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Open online courses on basic life support: Availability and resuscitation guidelines compliance

Early bystander cardiopulmonary resuscitation (CPR) is critical for survival in out-of-hospital cardiac arrest [1]. Effective education of the public in CPR increases the number of people being willing and able to provide the lifesaving help and is recognized as an essential contributor to improved outcomes after cardiac arrest [2,3].

Despite the efforts to enhance penetration of CPR training into the society [3,4], yet the opportunities to get trained in CPR are limited [5,6] and population coverage with resuscitation education remains low [7-9]. Layperson resuscitation training is less accessible for specific racial, ethnic and low socioeconomic status populations [3,10,11] and for people with disabilities [12]. Further, face-to-face training in CPR was and still is hindered globally by the COVID-19 pandemic [13,14].

In order to intensify involvement of the general public into resuscitation training it is recommended to utilize alternative educational strategies, including self-directed digital learning [3,4]. Online learning in resuscitation is effective in improving knowledge, self-confidence and willingness to perform CPR [15-19]. When paired with hands-on practice, web-based self-instruction may develop psychomotor skills as effectively as through instructor-led Basic Life Support (BLS) courses [17,20]. Online courses could also be a part of blended learning programs, thus decreasing burden to instructors and reducing costs of training [16,21], and offer other advantages, including safety, learning autonomy, flexibility, comfort, time savings and standardized delivery of training content [22,23].

Unlike paid online courses, massive open online courses (MOOC) provide unrestricted opportunities for training and retraining free of charge. With rapidly growing number of active internet users worldwide [24], distance resuscitation education through MOOC has the potential to reach hundreds thousands people, including those who have no way to attend BLS training in a classroom. However, current availability of MOOC on BLS is unknown and no previous studies have evaluated quality of educational content of existing online BLS courses in terms of conformity with international CPR guidelines. This study aimed to address this gap.

A search of MOOC on adult BLS was conducted in December 2021 (see Table 1 for the search strategy). Courses meeting the following criteria were selected for analysis: 1) a course devoted to adult BLS or contains adult BLS as part of a syllabus; 2) free of charge; 3) English-language; 4) suitable for any layperson; 5) self-paced and provided on an ongoing basis with time-unlimited access. Fig. 1 shows the selection process.

Two researchers independently evaluated educational content of eligible courses using a 72-item checklist developed based on prior work by Jensen and colleagues [25] and considering the latest consensus and guidelines on CPR [14,26,27].

A total of 28 eligible MOOC were analyzed (Table 2). Although being frequently declared as compliant with relevant guidelines, the courses'

content often omitted core evidence-based recommendations on CPR (see Table 3 for a summary of evaluation of the MOOC conformity with CPR guidelines; for detailed results see Dataset [dataset] [28]). In particular, the majority of the MOOC did not concern abnormal or agonal breathing and seizures as a sign of cardiac arrest, neglected instructions to open airways for breathing check, restrict assessment of breathing to 10 s, use hands-free function of the phone when talking with a dispatcher, avoid leaving a cardiac arrest victim to get an automated external defibrillator, ensure correct victim's and rescuer's positioning. An emphasis on early start and minimization of pauses in chest compressions was also commonly missing. Fifty percent of the MOOC did not explain conditions for cessation of CPR attempt and almost 90% were lacking proper description of signs of victim's recovery from cardiac arrest. For courses addressing rescue breathing, choking and recovery position, correct description of respective techniques was frequently absent or incomplete. Whereas a quarter of the MOOC concerned peculiarities of BLS in settings of COVID-19 pandemic, no course has covered all the infection-related aspects of lay rescuer CPR from respective guidelines [14]. Concepts of compression-only CPR and dispatcher-assisted CPR were commonly omitted from the MOOC syllabus, and most courses did not touch upon potential barriers to bystanders' willingness to provide CPR. Furthermore, three fourths of the MOOC contained instructions disagreeable with current guidelines (Fig. 2).

We suppose that the shortcomings of the MOOC educational content may lead to formation of incomplete or wrong competencies and set erroneous priorities that may have negative impact on trainees' willingness to act and on performance of the lifesaving actions in a real-life emergency. Alongside this the observed weaknesses of the MOOC suggest that paid online courses may have similar quality issues.

The revealed faults of the MOOC could be attributed to negligence or incompetence of the course developers and selection of inappropriate (e.g., non-evidence-based or outdated) information sources for creation of the educational content. Multiple courses were declared to be compliant with American Heart Association (AHA) guidelines or International Liaison Committee on Resuscitation (ILCOR) consensus on CPR. These documents are meant for providing an evidence-informed update for a set of specific scientific questions, rather than outlining the whole procedure and all peculiarities of BLS. Some of the course developers may have used AHA guidelines or ILCOR consensus as a single source of evidence-based information that could have resulted in omission of relevant resuscitation techniques and principles from the courses' content.

As a step towards quality improvement the checklist from this study could be further refined through a Delphi-based expert consensus process and recommended for developers of educational content on BLS to ensure complete coverage and correct presentation of essential resuscitation issues. Further, the checklist could be utilized for performing an expert-led systematic appraisal of available web-based resuscitation training resources with subsequent development of an electronic aggregator of validated guidelines-compliant free-of-charge online BLS courses and training materials [29]. Creation of the aggregator would

Table 1
Sources and keyword combinations utilized for searching MOOC in BLS.

Sources	Keywords
Google search engine*	free, basic life support, course, online free, BLS, course, online free, cardiopulmonary resuscitation, course, online free, CPR, course, online free, basic life support, training, online free, BLS, training, online free, cardiopulmonary resuscitation, training, online free, CPR, training, online basic life support BLS cardiopulmonary resuscitation CPR
MOOC aggregators (Class Central, CourseBuffet, MOOC List, My Education Path) and MOOC platforms (Coursera, edX, FutureLearn, Swayam, Udemy)	

Notes. * For the Google search, the United Kingdom was selected as a default search region. For every keyword combination, first 100 Google search results were screened for eligibility. Abbreviations: BLS, Basic Life Support; CPR, cardiopulmonary resuscitation; MOOC, massive open online course.

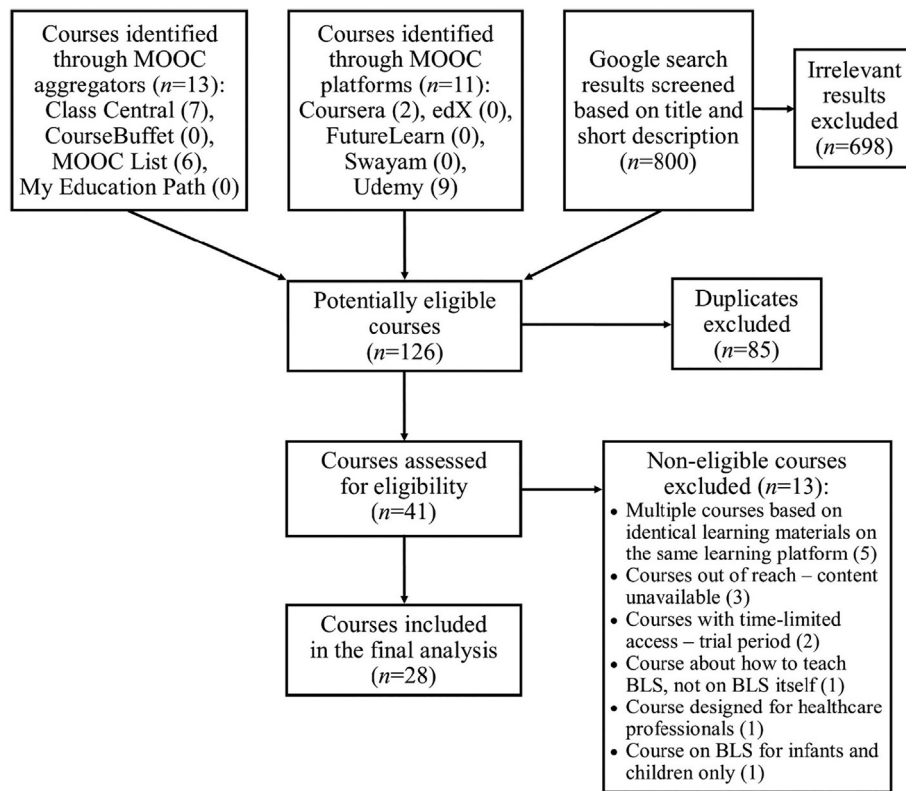


Fig. 1. Course search and selection flow diagram.

Notes. Courses designed for healthcare professionals (as declared in a course description) were excluded. Whenever multiple eligible courses based on identical learning materials were found on the same learning platform or website, duplicate courses were excluded.

Abbreviations: BLS, Basic Life Support; MOOC, massive open online course.

Table 2
Characteristics of the MOOC on adult BLS ($n = 28$).

Parameter	Courses, % (n)
Course developer	
Non-profit organisation	35.7 (10)
Corporation/Limited liability company	46.4 (13)
Healthcare entity	3.6 (1)
Unknown	14.3 (4)
MOOC platform	
Alison	7.1 (2)
OpenLearning	3.6 (1)
Stepik	3.6 (1)
Udemy	17.9 (5)
Not applicable (stand-alone website)	67.9 (19)
Syllabus	
Adult BLS	100.0 (28)
Automated external defibrillation	78.6 (22)
Child BLS	75.0 (21)
Choking	64.3 (18)
COVID-19 considerations	25.0 (7)
First aid topics (e.g., first aid in bleeding, burns, seizures)	35.7 (10)
Infant BLS	78.6 (22)
Recovery position	46.4 (13)
Guidelines compliance (as declared by the developer)*	
American Heart Association, year not specified	10.7 (3)
American Heart Association, 2015	7.1 (2)
American Heart Association, 2020	7.1 (2)
American Red Cross, year not specified	3.6 (1)
American Red Cross, 2015	3.6 (1)
European Resuscitation Council, 2021	3.6 (1)
International Liaison Committee on Resuscitation, year not specified	3.6 (1)
International Liaison Committee on Resuscitation, 2015	3.6 (1)
International Liaison Committee on Resuscitation, 2020	32.1 (9)
Resuscitation Council UK, year not specified	3.6 (1)
Not stated	39.3 (11)
Multimedia content	
Text	96.4 (27)
Static images	71.4 (20)
Animated images	10.7 (3)
Videos	92.9 (26)
Requirement to register/create an account	
Yes	60.7 (17)
No	39.3 (11)
Option for communication with instructor(s)	
Yes	7.1 (2)
No	92.9 (26)
Trainee's knowledge assessment	
Intermediate tests only	14.3 (4)
Intermediate tests & Free final test exam	32.1 (9)
Intermediate tests & Paid final test exam	0.0 (0)
Free final test exam only	32.1 (9)
Paid final test exam only	14.3 (4)
Absent	7.1 (2)
Certificate of completion awarded	
Yes, free	25.0 (7)
Yes, paid	53.6 (15)
No	21.4 (6)

Notes. * Some courses were declared as compliant with two guidelines.

Abbreviations: BLS, Basic Life Support; COVID-19, coronavirus disease 2019; MOOC, massive open online course; UK, United Kingdom.

Table 3
Quality appraisal of the MOOC on adult BLS ($n = 28$) in terms of conformity with resuscitation guidelines

No.	Checklist items	Satisfied, % (n) of courses
	Safety	
1	Does the course state that the rescuer should make sure that he/she, victim and any bystanders are safe?	92.9 (26)
	Recognition	
2	Is cardiac arrest defined as a state when a person is unresponsive with absent or abnormal (agonal) breathing?	25.0 (7)
3	<i>Response check</i> : Does the course instruct to shake gently by shoulders and ask loudly to examine if the victim is responsive?	92.9 (26)
4	<i>Victim's position</i> : Does the course instruct to position the victim on their back if unresponsive?	7.1 (2)
5	<i>Airway opening</i> : Is there instruction for head tilt maneuver?	32.1 (9)
6	<i>Airway opening</i> : Is there instruction for chin lift maneuver?	28.6 (8)
7	<i>Breathing check</i> : Does the course instruct to look for breathing?	85.7 (24)
8	<i>Breathing check</i> : Is it clear that the rescuer should use a maximum of 10 s to check breathing?	32.1 (9)
9	<i>Agonal breathing</i> : Does the course state that agonal breathing should be interpreted a sign of cardiac arrest?	39.3 (11)
10	<i>Agonal breathing</i> : Does the course describe agonal breathing pattern (e.g., infrequent, slow, noisy gasps, labored breathing)?	46.4 (13)
11	<i>Seizures</i> : Does the course state that seizures could be a sign of cardiac arrest?	7.1 (2)
	Call for help	
12	<i>Call EMS</i> : Does the course state that the rescuer should immediately ask a helper to call EMS or call themselves when recognising cardiac arrest?	96.4 (27)
13	<i>Call EMS</i> : Does the course instruct to use speaker function (hands-free) on a telephone to start CPR whilst talking to a dispatcher?	25.0 (7)
14	<i>Send for AED</i> : Does the course instruct to ask a helper to collect nearest AED?	75.0 (21)
15	<i>Send for AED</i> : Does the course state that the rescuer should not leave the victim to collect AED themselves?	10.7 (3)
	Chest compressions	
16	Does the course instruct to start compressions as soon as possible?	53.6 (15)
17	<i>Rescuer's position</i> : Does the course instruct to kneel by the side of the victim?	28.6 (8)
18	<i>Firm surface</i> : Does the course instruct to perform compressions on a firm surface?	28.6 (8)
19	<i>Hand position</i> : Does the course instruct to place the heel of one hand at the center of the chest (lower half of the breastbone)?	89.3 (25)
20	<i>Hand position</i> : Does the course instruct to place the heel of other hand on top of the first hand and interlock fingers?	96.4 (27)
21	<i>Rescuer's position</i> : Does the course instruct to keep arms straight?	64.3 (18)
22	<i>Rescuer's position</i> : Does the course instruct the rescuer to position themselves vertically above the victim's chest?	57.1 (16)
23	<i>Compressions depth</i> : Does the course state the correct depth is 5–6 cm?	92.9 (26)
24	<i>Compressions rate</i> : Does the course state the correct rate is 100–120 per minute?	92.9 (26)
25	<i>Chest recoil</i> : Does the course instruct to ensure chest recoil after each compression (release pressure on the chest without losing contact with the chest)?	82.1 (23)
26	<i>Minimisation of pauses</i> : Does the course state that any pauses in chest compressions should be minimized?	60.7 (17)
	Rescue breathing, $n = 26^*$	
27	<i>Compression-ventilation ratio</i> : Does the course instruct to use compression-ventilation ratio of 30:2?	100.0 (26)
28	<i>Airway opening</i> : Is it clear that the rescuer should open airways again prior to ventilation?	100.0 (26)
29	<i>Airway opening</i> : Does the course instruct to maintain head tilt and chin lift during rescue breathing?	42.3 (11)
30	<i>Nasal pinch</i> : Does the course instruct to pinch the nose prior to ventilation?	92.3 (24)
31	<i>Sealing</i> : Does the course instruct to place lips around the victim's mouth ensuring airtight seal?	92.3 (24)
32	<i>Ventilations</i> : Does the course state that each rescue breath should last about 1 s?	76.9 (20)
33	<i>Ventilations</i> : Does the course instruct to give a normal breath volume (avoid excessive ventilation)?	50.0 (13)
34	<i>Ventilations</i> : Does the course instruct to look for chest rise?	88.5 (23)
35	<i>Ventilations</i> : Does the course instruct to take mouth away from the victim to allow for passive exhalation?	19.2 (5)
36	<i>Ventilations</i> : Does the course instruct to give a total of two rescue breaths?	96.2 (25)
37	<i>Resume compressions</i> : Does the course instruct to resume compressions immediately after the second breath (even if breaths are ineffective)?	46.2 (12)
38	<i>Minimum pause</i> : Does the course state that compressions shouldn't be interrupted for more than 10 s to deliver two rescue breaths?	38.5 (10)
	Defibrillation, $n = 22^*$	
39	<i>Turn AED on</i> : Does the course instruct to turn on AED as soon as it arrives?	81.8 (18)
40	<i>Attach electrodes</i> : Does the course instruct to attach electrodes to the victim's bare chest?	90.9 (20)
41	<i>Continue CPR</i> : Does the course instruct to continue CPR whilst AED is prepared if more than one rescuer is present?	50.0 (11)
42	<i>Follow instructions</i> : Is it clear that rescuers should follow spoken and visual instructions of AED?	86.4 (19)
43	<i>Do not touch, analysis</i> : Is it clear that bystanders cannot be in physical contact with the victim during analysis?	90.9 (20)
44	<i>Do not touch, shock</i> : Is it clear that bystanders cannot be in physical contact with the victim when applying shock?	86.4 (19)
45	<i>Resume CPR</i> : Does the course state that after shock (or if no shock is advised) the rescuer should immediately resume CPR and continue as directed by AED?	68.2 (15)
46	<i>Minimum pause</i> : Does the course state that long pauses in compressions should be avoided when applying and using AED?	18.2 (4)
	Continuation of CPR	
47	Does the course state that CPR should be continuous until a professional tells to stop, the rescuer is exhausted or the victim recovers?	50.0 (14)
48	Does the course describe signs of victim's recovery (waking up, moving, opening eyes and for sure breathing normally)?	10.7 (3)
	Recovery position, $n = 13^*$	
49	Does the course instruct to place the victim in recovery position if the victim is breathing normally but unresponsive?	100.0 (13)
50	Does the course describe correct technique for placing the victim in recovery position?	46.2 (6)
51	Does the course instruct to continuously monitor normal breathing for the victim placed in recovery position?	76.9 (10)
	Choking, $n = 18^*$	
52	<i>Recognition</i> : Does the course instruct to suspect choking if someone is suddenly unable to speak or talk, particularly if eating?	83.3 (15)
53	<i>Recognition</i> : Does the course instruct to ask the conscious victim "Are you choking?"	33.3 (6)
54	<i>Coughing</i> : Does the course instruct to encourage coughing when the victim is conscious and able to cough?	77.8 (14)
55	<i>Back blows</i> : Does the course instruct to give up to 5 back blows if coughing fails to clear the obstruction or the victim starts to show signs of fatigue?	22.2 (4)
56	<i>Back blows</i> : Does the course describe correct technique for back blows?	22.2 (4)
57	<i>Abdominal thrusts</i> : Does the course instruct to give up to 5 abdominal thrusts if back blows are ineffective?	22.2 (4)
58	<i>Abdominal thrusts</i> : Does the course describe correct technique for abdominal thrusts?	100.0 (18)
59	<i>Continue blows/thrusts</i> : Does the course instruct to continue series of 5 back blows followed by 5 abdominal thrusts if prior measures are ineffective?	22.2 (4)
60	<i>Start CPR</i> : Does the course instruct to start CPR when the victim is unconscious with absent or abnormal breathing?	88.9 (16)
61	<i>Avoid blind finger sweep</i> : Does the course state that blind finger sweep should be avoided?	5.6 (1)

Table 3 (continued)

No.	Checklist items	Satisfied, % (n) of courses
COVID-19, n = 7*		
62	Does the course provide guidance on CPR during COVID-19 pandemic?	100.0 (7)
63	<i>Recognition</i> : Does the course instruct to avoid opening airways and placing face next to the victims' mouth or nose for breathing check?	14.3 (1)
64	<i>Compression-only CPR</i> : Does the course state that lay rescuers should consider compression-only CPR and AED?	71.4 (5)
65	<i>Ventilations</i> : Does the course state that lay rescuers who are willing, trained and able to do so, may deliver rescue breaths to children in addition to compressions?	42.9 (3)
66	<i>Face covering</i> : Does the course instruct to place a cloth/towel over the victim's mouth and nose before performing compressions and using AED?	42.9 (3)
67	<i>Disinfection</i> : Does the course state that after providing CPR, lay rescuers should wash/disinfect their hands and enquire COVID-19 screening?	28.6 (2)
Miscellaneous		
68	<i>Concerns of harm</i> : Does the course state that lay rescuers should initiate CPR for presumed cardiac arrest without concerns of harm to victims not in cardiac arrest?	42.9 (12)
69	<i>Other concerns</i> : Does the course address other barriers to bystanders' willingness to perform CPR (e.g., fear of prosecution, infection, etc.)?	35.7 (10)
70	<i>Compression-only CPR</i> : Does the course state that bystanders who are untrained, unable or unwilling to give rescue breaths should give continuous chest compressions without rescue breaths?	64.3 (18)
71	<i>Dispatcher-assisted CPR</i> : Does the course address the concept of dispatcher-assisted CPR (in particular, that lay rescuer can actively ask for the assistance)?	28.6 (8)
72	<i>Excessive actions</i> : Does the course instruct to perform any superfluous actions that are noncompliant with current guidelines on BLS?	75.0 (21)

Notes. Content not related to adult BLS (e.g., BLS in children or first aid issues), supplementary resources and external links were omitted from the MOOC evaluation.

*Number of courses addressing the subtopic; where indicated, percentages were calculated out of this number, where not indicated – out of the total number of courses (n = 28).

Abbreviations: AED, automated external defibrillator; BLS, Basic Life Support; COVID-19, coronavirus disease 2019; CPR, cardiopulmonary resuscitation; EMS, emergency medical services.

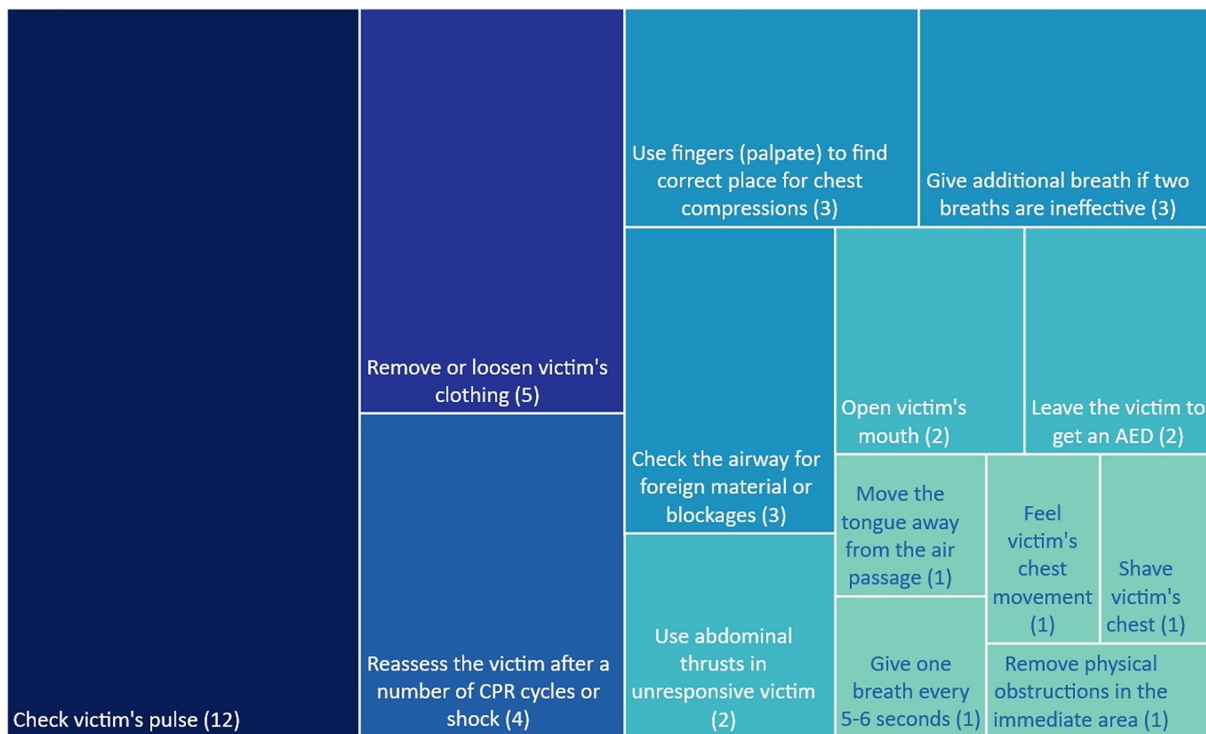


Fig. 2. Distribution of the MOOC on adult BLS (n) that included instructions inconsistent with resuscitation guidelines.

Abbreviations: AED, automated external defibrillator; CPR, cardiopulmonary resuscitation.

improve engagement of laypeople in BLS training and bystander CPR globally, including low-resource regions where availability of in-person resuscitation training is limited but the number of Internet users continues to raise considerably.

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Credit authorship contribution statement

Alexei Birkun: Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Formal

analysis, Conceptualization. **Adhish Gautam:** Writing – original draft, Validation, Investigation, Formal analysis. **Fatima Trunkwala:** Writing – original draft, Validation, Investigation, Formal analysis. **Bernd W. Böttiger:** Writing – original draft, Validation, Investigation, Formal analysis.

Declaration of Competing Interest

A.B. is the main author of the “Basic Life Support and Automated External Defibrillation” course that was analyzed in this study. A.G. and F.T. have no conflicts of interest. B.W.B. is Board member and treasurer of the European Resuscitation Council (ERC), Chairman of the German Resuscitation Council (GRC), Federal state doctor of the German Red

Cross (DRK). Member of the Advanced Life Support (ALS) Task Force of the International Liaison Committee on Resuscitation (ILCOR), Member of the Board of the German Interdisciplinary Association for Intensive Care and Emergency Medicine (DIVI), Founder of the Deutsche Stiftung Wiederbelebung / German Resuscitation Foundation, Founder of the ERC Research NET, Co-Editor of "Resuscitation", Editor of the Journal "Notfall + Rettungsmedizin", Co-Editor of the "Brazilian Journal of Anesthesiology". He received fees for lectures from the following companies: Forum für medizinische Fortbildung (FomF), Baxalta Deutschland GmbH, ZOLL Medical Deutschland GmbH, C.R. Bard GmbH, GS Elektromedizinische Geräte G. Stemple GmbH, Novartis Pharma GmbH, Philips GmbH Market DACH, Bioscience Valuation BSV GmbH.

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References

- Yan S, Gan Y, Jiang N, Wang R, Chen Y, Luo Z, et al. The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: a systematic review and meta-analysis. *Crit Care*. 2020;24:61. <https://doi.org/10.1186/s13054-020-2773-2>.
- Greif R, Lockey AS, Conaghan P, Lippert A, De Vries W, Monsieurs KG, et al. European resuscitation council guidelines for resuscitation 2015: section 10. *Edu Implement Resuscit Resuscit*. 2015;95:288–301. <https://doi.org/10.1016/j.resuscitation.2015.07.032>.
- Cheng A, Magid DJ, Auerbach M, Bhanji F, Bigham BL, Blewer AL, et al. Part 6: resuscitation education science: 2020 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2020;142:S551–79. <https://doi.org/10.1161/CIR.0000000000000903>.
- Greif R, Lockey A, Breckwoldt J, Carmona F, Conaghan P, Kuzovlev A, et al. European resuscitation council guidelines 2021: education for resuscitation. *Resuscitation*. 2021;161:388–407. <https://doi.org/10.1016/j.resuscitation.2021.02.016>.
- Birkun A, Trunkwala F, Gautam A, Okoroanyanwu M, Oyewumi A. Availability of basic life support courses for the general populations in India, Nigeria and the United Kingdom: an internet-based analysis. *World J Emerg Med*. 2020;11:133–9. <https://doi.org/10.5847/wjem.j.1920-8642.2020.03.001>.
- Schnaubelt S, Schnaubelt B, Pilz A, Oppenauer J, Yildiz E, Schrieff C, et al. BLS courses for refugees are feasible and induce commitment towards lay rescuer resuscitation. *Eur J Clin Invest*. 2022;52:e13644. <https://doi.org/10.1111/eci.13644>.
- Duber HC, McNellan CR, Wollum A, Phillips B, Allen K, Brown JC, et al. Public knowledge of cardiovascular disease and response to acute cardiac events in three cities in China and India. *Heart*. 2018;104:67–72. <https://doi.org/10.1136/heartjnl-2017-311388>.
- Bartlett ES, Flor LS, Medeiros DS, Colombara DV, Johanns CK, Camargo Vaz FA, et al. Public knowledge of cardiovascular disease and response to acute cardiac events in three municipalities in Brazil. *Open Heart*. 2020;7:e001322. <https://doi.org/10.1136/openhrt-2020-001322>.
- Birkun A, Gautam A, Trunkwala F. Global prevalence of cardiopulmonary resuscitation training among the general public: a scoping review. *Clin Exp Emerg Med*. 2021;8:255–67. <https://doi.org/10.15441/ceem.21.066>.
- Anderson ML, Cox M, Al-Khatib SM, Nichol G, Thomas KL, Chan PS, et al. Rates of cardiopulmonary resuscitation training in the United States. *JAMA Intern Med*. 2014;174:194–201. <https://doi.org/10.1001/jamainternmed.2013.11320>.
- Greif R, Bhanji F, Bigham BL, Bray J, Breckwoldt J, Cheng A, et al. Education, implementation, and teams: 2020 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Circulation*. 2020;142:S222–83. <https://doi.org/10.1161/CIR.0000000000000896>.
- Birkun A, Kosova Y. Limited accessibility of free online resuscitation education for people with disabilities. *Am J Emerg Med*. 2022;56:100–3. <https://doi.org/10.1016/j.ajem.2022.03.039>.
- Baldi E, Contri E, Savastano S, Cortegiani A. The challenge of laypeople cardiopulmonary resuscitation training during and after COVID-19 pandemic. *Resuscitation*. 2020;152:3–4. <https://doi.org/10.1016/j.resuscitation.2020.04.040>.
- Nolan JP, Monsieurs KG, Bossaert L, Böttiger BW, Greif R, Lott C, et al. European resuscitation council COVID-19 guidelines executive summary. *Resuscitation*. 2020;153:45–55. <https://doi.org/10.1016/j.resuscitation.2020.06.001>.
- Teague G, Riley RH. Online resuscitation training. Does it improve high school students' ability to perform cardiopulmonary resuscitation in a simulated environment? *Resuscitation*. 2006;71:352–7. <https://doi.org/10.1016/j.resuscitation.2006.05.007>.
- Moule P, Albarran JW, Bessant E, Brownfield C, Pollock J. A non-randomized comparison of e-learning and classroom delivery of basic life support with automated external defibrillator use: a pilot study. *Int J Nurs Pract*. 2008;14:427–34. <https://doi.org/10.1111/j.1440-172X.2008.00716.x>.
- Krogh LQ, Bjørnshave K, Vestergaard LD, Sharma MB, Rasmussen SE, Nielsen HV, et al. E-learning in pediatric basic life support: a randomized controlled non-inferiority study. *Resuscitation*. 2015;90:7–12. <https://doi.org/10.1016/j.resuscitation.2015.01.030>.
- Tobase L, Peres HHC, Gianotto-Oliveira R, Smith N, Polastri TF, Timmerman S. The effects of an online basic life support course on undergraduate nursing students' learning. *Int J Med Educ*. 2017;8:309–13. <https://doi.org/10.5116/ijme.5985.cbce>.
- Birkun A. Distant learning of BLS amid the COVID-19 pandemic: influence of the outbreak on lay trainees' willingness to attempt CPR, and the motivating effect of the training. *Resuscitation*. 2020;152:105–6. <https://doi.org/10.1016/j.resuscitation.2020.05.023>.
- Ali DM, Hisam B, Shaikat N, Baig N, Ong MEH, Epstein JL, et al. Cardiopulmonary resuscitation (CPR) training strategies in the times of COVID-19: a systematic literature review comparing different training methodologies. *Scand J Trauma Resusc Emerg Med*. 2021;29:53. <https://doi.org/10.1186/s13049-021-00869-3>.
- Park JY, Woo CH, Yoo JY. Effects of blended cardiopulmonary resuscitation and defibrillation E-learning on nursing students' self-efficacy, problem solving, and psychomotor skills. *Comput Inform Nurs*. 2016;34:272–80. <https://doi.org/10.1097/CIN.0000000000000227>.
- Bhanji F, Donoghue AJ, Wolff MS, Flores GE, Halamek LP, Berman JM, et al. Part 14: education: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2015;132:S561–73. <https://doi.org/10.1161/CIR.0000000000000268>.
- Hsieh MJ, Bhanji F, Chiang WC, Yang CW, Chien KL, Ma MH. Comparing the effect of self-instruction with that of traditional instruction in basic life support courses—a systematic review. *Resuscitation*. 2016;108:8–19. <https://doi.org/10.1016/j.resuscitation.2016.08.021>.
- Statista. Internet. Demographics & Use. Global internet penetration rate as of April 2022, by region, 2022. <https://www.statista.com/statistics/269329/penetration-rate-of-the-internet-by-region/>; 2022. [accessed 30 June 2022].
- Jensen TW, Møller TP, Viereck S, Roland Hansen J, Pedersen TE, Ersbøll AK, et al. A nationwide investigation of CPR courses, books, and skill retention. *Resuscitation*. 2019;134:110–21. <https://doi.org/10.1016/j.resuscitation.2018.10.029>.
- Olasveengen TM, Mancini ME, Perkins GD, Avis S, Brooks S, Castrén M, et al. Adult basic life support: 2020 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Circulation*. 2020;142:S41–91. <https://doi.org/10.1161/CIR.0000000000000892>.
- Olasveengen TM, Semeraro F, Ristagno G, Castren M, Handley A, Kuzovlev A, et al. European resuscitation council guidelines 2021: basic life support. *Resuscitation*. 2021;161:98–114. <https://doi.org/10.1016/j.resuscitation.2021.02.009>.
- Birkun A, Gautam A, Trunkwala F, Böttiger BW. Dataset of quality appraisal of English-language massive open online courses on basic life support in terms of their compliance with cardiopulmonary resuscitation guidelines. *Mendeley Data*. 2022;V1. <https://doi.org/10.17632/z4pvtg87mk.1>.
- Birkun A. Free distance learning of cardiopulmonary resuscitation for laypeople - a reasonable way for improving cardiac arrest outcomes in low-resource settings. *Resuscitation*. 2021;168:91–2. <https://doi.org/10.1016/j.resuscitation.2021.09.020>.

Alexei Birkun, M.D., Ph.D.*

Department of General Surgery, Anesthesiology, Resuscitation and Emergency Medicine, Medical Academy named after S.I. Georgievsky of V.I. Vernadsky Crimean Federal University, Lenin Blvd, 5/7, Simferopol 295051, Russian Federation

*Corresponding author at: Lenin Blvd, 5/7, Simferopol 295051, Russian Federation.

E-mail address: birkunalexei@gmail.com

Adhish Gautam, M.D.
Regional Government Hospital, Una (H.P.) 174303, India

Fatima Trunkwala, M.D.
University Hospital Coventry & Warwickshire, Clifford Bridge Road, Coventry CV2 2DX, England, United Kingdom

Bernd W. Böttiger, M.D.
University of Cologne, Faculty of Medicine and University Hospital Cologne, Department of Anesthesiology and Intensive Care Medicine, Kerpener Str. 62, 50937 Cologne, Germany

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