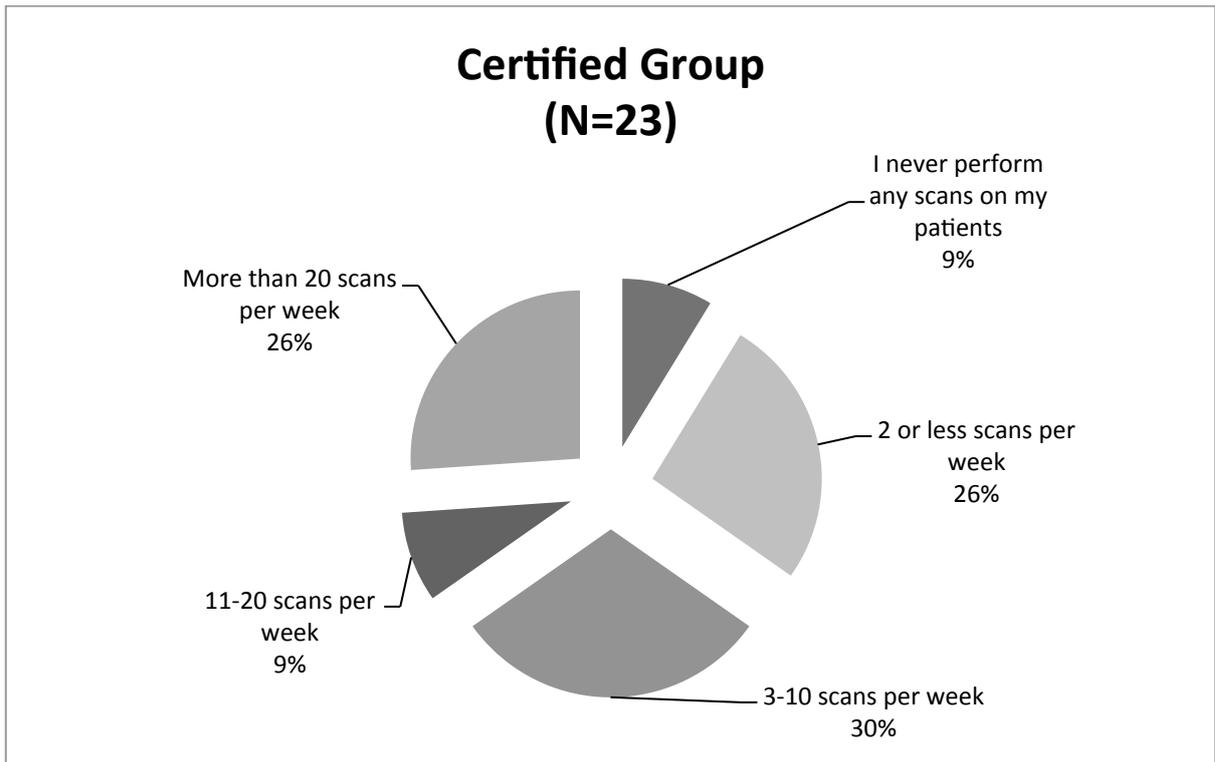


**Figure 8** Most common obstacles faced by certified group

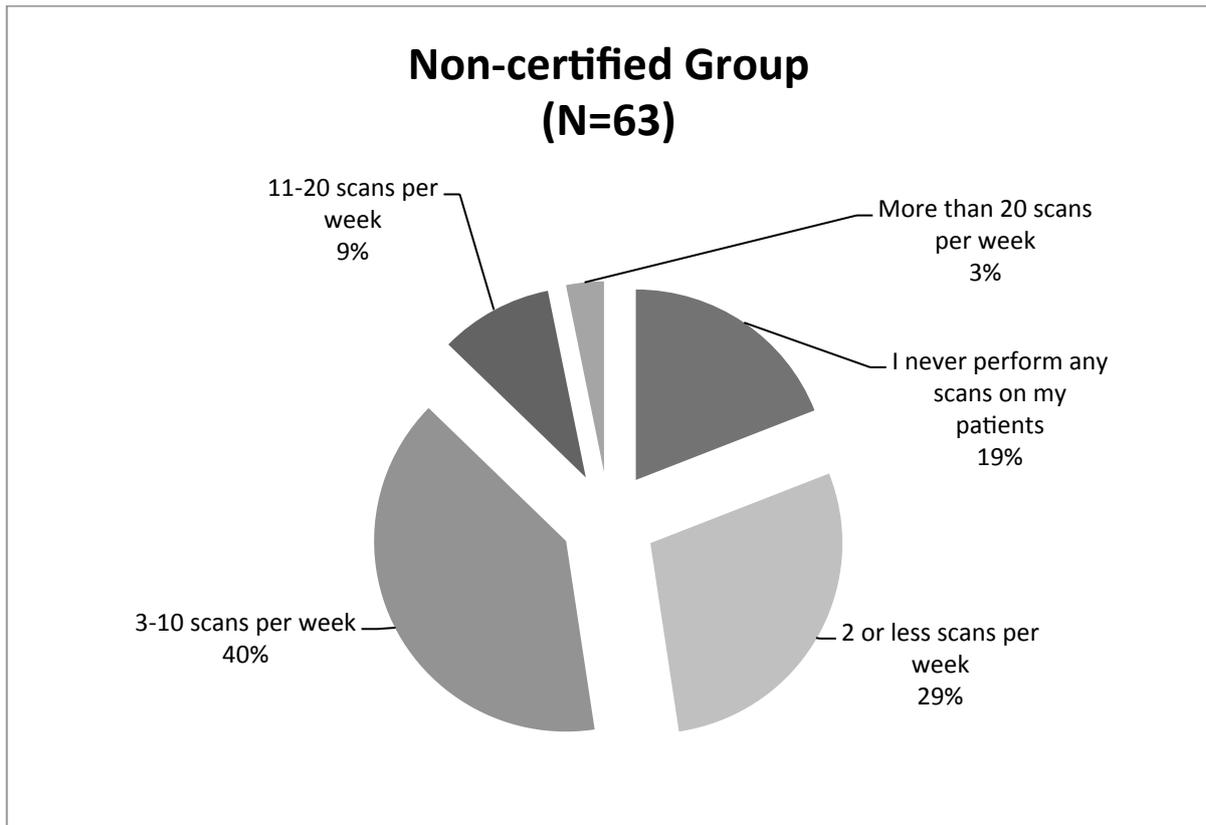


**Figure 9** Most common obstacles faced by the non-certified group

52.4 % (33/63) of non-certified providers utilise POCUS more than three times a week in their clinical practice. (Refer to Figure 11). 70 % (44/63) of non-certified providers stated that they were planning to complete the certification process in the future.



**Figure 10** Use of POCUS in daily clinical practice by certified group



**Figure 11 Use of POCUS in daily clinical practice by non-certified group**

Included in Box 1 below is the free-text responses provided by the Cape Town course attendees. Two themes are common amongst the responses. Firstly, the lack of trainee access to both ultrasound machines and certified trainers. Secondly, difficulty with the logging of the trainee's ultrasound scans. Suggestions were also made regarding the creation of a website where providers could be able to upload their scans for remote evaluation by trainers, thereby overcoming the obstacle caused by limited access to trainers. Another suggestion to address the limited pathology and trainers is to have regular follow-up scan sessions and so called master classes.

## Box 1 Free-text responses

“Electronic format & interactive online review process / image storage” **Certified**

“I would use the us (ultrasound) many times a day but it is not available in private practice. Ultrasound training should be done on a modular basis regularly in each institution. I question the need for ultrasound exam at the end of credentialing.” **Certified**

“As I only do part-time clinical work (the rest in an academic environment) opportunities to scan are less than some of my full-time clinical colleagues. Occasional refresher courses would be nice.” **Certified**

“Really good to have 1 month specifically dedicated to only doing ultrasound.” **Certified**

“Online credentialing would be helpful for people working in remote sites. However my experience has been that the faculty doesn't keep trainees updated about access.” **Certified**

“I completed the training and credentialing process without any supervision. It would have been more ideal to have access to an accredited provider. Unfortunately I was allocated to work in departments at that time where there was no ultrasound machine nor credentialed trainers. I had to log my scans after hours without senior input.” **Certified**

“The training requirements need to be focused towards the pathology seen in the part of the world that you work in. Aortic aneurysms are not a frequent presentation in SA. Pathology such as sepsis and HIV are much more common and there needs to be a greater focus on becoming experts in scanning systems relevant to this pathology. Options for AAA scan acquisition would be to purchase ultrasound simulators so that candidates can scan sufficient AAAs without having to run around numerous hospitals searching for patients. This is important for patients so that one patient is not scanned multiple times (which is uncomfortable and irritating for them).” **Certified**

“I think it's appropriate but as more and more people do US, it will be normal practice vs. an additional skill like using your stethoscope.” **Certified**

“Same machines linked to central bank for images.” **Certified**

“Every PHC to be supplied with an U/S machine. Incentivise trainers e.g., with financial benefits - the more numbers they train, the more financial benefit.” **Non-certified**

“The introductory course itself was informative, however, the need to perform an online test after practical assessment had already been performed at the end of the course was both tedious and no one who had done the course seemed to know where to "find" the online test and the link was not indicated in the course material provided.” **Non-certified**

“This needs to be made easier for busy hospital doctors who perform the scans but are unable to get accreditation because of time constraints.” **Non-certified**

“It would be great to set up training and credentialing process for ultrasound in HIV/TB. I have developed a first draft of a manual and so far trained two primary care doctors to a level of basic diagnostic skill in diagnosing common HIV/TB conditions. They are now offering a small service in a CHC in Khayelitsha. Developing this further with other interested clinicians/sonographers would be worthwhile venture, perhaps outside your field of interest though.” **Non-certified**

“Training was good and effective, but I get difficult on how to send my scanned images so as to get credential. I scan average of 10 patients per day. I have enough skill and experience.” **Non-certified**

“As a trauma surgeon (subspecialist) registered in SA and working as a consultant and teaching constantly over last 12 years, I didn't take the time to formalise the Ultrasound training.” **Non-certified**

“The course and the training provided was excellent. I do not have suggestions on how it could be improved - it was unfortunately secondary to time constraints and a new focus that I was not able to keep up with doing regular ultrasounds and logging scans.” **Non-certified**

“I enjoyed the course but don't think I will be able to meet the credentialing criteria due to my work. Keep the credentialing standards high. Don't make it cheap.” **Non-certified**

“Since changing from Emergency medicine to surgery time and access to do EPCUS is limited.” **Non-certified**

“Perhaps we could submit the completed scans as we go along; and get an email as a reminder to the numbers of outstanding scans. This could be a motivator to complete the necessary scans.” **Non-certified**

“No machine in private EC, easy access to Radiologist.” **Non-certified**

“A one-day course is very ambitious to put across a lot of knowledge and skill. A two-day course would probably be better, even though would create more logistical problems and maybe not be so viable? Life is about compromises, and whichever way, there will always need to be compromises.” **Non-certified**

“An electronic logging and review process would be wonderful. Access to more formal training lectures/online resources etc.” **Non-certified**

“Someone has to drive the agenda that all current consultants in all clinical specialities need to know how to use ultrasound. If my boss isn't doing it I probably won't either.” **Non-certified**

“Follow-up practical sessions.” **Non-certified**

“I found the training useful at the time, however, more so in the Emergency Unit context.” **Non-certified**

“Explain how to save scans on a memory stick etc at time of training; have subsequent 'practice workshops' for those who do not have time to do practices that much at work; facilitate link-up of credentialed trainer.” **Non-certified**

“Needs to be more formalised guidance on what pictures exactly are needed for the actual exam purpose Trainers need to teach a consistent method.” **Non-certified**

“I would use it frequently if I had the skill. the access to scan equipment is not a problem.” **Non-certified**

“I think the course objective is great, however I just cannot find any time to log the scans and find someone to discuss them with. I am confident making clinical decisions on obvious pathology but where subtle things are possible, I refer to a radiologist.” **Non-certified**

“Make it officially required for EM - if it isn't already.” **Non-certified**

"I don't know how the course is structured these days but it may be better to give exact details of how to go about logging the scans at the end of the course. Then one can ask questions and make arrangements immediately. I only did the beginners course and would really love to do the advanced one too but am unable to attend this year's date. It would be great if the course could be given several times a year." **Non-certified**

"Yes. If the scans after the classes could be arranged by you, would help to get the tasks done." **Non-certified**

"It doesn't matter what the course teaches you. It's only when you start performing scans on not-so-ideal patients that you face difficulties which you are not sure how to overcome. And this typically happens when there is no consultant on the floor as most of the EC shifts are after hours or at night. It's a great idea to publish ("advertise") good cases to scan on social medial sites such as Facebook©. Because when you look for them (the AAA's) - they are nowhere to be found! The manual isn't so specific about exactly what images need to be saved - the manual says you need 15 positive and 15 negative FAST/EFAST, but the consultants say 20 in total. The manual should specify the total number of scans - so if you have more positive than negative scans, it's OK. It's the total that counts, and the minimum positive scans that should make up the total. A "master class" or session at hospitals with scans would be really useful in leading up to the USS exam, or once every 3-4 months - especially for those not in rotations with scanners." **Non-certified**

## Chapter 5: DISCUSSION

### Limitations to the Study

Unfortunately, the data analyst and collector was the principal investigator due to budget constraints and would therefore not be blinded to the aims and objectives of the study.

The investigators expected a degree of responder bias from the survey. Due to the fact that both investigators are well known to the Cape Town Emergency Medicine community, and the fact that the survey was done as part of a MMED dissertation, the investigators expected a higher response from the local emergency physicians and registrars at the Cape Town UCT/US combined Division of Emergency Medicine than from the other disciplines of medicine or Emergency Physicians in the rest of the country. Secondly, due to the fact that POCUS has been rapidly adopted by the Emergency Medicine community in South Africa, we expected more Emergency Physicians to be interested in assisting with the study. This responder bias could partly explain why in our study population the certification percentage is 26.7 % rather than the 18.9 % in the sample population.

Due to the fact that there are only three faculties/units running the POCUS course in South Africa, (Cape Town, Johannesburg and Durban), and only Cape Town kept a database of providers, the study and sample population would be limited, sample n=218. 90 surveys were returned and four were excluded, resulting in a final study population of 39.4 % (86/218).

As part of the training in Emergency Medicine, it is a pre-requisite for all emergency medicine registrars to complete the POCUS certification before they are allowed to attempt the College of Medicine of South Africa (CMSA) Fellowship of Emergency Medicine (FCEM) exit examination. This would result in many more emergency medicine registrars attending the POCUS course and completing the certification process than any other medical specialties.

### Discussion of obstacles

As Benjamin Franklin eloquently stated, "*time is money*". The fact that time constraints featured as the top obstacle faced by both the certified and non-certified groups reaffirms this fact. Unfortunately there is no easy solution. Possibly looking at making the courses more accessible

to all providers, by sending faculty out to areas more remote from the three main training centres, would allow more clinicians to be exposed to this powerful modality. Secondly, arranging follow-up visits by faculty and “training weekends” or “master classes” where providers are supervised doing scans might help with time management and with the fact that there is a certified provider shortage. This could take the shape of a two-day seminar, over a weekend, where one or two trainers have a small group for hands-on training at the facility where the providers work. Scans done at this time would count as logged scans and be more useful as would be done under direct supervision. In the Australian survey, time constraints were the most commonly identified obstacle, with no credentialing process at the hospital and lack of relevant patients coming in number two and three<sup>19</sup>.

Issues related to limited access to trainers and certified faculty could be addressed by faculty going to the providers as discussed in the previous paragraph. Also, as soon as the tipping point is reached (enough providers at grass-root level) there should be enough trainers and the snowball effect will carry on with its own momentum.

The issue of lack of pathology is noted. It will always be challenging to be able to find enough positive scans for certification if you work in a small and rural facility. This is a common, global obstacle, as noted in the Australian survey, a first world environment<sup>19</sup>. This could possibly be addressed by adding an extra day to the initial POCUS course when it is run in one of the three big centres (Cape Town, Johannesburg and Durban) and reserving that day for supervised scans only. This could comprise of going to the vascular ward in order to scan abdominal aorta aneurisms or DVT's.

It is critically important to know why people are doing the POCUS course. Due to the fact that it is compulsory for emergency medicine registrars to complete certification before they are allowed to challenge their FCEM exit examination, they are obliged to attend and complete the POCUS certification process. No other discipline requires certification at this stage (before CMSA examination) - this might mean that providers feel comfortable enough after the one day course to do scans and do not see the need for certification. This would change if for instance financial reimbursement is limited to those who have certified (medical aids only reimbursing certified providers) or if there are medico-legal ramifications secondary to a provider making a judgement

error due to not being trained but still utilizing ultrasound in his daily practice as more than 50 % of non-certified providers are doing at this time. The fact that candidates are able to progress to the advanced ultrasound modules without completing the certification process for the introductory course might be attributing to the low certification rate. Physicians might be only interested in doing the advanced cardiac and renal/gallbladder modules, and after attending those modules not see the value in completing the POCUS certification process by doing the required E-FAST's and FEER's etc.

Most of the providers who attended the introductory course (33.6 %) were from tertiary institutions (Refer to Figure 5). Unfortunately this did not translate to more doctors certifying as the regional hospitals had more doctors completing the process. This might be because most of the Emergency Physicians are not based at tertiary institutions. Secondly, most of the emergency medicine registrar rotations are at the regional/secondary level. The Cape Town Emergency Medicine Registrar program trains for four years. Three years are spent rotating through regional and peripheral institutions, and one year in a tertiary centre.

In the survey the investigators asked how often providers utilise POCUS in their day to day clinical practice. Extremely concerning 52.4 % (33/63) of non-certified providers utilise POCUS more than three times a week in their clinical practice. (Refer to Figure 10) This has both medico-legal and clinical implications. As a provider who is not certified, it will be impossible to justify making clinical decisions on an acutely ill patient when the provider has not completed their training. Medico-legally, attempting to explain why for instance a deep venous thrombosis was missed due to operator error, possibly ending in death secondary to a pulmonary embolus, would be impossible if the provider is not sufficiently certified to be competent to perform the investigation in the first place.

The investigators have identified multiple obstacles faced by providers preventing them from completing the credentialing process. Most of these obstacles are related to accessibility, either to ultrasound machines, patients with pathology, credentialed trainers or logging of scans. Time constraints have consistently been noted as a significant barrier. Unfortunately there is no single, simple answer, but problem identification is the first step to finding a solution.

On a positive note many providers do see the advantages that POCUS add to their daily clinical practice, and thus, hopefully by limiting the obstacles faced by providers towards their certification, more providers will complete the process in the future.

## **Chapter 6: CONCLUSION**

POCUS is a rapidly evolving clinical modality worldwide, and it is rapidly expanding in South Africa, as seen by the growing amount of providers utilizing it in their daily clinical practice. POCUS is a powerful tool assisting the doctor in their clinical decision making, diagnosis and assisting with procedures. The main achilles heel is inter-operator variability with operator skill the critical factor to effective utilisation. The aim of the POCUS certification process is to train competent providers who are able to use POCUS to its optimal effect but still appreciate the limitations. This study has shown that there are multiple obstacles faced by providers limiting certification. Heartening, most non-certified providers are still planning to complete the process once these barriers are lifted.

## REFERENCES

1. Coskun F, Akinci E, Ceyhan MA, et al. Our new stethoscope in the Emergency Department: Handheld ultrasound. *Ulus Travma Acil Cerrahi Derg* 2011;**17**:488–92.
2. Newman PG, Rozycki GS. The history of ultrasound. *Surg. Clin. North Am.* 1998;**78**:179–95.
3. Jehle D, Davis E, Evans T, et al. Emergency department sonography by emergency physicians. *Am J Emerg Med* 1989;**7**:605–11.
4. Lamprecht H, Stander M, & van Hoving N. Emergency point-of-care ultrasound applications. *Continuing Medical Education* 2012;**30**:416-20.
5. Rippey JCR, Royse AG. Ultrasound in trauma. *Best Pract Res Clin Anaesthesiol* 2009;**23**:343–62.
6. Heller MB, Mandavia D, Tayal VS, et al. Residency training in emergency ultrasound: fulfilling the mandate. *Acad. Emerg. Med.* 2002;**9**:835–9.
7. Guidelines EU. Emergency ultrasound guidelines. *Ann Emerg Med* 2009;**53**:550–70.
8. Melniker LA, Leibner E, McKenney MG, et al. Randomized controlled clinical trial of point-of-care, limited ultrasonography for trauma in the emergency department: the first sonography outcomes assessment program trial. *Ann Emerg Med* 2006;**48**:227-34.
9. Lanoix R. Credentialing issues in emergency ultrasonography. *Emerg. Med. Clin. North Am.* 1997;**15**:913–20.
10. Dolich MO, McKenney MG, Varela JE, et al. 2,576 Ultrasounds for Blunt Abdominal Trauma. *J Trauma* 2001;**50**:108–12.
11. Smith ZA, Postma N, Wood D. FAST scanning in the developing world emergency department. *S Afr Med J* 2010;**100**:105-08.

12. Ma OJ, Mateer JR. Trauma ultrasound examination versus chest radiography in the detection of hemothorax. *Ann Emerg Med* 1997;**29**:312-16.
13. Stein JC, Nobay F. Emergency Department Ultrasound Credentialing: a sample policy and procedure. *J. Emerg. Med.* 2009;**37**:153–9.
14. Goodman TR, Scoutt LM, Brink JA. A survey of emergency physician-performed ultrasound: implications for academic radiology departments. *J. Am. Coll. Radiol.* 2011;**8**:631–4.
15. Eisen L , Leung S, Gallagher AE, et al. Barriers to ultrasound training in critical care medicine fellowships: a survey of program directors. *Crit. Care Med.* 2010;**38**:1978–83.
16. Policy on credentialing for Emergency Department ultrasonography: Trauma examination and suspected AAA. [Internet] 2000 July [updated 2006 July, updated 2011 March; cited 2014 Feb 4] Reviewed and adopted March 2011 Available from: <http://svc002.wic004pa.server-web.com/media/P22.pdf> Australasian College for Emergency Medicine, March 2011
17. Guidelines on minimum criteria for ultrasound, Australasian College for Emergency Medicine.[Internet] July 2012 [cited 2013 Dec 3].Available from: <https://www.acem.org.au/getattachment/d2300e81-4cc9-4383-9346-4126ec982fe5/G25-Minimum-criteria-for-ultrasound-workshop.aspx>
18. Policy on credentialing for echocardiography in life support, Australasian College for Emergency Medicine [Internet] 2011; [cited 2014 Feb 28]. Available from: <https://www.acem.org.au/getattachment/2cbfee3-dd4e-48fe-9e42-f77d2f145893/Policy-on-Credentialling-for-Echocardiography-in-L.aspx>.
19. Craig S, Egerton-Warburton D, Mellett, Tanya. *Ultrasound Use in Australasian Emergency Departments: A Survey of Emergency Medicine Fellows and Trainees.* 2012; Manuscript submitted for publication.

20. Emergency Medicine Ultrasound Level 1 training. College of Emergency Medicine Ultrasound Sub-committee. [Internet] March 2006, [modified October 2009;cited 2014 Jan 3]. Available from:  
[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCcQFjAA&url=http%3A%2F%2Fwww.collemergencymed.ac.uk%2Fcode%2Fdocument.asp%3FID%3D3570&ei=xxE7U4jeGsjB7Ab12YEI&usg=AFQjCNFxJHMPTCI7kXEXLnAvKxvVHzv\\_sg&bvm=bv.63934634,d.ZGU](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCcQFjAA&url=http%3A%2F%2Fwww.collemergencymed.ac.uk%2Fcode%2Fdocument.asp%3FID%3D3570&ei=xxE7U4jeGsjB7Ab12YEI&usg=AFQjCNFxJHMPTCI7kXEXLnAvKxvVHzv_sg&bvm=bv.63934634,d.ZGU).
21. Sloan J, Connolly J, Brenchley J, et al. Ultrasound sub committee statement. May 2008.
22. Lamprecht H. Emergency point-of care ultrasound training, credentialing and accreditation. *Continuing Medical Education* 2012;**30**:422-24.
23. Wells M, Bruijns S. College of Emergency Medicine of South Africa Policy Document—Emergency Ultrasound in South Africa Part 1—Credentialing for Emergency Ultrasound.[Internet] cited 2014 Jan 4. Available from:  
[http://academic.sun.ac.za/emergencymedicine/documents/CEM\(SA\)%20Emergency%20Ultrasound%20POLICY%20v3.pdf](http://academic.sun.ac.za/emergencymedicine/documents/CEM(SA)%20Emergency%20Ultrasound%20POLICY%20v3.pdf)
24. Oxford dictionaries. Internet. Oxford University Press, Oxford, UK. [cited 5 Jan 2014]. Available from:<http://www.oxforddictionaries.com/definition/english/competence>.
25. Medlej K, Lewiss R. I'm an emergency medicine resident with a special interest in ultrasonography: should I take a certification examination? *Ann. Emerg. Med.*2011;**58**:490–3.
26. Cook C, Heath F, Thompson RL. A Meta-Analysis of Response Rates in Web- or Internet-Based Surveys. *Educ. Psychol. Meas.* 2000;**60**:821–36.
27. Kittleson M. Determining effective follow-up of e-mail surveys. *Am. J. Health Behav.* 1997;**21**:193–6.
28. Schulz KF, Altman DG, Moher D, for the CONSORT group. Consort 2010 Statement: updated guidelines for reporting parallel group randomised trials. *BMJ* 2010;**340**:c332.

APPENDICES

Appendix I (Training schematic)

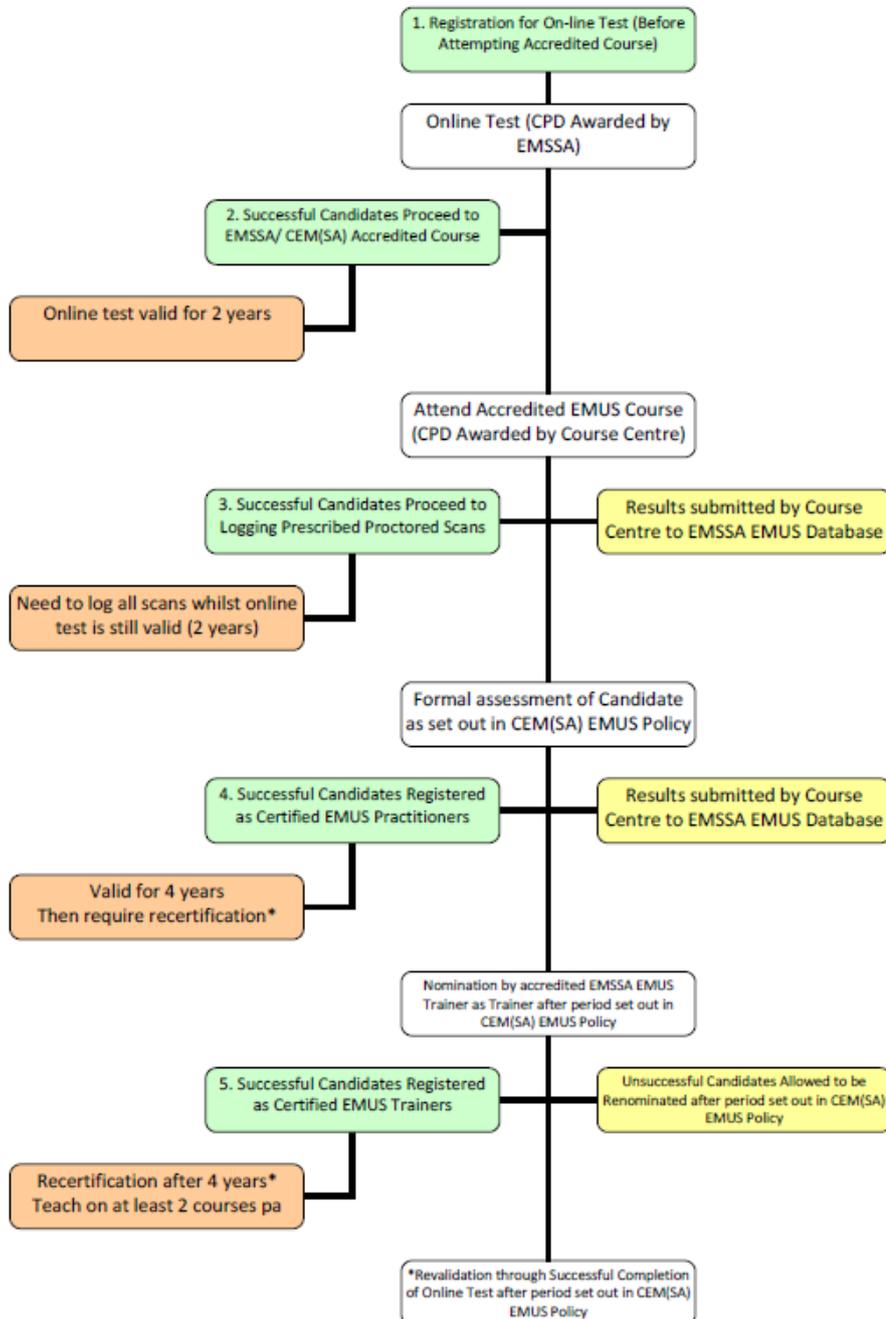


Figure 12 The proposed process of EMUS training, certification and revalidation<sup>23</sup>.