

Peer Review File

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Reviewer A.

Response: Thank you for your constructive comments and suggestions. We have modified the manuscript according to your suggestions. Please see the responses and changes for each comment below.

Comments:

There is an extensive focus on the development of the training curriculum and training in Europe thereby referring to several publications “fishing in the same pond” resulting in many overlaps because, as seen in table 1, several publications by the same senior authors.

Response: Yes, we do agree that there is a lot of publication and extensive focus on the development of the training curriculum and training in Europe. The main focus of this invited article was to give an overview of training and certification in thoracic surgery.

The conclusions invariably stressing the need for a harmonization and thereby highlighting the related efforts made by UEMS in collaboration with scientific societies. It is a bit rehashing the same data from literature over and over again.

All together the manuscript reflects a negative image of the current state of education programs and certification within thoracic surgery in Europe highlighted by sentence 148 and 149 “.... *in the majority of* see one, do one, one, doteach one....”

This obviously is not true, at least in the EU member states.

Indeed, most countries have a structured approach with a compulsory number of interventions as first assistant, as 1st surgeon under supervision and finally a first surgeon. Logbooks with minimum of required interventions, albeit in varying numbers, are used in most European member states and an exit exam being required to obtain the certification.

Response: We do agree with your point of view, and we have removed the sentence from the manuscript and added: “**Trainees in many institutions** start with minor procedures such as pleural chest tube insertion, VATS cyst resection, VATS wedge resection and then they move on to more complex and advanced procedures, such as VATS lobectomy and segmentectomy.”

There are of course variations in the general concept and the duration of dedicated thoracic training. Which is also the case in the USA. It is not true that that in the US a full 5-year training in general surgery is always required. This is one option, but there are more options, the so called I6 integrated program starting from day one in thoracic and becoming increasingly popular (as seen in the link ABTS in ref 10) and the 4 +3 option, here the board certification after 4 yrs general surgery is no longer compulsory

Sentence 151 152 : “ *...A structured and evidence-based curriculum is not available on how to train and certify trainees....*”

Reference 9 deals with: A harmonized European training syllabus for thoracic surgery: report from the ESTS–ERS task force.

Response: Thank you for pointing out this issue. In the article written by Massard et al. they are arguing for providing a structured and evidence-based curriculum. We have changed the line 15-152: **A structured and evidence-based curriculum is not available on how to train and certify trainees in thoracic surgery.**

We do agree that this sentence is not completely true and that's why we removed this sentence from the manuscript.

The manuscript describing the building of a structured syllabus based on a Delphi process is contradicting this statement. A Delphi process is well well-established method to obtain a broad-based consensus.

In this discussion part on the structure of training and certification, the authors take only the Danish system into account, not Europe...

Response: We have changed to as an e.g., the Danish regulation and compared to the Canadian regulation. **Line 68-69: An e.g., the thoracic residency program in Denmark is based on the Danish regulations for all specialties (11).**

The Kern six steps is basically a self-evaluation tool of assessment of progress during training with the purpose to increase the quality of training. This is different from the summative evaluation after training e.g., the Board certification exam. The Kern six steps is a sort of generic process and should be valued against the six competences evaluation as used in Canned or other systems

Response: We do agree that the Kern's framework is a generic process, and we also believe that this framework can be used to develop an evidence-based training program and curriculum. The Summative and formative evaluation can be used once a training program is developed.

We have removed some of the text about Kerns framework.

Line 155-160: Kern's six-step approach to curriculum development is widely used in health care systems. The first step is to identify problems and needs. Expert consensus must be gathered in a Delphi process on how to train surgical residents. Once the procedures are identified, the Kern's six-step approach can continue to guide the development and implementation of evidence-based training programs and curriculum.

In view of the title of the manuscript, one would rather expect a more in-depth overview of the value of simulation, information of existing simulation systems and their variability and related fidelity.

In the introduction is stated: "...A common European curriculum, based on the consensus of key thoracic leaders to include theoretical and hands-on courses, where simulation is a part of training to reach competency outside the operation theatre is needed. This article reviews the data for the current training and education system in thoracic surgery."

Response: We could have gone more in-depth of simulation and information of existing simulation, however, however, this would be a future manuscript to describe the existing simulation systems and their variability and fidelity.

And further down in the methods: "*We performed a comprehensive search of the literature...focusing on thoracic surgery education and training, thoracic surgery education and certification in Europe, certification, and training of general thoracic surgeons in Europe, and Canadian and American training and certification in thoracic surgery.....*" Obviously "simulation" was not in this search.

Response: It's a mistake that is changed now. Simulation training was a part of the search.

Changes: Line 93-96: "focusing on thoracic surgery education and training, thoracic surgery education and certification in Europe, certification, and training of general thoracic surgeons in Europe, and Canadian and American training and certification in thoracic and simulation training."

Only a Danish simulation system is mentioned. No information when and how to integrate simulation in the training curriculum and certification process and its evidence based added value.

Response: We do not know when simulation will be integrated in the training curriculum. We believe integrating of simulation in the curriculum and certification process is a long process. In Denmark, our institution is working on integrating simulation in to the cardiothoracic curriculum.

The references 9 and 28 are not providing any information on how to integrate simulation in the curriculum, the training...

Response: Yes, we agree, the above-mentioned references has mentioned that thoracic societies are working toward a common educational program in thoracic surgery.

Other comments:

-please provide the reference numbers in the section results for each group of articles, same in the fig 1.

Response: Line 113 – 127 in the result section describes the amount of article and what category they are covering. We totally agree with you that it would give an overview of the articles that are used in this manuscript, however, we believe providing references in the result section would be confusing to the readers and references are not required in the result section. At the same time the table provides an overview for each group. Hope you accept the answer.

-sentence 60: what is meant by: catheter-based interventions? Please specify by a couple of examples.

Response: *We made the sentence more specific, so we changed: Line 60-61 “Thoracic surgery has advanced in recent years with the development of minimally invasive surgery, robotic surgery, laser or endoscopic cryotherapy.”*

-sentence 127: joint European examination ??? there is only one European EBTS examination for thoracic surgery. There is a separate examination EBCTS organized in collaboration EACTS. But no joint examination

Response: Thank you for pointing this. We have erased “**joint**” in the manuscript now.

-sentence 137: "The European thoracic surgery committee ... i"s this the ESTS thoracic ???please clarify.

Response: Once again thank you for pointing the mistake. Now the committee is changed to society: Line 137-139 “**The European thoracic surgery society and organizations are working toward a common, evidence-based European educational training programs.**”

-sentence 142 ref 8: please use also the landmark publication by Klepetko from 2000, the 2014 publication is just an update of this publication. Both references illustrate the continuous efforts in Europe to improve quality.

-the same for reference 29: this is the synopsis of the original article; it should be replaced by the 2000 original publication.

Response: Thank you for advice: The ref. is changed according to your suggestion. “*Klepetko W, Aberg TH, Lerut AE, Grodzki T, Velly JF, Walker WS, Ahren C, Arsovski A, Bellenis I, Bequiri S, Berrisford RG, Branscheid D, Bibicic J, Csekeö A, Drescik I, Dussek J, Erzen J, Furmanik F, Godinho MT, Goldstraw P, Gotti G, Halezeroglu S, Hamzik J, Harustiak S, Hasse J, Hartl P, Hostrup P, Horvat T, Ilic N, Jeyasingham K, Kappetein AP, Kecskes L, Laisaar T, Lampl L, Lefevre P, Maggi G, Magnanelli G, Massard G, Moghissi K, Molnar T, Noirhomme PH, Orłowski T, Pafko P, Petricevic A, Pujol JL, van Raemdonck EM, Ramos Seisdedos G, Ris HB, Salo J, van Schil P, Schmid RA, Thorpe A, Toomes H, Varela A, Varela G, Venuta F, sa Vieira VM, Weder W, Wihlm JM, Zannini P, Marta GM; EACTS/ESTS Working Group on Structures in Thoracic Surgery. Structure of general thoracic surgery in Europe. Eur J Cardiothorac Surg. 2001 Oct;20(4):663-8. doi: 10.1016/s1010-7940(01)00942-3*”

Reviewer B

This article is the first one to point out the major changes that occurred in surgical training, owing to early overspecialization, minimally invasive approaches and innovative technologies, liability issues and other. It stresses the need for harmonization of curricula and assessment at completion of specialist training. It highlights simulation training as an important prerequisite before surgical trainees perform operations on patients.

Being from an older generation, having grown up without any regulation of working time, I suggest to develop a little bit more that section. I wished to point out a survey that has been made among European trainees.

McElnay PJ, Massard G. Thoracic training across Europe: the trainees' perspective. Eur J Cardiothorac Surg 2015;47:395-6

Response: Thank you for reading this article and your time. After reading the above-mentioned article the ref. is added to the article. It's a very well written and important manuscript.

Reviewer C

The article calls for a unification of thoracic training and certification efforts among European countries which is a noble but enormous task. The article states that its main focus is to review the data of current training programs in thoracic surgery and cites several peer reviewed studies from the USA, Canada, and others. Overall, the organization of the paper is poor and the content does not appear to answer the authors initial question in terms of relevancy to improving training in Europe. A review of American/Canadian training programs is not applicable to the unique challenges of surgical training in multiple European countries.

Response: Thank you for reading this manuscript. This article gives a short overview of challenges we face across European countries. We did not discuss how to improve the training in Europe; however, we chose to put the training of thoracic surgeon in perspective. We do believe that American/Canadian training program is not applicable to the challenges we face in European countries.

Reviewer D

The manuscript is a review of current trends in CT surgery training in Europe. The authors conclude that there is a need for change in the structure and certification in cardiothoracic education and recommend simulation as part of the thoracic curriculum. Although the topic is important and timely, my main concerns are regarding the scientific merit of the study. The inclusion and exclusion criteria were not clearly defined a priori in the Methods section. Instead, it seems that the investigators made the decisions to include the studies as they were reviewed. The results then cannot be reproduced since selection criteria were not pre-defined. The Results section did not include a summary of the findings in the papers included. The discussion and conclusions reached at the end are less based on the available evidence than the investigators own opinions on the subject. Because of this, the manuscript should be less considered original review than expert opinion.

Response: Thank you for reading this manuscript and your opinion. In this scoping review we tried to give the readers an overview of the current challenges. We believe in order to cover all the points, there is a need for a systematic review to clearly define each point by point.

Editorial Comments

1. We suggest the authors modify the title to make it more informative. For example, clarify that the aim of this scoping review is to summarize the current state of simulation training and certification in thoracic surgery. Also, "Europe" should be emphasized.

2. In the title, please clearly identify this manuscript as a Scoping Review.

Response: Thank you for the comments. We changed the title as: "The current status of simulation training and certification for thoracic surgery in Europe: A scoping review."

3. It's suggested the authors structure the abstract into 1) **Background**, 2) **Methods** (including the inclusion and exclusion criteria, databases, and timeframe), 3) **Results** (e.g., the total number of included studies), and 4) **Conclusions**, which would help the readers quickly access the main content of this review.

Response: Thank you for the suggestion: We have structured the abstract as advised. Please see the manuscript.

4. Lines 85-86: "To date, a common curriculum has not yet been developed and the specific content and organization of the curriculum in each country depend on the individual national regulations". Given the practicalities, we suggest that the authors clarify why the training content needs to be harmonized across Europe.

Response: A very important issue is mentioned here. We did change: Line 87-89: "This causes imbalance in the qualification and competency of thoracic surgeons, which can affect the quality of care offered to the patients."

5. We recommend authors highlight the value and the knowledge gap of this review: what does this review add to existing knowledge? How does this review differ from previous reviews? Maybe a more expansive overview has been provided in this review, or more up-to-date evidence has been presented (just for your information).

Response: We added line 92-94: "This review provides an up-to-date information on challenges within training thoracic surgeons and discuss the existing knowledge within educational systems."

6. Please report the timeframe and the date when each source was last searched or consulted (specified to date, month, and year). Or please specify the reason for "NA" in the checklist.

Response: The time frame has been updated, reported as suggested, and the sources were checked in the past month once again. NA (not available) means data are missing. Specified in the checklist.

7. Line 94: "PubMed Database, Medline, and Google Scholar". Line 106: "PubMed/Medline, Embase, and Cochrane". Please recheck and confirm the database source. Also, as a scoping review, the database must include at least one search for grey literature sources.

Response: We did recheck the database sources. The grey literature source is included (Google Scholar).

8. For a scoping review, simply saying "Inclusion criteria included studies that reported on thoracic surgery training, education, certification, and educational platform in European countries, as well as Canadian and American guidelines" may not be comprehensive enough. We suggest the authors present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.

Response: Thank you for the suggestion. Here is how the search was performed and it's included in the manuscript.

Line 102-108: "We first conducted a search of the PubMed and OVID/Medline databases using the keywords 'thoracic surgery education', 'training thoracic surgeon in Europe, 'certification in thoracic surgery' – we also included more general terminology such as certification and training, but excluded articles clearly conference presentation and editorial letters, including full-text accessible articles in English. We then performed an analysis that included all these studies from May 2000 to June 2023. After reviewing the articles, all potentially relevant studies were elevated." See the supplementary table.

Search number	Query	Search Details	Results
10	training of general thoracic surgeons in Europe[Title/Abstract]	((("education"[MeSH Subheading] OR "education"[All Fields] OR "training"[All Fields] OR "education"[MeSH Terms] OR "train"[All Fields] OR "train s"[All Fields] OR "trained"[All Fields] OR "training s"[All Fields] OR "trainings"[All Fields] OR "trains"[All Fields]) AND ("drugs, generic"[MeSH Terms] OR ("drugs"[All Fields] AND "generic"[All Fields]) OR "generic drugs"[All Fields] OR "generic"[All Fields] OR "family characteristics"[MeSH Terms] OR ("family"[All Fields] AND "characteristics"[All Fields]) OR "family characteristics"[All Fields] OR "generation"[All Fields] OR "generations"[All Fields] OR "general"[All Fields] OR "general s"[All Fields] OR "generalisability"[All Fields] OR "generalisable"[All Fields] OR "generalisation"[All Fields] OR "generalization, psychological"[MeSH Terms] OR ("generalization"[All Fields] AND "psychological"[All Fields]) OR "psychological generalization"[All Fields] OR "generalization"[All Fields] OR "generalisations"[All Fields] OR "generalise"[All Fields] OR "generalised"[All Fields] OR "generalises"[All Fields] OR "generalisability"[All Fields] OR "generalising"[All Fields] OR "generalities"[All Fields] OR "generality"[All Fields] OR "generalizability"[All Fields] OR "generalizable"[All Fields] OR "generalizations"[All Fields] OR "generalize"[All Fields] OR "generalized"[All Fields] OR "generalizes"[All Fields] OR "generalizing"[All Fields] OR "generally"[All Fields] OR "generals"[All Fields] OR "generate"[All Fields] OR "generated"[All Fields] OR "generates"[All Fields] OR "generating"[All Fields] OR "generation s"[All Fields] OR "generational"[All Fields] OR "generative"[All Fields] OR "generatively"[All Fields] OR "generativity"[All Fields] OR "generator"[All Fields] OR "generator s"[All Fields] OR "generators"[All Fields] OR "generically"[All Fields] OR "genericity"[All Fields] OR "generics"[All Fields]) AND ("thoracal"[All Fields]	7

		OR "thoracical"[All Fields] OR "thorax"[MeSH Terms] OR "thorax"[All Fields] OR "thoracic"[All Fields] OR "thoracics"[All Fields]) AND ("surgeon s"[All Fields] OR "surgeons"[MeSH Terms] OR "surgeons"[All Fields] OR "surgeon"[All Fields])) AND "in europe"[Title/Abstract] AND ((ffrft[Filter]) AND (fha[Filter]))	
8	certification[Title/Abstract] AND training program[Title/Abstract]	("certification"[Title/Abstract] AND "training program"[Title/Abstract]) AND ((ffrft[Filter]) AND (fha[Filter]))	116
4	certification in thoracic surgery[Title/Abstract]	("certificate"[All Fields] OR "certificate s"[All Fields] OR "certificated"[All Fields] OR "certificates"[All Fields] OR "certification"[MeSH Terms] OR "certification"[All Fields] OR "certifications"[All Fields]) AND "in thoracic surgery"[Title/Abstract]	18
3	training thoracic surgeon in Europe[Title/Abstract]	((("education"[MeSH Subheading] OR "education"[All Fields] OR "training"[All Fields] OR "education"[MeSH Terms] OR "train"[All Fields] OR "train s"[All Fields] OR "trained"[All Fields] OR "training s"[All Fields] OR "trainings"[All Fields] OR "trains"[All Fields]) AND ("thoracal"[All Fields] OR "thoracical"[All Fields] OR "thorax"[MeSH Terms] OR "thorax"[All Fields] OR "thoracic"[All Fields] OR "thoracics"[All Fields]) AND ("surgeon s"[All Fields] OR "surgeons"[MeSH Terms] OR "surgeons"[All Fields] OR "surgeon"[All Fields])) AND "in europe"[Title/Abstract]	21
2	thoracic surgical education[Title/Abstract]	"thoracic surgical education"[Title/Abstract]	14

9. In addition, we suggest the authors list and define all outcomes for which data were sought in the text, which needs to be consistent with Table 1 and results (lines 105-131).

Response: Thank you for the suggestion. In the table we made clear the main output for each article.

10. The content of Table 1 should be as concise as possible. The "Title" column should be deleted.

Response: The title column is deleted.

11. In addition, it is suggested to add a column to reflect the authors' understanding, summary, and classification of these findings.

Response: We added a new column that reflects my understanding of these findings. Please find the changes in the table in the manuscript.

12. For ease of reading and double-checking, it would be better to add the reference number of the included studies in the tables.

Response: We added the reference number in the table.

13. "Table 1: Shows the articles included in this study with summary of key findings": We suggest optimizing the title of Table 1 to be more readable.

Response: The title is changed to Key findings and summary of the papers included in the scoping review.

Discussion

14. Related to comment 5, we suggest the authors provide some suggestions for solutions to the obstacles now faced in the Discussion. For example, regarding "Working hours and academic enrichment", are there any solutions for surgeons who do not have time for training? We do believe it will be more enlightening to readers and colleagues.

Response: Thank you for the suggestion, we added this section in the manuscript, line 228-230: "With reducing working hours and more complex procedures being performed, it is crucial to prepare trainees with simulation training and supervision by experienced surgeons."

15. We recommend including a separate section on the STRENGTHS and LIMITATIONS of this review to promote a more intellectual interpretation.

Response: Thank you for the recommendation, we added to separate sections on strengths and limitations. Line 231-236. This is an up-to-date scoping review of the current status of simulation training and certification for thoracic surgery in Europe, providing the latest knowledge in this topic.

However, the manuscript is limited because we only focus on training of thoracic surgeons in Europe. Including Asia, US and Africa could have made the manuscript more generalizable, but this was beyond the scope. We could also have included other specialties, such as abdominal surgery, invasive cardiology, orthopedic surgery to see how they train and educate future surgeons.

16. Please place the references as they are referenced, not altogether in the end. E.g., "Massard et al. [9] and Lerut et al. [28] provided consensus about the procedures and content of training curriculum for a harmonized European-based thoracic education and certification program in a Delphi Study".

Response: The reference is changed in the text as suggested: Massard et al. (9) and Lerut et al. (28) provided consensus about the procedures and content of training curriculum for a harmonized European-based thoracic education and certification program in a Delphi Study.