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## Validation of the performance of “Fast Lung Ultrasound Teaching Program” for gynecologists/obstetricians dealing with pregnant women with suspicion of COVID-19 infection: an Italian prospective multicenter study

F. Moro<sup>1</sup>, F. Mascilini<sup>1</sup>, D. Buonsenso<sup>1</sup>, R. Inchingolo<sup>2</sup>, A. Smargiassi<sup>2</sup>, G. Soldati<sup>3</sup>, R. Copetti<sup>4</sup>, L. Demi<sup>5</sup>, P. Giorgini<sup>5</sup>, M. C. Moruzzi<sup>1</sup>, F. Ciccarone<sup>1</sup>, R. Moroni<sup>6</sup>, T. Frusca<sup>7</sup>, G. Scambia<sup>1,8</sup>, A. C. Testa<sup>1,8</sup>

<sup>1</sup>Departments of Woman, Child and Public Health, Policlinico Universitario Agostino Gemelli Foundation, IRCCS, Rome, Italy

<sup>2</sup>Department of Medical and Surgical Science, Policlinico Universitario Agostino Gemelli Foundation, IRCCS, Rome, Italy

<sup>3</sup>Diagnostic and Interventional Ultrasound Unit, Valle del Serchio General Hospital, Lucca, Italy

<sup>4</sup>Department of Emergency Medicine, Ospedale Civile di Latisana (UD), A.A.S. 2 Bassa Friulana - Isontina, Latisana, Udine, Italy

<sup>5</sup>Department of Information Engineering and Computer Science, University of Trento, Trento, Italy

<sup>6</sup>Scientific Direction, Policlinico Universitario Agostino Gemelli Foundation, IRCCS, Rome, Italy

<sup>7</sup>Department of Medicine and Surgery, Obstetrics and Gynaecology Unit, University of Parma, Parma, Italy

<sup>8</sup>Department of Science Life and Public Health, Cattolica del Sacro Cuore University, Rome, Italy

### ABSTRACT

**Objective.** The goal of this study was to validate a “fast lung ultrasound teaching program” in a large number of Italian gynaecologists/obstetricians skilled on ultrasound, by comparing the number of correct answers in pre and post-training tests.

**Methods.** This is a prospective, multicenter study. Gynaecologic consultants, who are member of two Italian Societies – SIGO and SIEOG, with at least 5 years of experience in ultrasound, were invited to participate. The fast lung teaching program was available online and consisted of three phases: 1) a pre-test with 10 ultrasound video-clips, 2) a 40 minutes theoretical course, 3) a post-test with the administration of the same 10 ultrasound video-clips, showed in a different order. The results of the pre-test were compared with those of post-test analysis.

**Results.** 108 gynaecologists/obstetricians completed the program. Considering pre-test results, the median number of correct answers was 7 (range 2-10). In particular, 55 of them (50.9%) had a number of correct answers equal or less than 7/10 (“inadequate pre-test group”), whereas 53/108 (49.1%) had a number of correct answers equal or more than 8/10. Considering post-test analysis of all trainees, the median number of correct answers was 9 (range 6-10), with a mean dif-

### SOMMARIO

**Obiettivo.** L’obiettivo di questo studio è stato quello di convalidare un “programma di insegnamento dell’ecografia polmonare veloce” in un gran numero di ginecologi/ostetrici italiani esperti in ultrasuoni, confrontando il numero di risposte corrette nei test pre e post allenamento.

**Metodi.** Questo è uno studio prospettico multicentrico. Sono stati invitati a partecipare consulenti ginecologici, membri di due Società italiane – SIGO e SIEOG, con almeno 5 anni di esperienza nell’ecografia. Il programma di insegnamento del polmone veloce era disponibile online e consisteva in tre fasi: 1) un pre-test con 10 videoclip ecografici, 2) un corso teorico di 40 minuti, 3) un post-test con somministrazione degli stessi 10 video ecografici -clips, mostrati in un ordine diverso. I risultati del pre-test sono stati confrontati con quelli dell’analisi post-test.

**Risultati.** 108 ginecologi/ostetrici hanno completato il programma. Considerando i risultati pre-test, il numero medio di risposte corrette era 7 (range 2-10). In particolare, 55 di loro (50.9%) avevano un numero di risposte corrette uguale o inferiore a 7/10 (“gruppo pre-test inadeguato”), mentre 53/108 (49.1%) avevano un numero di risposte corrette uguale o superiore di 8/10. Considerando l’analisi post-test di tutti i partecipanti, il numero medio di risposte corrette è stato 9 (range 6-10), con una differenza media tra pre-test e post-test pari a

ference between pre-test and post-test equal to 1.9 points and a median difference of 2 points. When considering only the “inadequate pre-test group”, the median number of correct responses at pre-test analysis was 6 (range 2-7), and at post-test analysis was 9 (range 6-10).

**Conclusions.** The “fast lung ultrasound teaching program” was able to offer basic theoretical principles of lung ultrasound to gynaecologists/obstetricians. The consultants with inadequate pre-test results were also able to obtain a satisfactory result after the program.

**Corresponding Author:** Francesca Moro

E-mail: morofrancy@gmail.com

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1.9 punti e una differenza mediana di 2 punti. Quando si considera solo il “gruppo pre-test inadeguato”, il numero mediano di risposte corrette all’analisi pre-test era 6 (range 2-7) e all’analisi post-test era 9 (range 6-10).

**Conclusioni.** Il “programma di insegnamento dell’ecografia polmonare veloce” è stato in grado di offrire i principi teorici di base dell’ecografia polmonare a ginecologi/ostetrici. I consulenti con risultati pre-test inadeguati sono stati anche in grado di ottenere un risultato soddisfacente dopo il programma.

**Key words:**

*Lung ultrasound; pregnancy; COVID-19; teaching; Gynaecology.*

## INTRODUCTION

Lung ultrasound has newly been suggested as an imaging method to detect lung involvement in patients affected by COVID-19 (1-3). Although chest Computer Tomography (CT) is the most accurate technique in diagnosis chest involvement in patients with COVID-19 pneumonia (4) lung ultrasound can be a valid tool in the diagnostic path of this pathology, with some advantages (5). Indeed, the low cost, the large availability, and the possibility to perform the examination at the bed site of the patients, make this diagnostic method attractive in this health emergency (6-8).

Several efforts are being made to contain the Covid-19 pandemic also in the Gynaecological and obstetrical field (9, 10). To this regards, the International Society of Ultrasound in Obstetrics and Gynaecology (ISUOG) has fixed the potential utility of lung ultrasound examination in pregnant women and recently published an “how to” practical approach aimed at alerting and preparing gynaecologists/obstetricians, already skilled on ultrasound, to examine the lung of pregnant women with suspected COVID-19 (11). Moreover, we recently develop a “fast lung ultrasound teaching program” providing good results for the acquisition of theoretical skills in a small group of obstetricians/gynecologists of our Institution (12). In the present study, we aim at validating the “fast lung ultrasound teaching program” in a large number of Italian gynaecologists/obstetricians skilled on ultrasound.

## MATERIALS AND METHODS

This is a prospective, interventional, multicenter study, performed at Fondazione Policlinico Universitario A. Gemelli, IRCCS, in Rome, Italy. The protocol was approved by Ethical Committee (Prot. ID 30-87) on 2<sup>nd</sup> April 2020. The study aims at validating a fast lung ultrasound teaching program in a large number of gynecologists/obstetricians by comparing the number of correct answers in pre and post-training tests. The “fast lung ultrasound teaching program” is freely available on the ICLUS platform (<https://covid19.disi.unitn.it/iclusdb/login>). To obtain access to the platform please send a request to [libertario.demi@unitn.it](mailto:libertario.demi@unitn.it).

Gynaecologic consultants, who are member of two Italian Societies – SIGO (Società Italiana di Ginecologia e Ostetricia) and SIEOG (Società Italiana di Ecografia in Ostetricia e Ginecologia), with at least 5 years of experience in gynaecologic or obstetric ultrasound examination, were invited to participate. All the participants signed a written consent form. Demographic characteristics including age, type of hospital, years of experience on ultrasound were recorded.

The fast lung teaching program consisted of three phases. Phase 1 of 15 minutes pre-test, with 10 ultrasound video-clips, collected by G.S., R.C., A.S., R.I. Each video showed normal or pathological typical ultrasound patterns. After watching the video-clip, each learner had to answer about the pattern, choosing among 6 possibilities a) normal; b) clear and distinct vertical artifacts with small pleu-

ral alterations (score 1) or broken pleural line and small consolidations (score 2); c) white lung without evident subpleural consolidations (score 3); d) white lung with evident subpleural consolidations (score 3); e) pattern not compatible (vast consolidations); f) pattern not compatible (pleural effusions) (2). Phase 2 consisting of 40 minutes theoretical course, provided by two pneumologists with high expertise in lung ultrasonography (A.S. and R.I.), addressing clinical and ultrasound issues related to lung ultrasound. It included a first section on physical basic principles of the interaction between the ultrasound beam and the lung. A second section described the main semeiotic of lung ultrasound patterns. A third section included some data about the clinical meaning suggestive of lung patterns. A fourth section dedicated to the presentation of lung ultrasound patterns indicative of COVID-19 pneumonia. Phase 3 of 15 minutes post-test with the administration of the same 10 ultrasound video-clips of the phase 1, showed in a different order.

### Sample size and statistical analysis

Given the primary objective of the study and given the lack of previous data on this topic, we proposed a sample size of  $N = 102$  subject. This dimension is appropriate to detect a mean of paired differences ranging from 1 to 10, with a standard deviation of paired differences equal to 3 with a power ranging from 90% to 98%.

The results of the pre- test were compared with those of post-test analysis for each examiner.

Moreover, a second analysis including only those trainees with a number of correct answers equal or less than 7/10 (inadequate pre-test group) was performed. Results, expressed as number of correct answers, was summarized with median, minimum and maximum value. The Wilcoxon signed-rank test was used to determine whether there is a median difference between paired observations. Two-sided test was used and the significance level was set at  $\alpha = 0.05$ .

Statistical analyses were performed using the Statistical Package for the Social Sciences software (SPSS v. 25).

## RESULTS

One hundred and twenty gynecologists/obstetricians attended the training program and 108 of them completed the program, 84 females (77.8%) and 24

males (22.2%). Demographic details of trainees are presented in **table I**. Most participants were in the 30-40 age group (50/108, 46.3%), and living in the central Italian region (52/108, 48.1%). Most trainees had a previous experience of 5-10 years (43/108, 39.8%) on ultrasound. The vast majority of participants were working at a regional hospital (54/108, 50.0%) or at university hospital (37/108, 34.3%).

Considering pre-test results, the median number of correct answers was 7 (range 2-10). In particular, 55 of them (50.9%) had a number of correct answers equal or less than 7/10 ("inadequate pre-test group"), whereas 53/108 (49.1%) had a number of correct answers equal or more than 8/10.

Considering post-test analysis of all trainees, the median number of correct answers was 9 (range 6-10), with a mean difference between pre-test and post-test equal to 1.9 points and a median difference of 2 points. On a total of 108 participants only 6 of them (5.5%) performed better in the pre-test than in the post-test, 13 (12%) maintained the same number of correct answers and 89 (82.4%) improved the performance result.

When considering only the "inadequate pre-test group", the median number of correct responses at pre-test analysis was 6 (range 2-7), and at post-test analysis was 9 (range 6-10).

**Table I.** Demographic characteristics of the trainees.

Characteristics	Number (%)
<i>Gender</i>	
F	84 (77.8)
M	24 (22.2)
<i>Age</i>	
30-40	50 (46.3)
41-50	34 (31.5)
51-60	15 (13.9)
61-70	9 (8.3)
<i>Years of ultrasound experience</i>	
5-10	43 (39.8)
11-20	40 (37.0)
> 21	25 (23.2)
<i>Specific areas of interest</i>	
Both obstetric and gynecology	48 (44.4)
Prenatal diagnosis	26 (24.1)
Gynaecologic oncology	26 (24.1)
Gynecology	8 (7.4)
<i>Type of Hospital</i>	
Regional Hospital	54 (50.0)
University Hospital	37 (34.3)
Private Clinic	10 (9.2)
Other public Centers	7 (6.5)
<i>Geographical area of Italy</i>	
North	36 (33.3)
Center	52 (48.1)
South	12 (11.2)
Islands	8 (7.4)

The Wilcoxon signed-rank test highlighted a statistically significant median difference between paired observations,  $p < 0.0005$ .

## DISCUSSION

In this study, we presented the efficacy of “fast lung ultrasound teaching program” designed for gynaecologists/obstetricians already skilled on ultrasound. We demonstrated that such program is able to offer basic theoretical principles of lung ultrasound to gynaecologists and obstetricians. Indeed, also those consultants with inadequate pre-test results were able to obtain a satisfactory result after the program.

To the best of our knowledge this is the first “fast lung ultrasound teaching program” on lung ultrasound for gynaecologists/obstetricians involved in the assistance of pregnant patients affected by COVID-19.

Our study has some limitations. First, this does not include a practical program, therefore the dynamic aspects of real-time ultrasound, such as patient compliance (*e.g.*, a dyspneic woman) has not been considered and could affect lung ultrasound performance. Secondly, difficult cases in terms of differential diagnosis between chronic pulmonary disease and COVID-19 pneumonia were not specifically addressed; this does not represent a huge bias as chronic lung diseases are not expected in pregnant women.

Although there is currently no general agreement on the best method to provide teaching program on lung ultrasound, our report confirmed previous data on the feasibility and effectiveness of such training (13). Other studies proposed lung ultrasound teaching programs, but most of them included a longer teaching time than that of our study and none of them were planned to teach gynaecologists (14-20). These studies focused on also teaching differential diagnosis of different thorax pathologies (*i.e.*, pericardial effusion, pneumothorax, and cardiac standstill) (14). On the contrary, we developed a model to recognize ultrasound signs of COVID-19 pneumonia in pregnant patients.

Considering both the efficacy of lung ultrasound in the detecting of COVID-19 pneumonia in pregnant

women, and the large number of gynaecologists/obstetricians in the world with high level of experience on ultrasound, the fast teaching program could be of clinical relevance in this emergency.

Indeed, at this critical time of pandemic, the possibility to learn how to perform lung ultrasound in a short time could be very useful in low resource countries where there is a lack of CT scan machines and the number of clinicians expert in diagnosis and management of pulmonary pathologies could be insufficient.

On the other hand, the possibility to learn how to perform lung ultrasound in a fast way could be very helpful also in high resource countries in which many hospitals could face a shortage of radiologists or available CT machines, as it happened in some areas. Moreover, the ability to examine lung with an ultrasound could help in triaging pregnant patients admitted to emergency for suspicion of COVID-19 (5, 7, 8). Point of care and the possibility to perform the examination at patient bed site make this diagnostic method of important value in health emergency and intensive care unit, avoiding to transfer critical patients. Finally, the possibility to increase the number of clinicians able to perform lung ultrasound other than pneumologists or radiologists, could help in the management of patients at domicile reducing the hospital load. This may be of great help in the second phase of the pandemic, especially in the follow up of positive patients.

## CONCLUSIONS

In conclusion, our “fast lung ultrasound teaching program” is one possible model of implementing lung ultrasound education and it might be a useful launch pad for clinicians wishing to start using lung ultrasound in their clinical practice. At this critical point of pandemic, lung ultrasound can be of support in both low and high resource countries.

## CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.



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