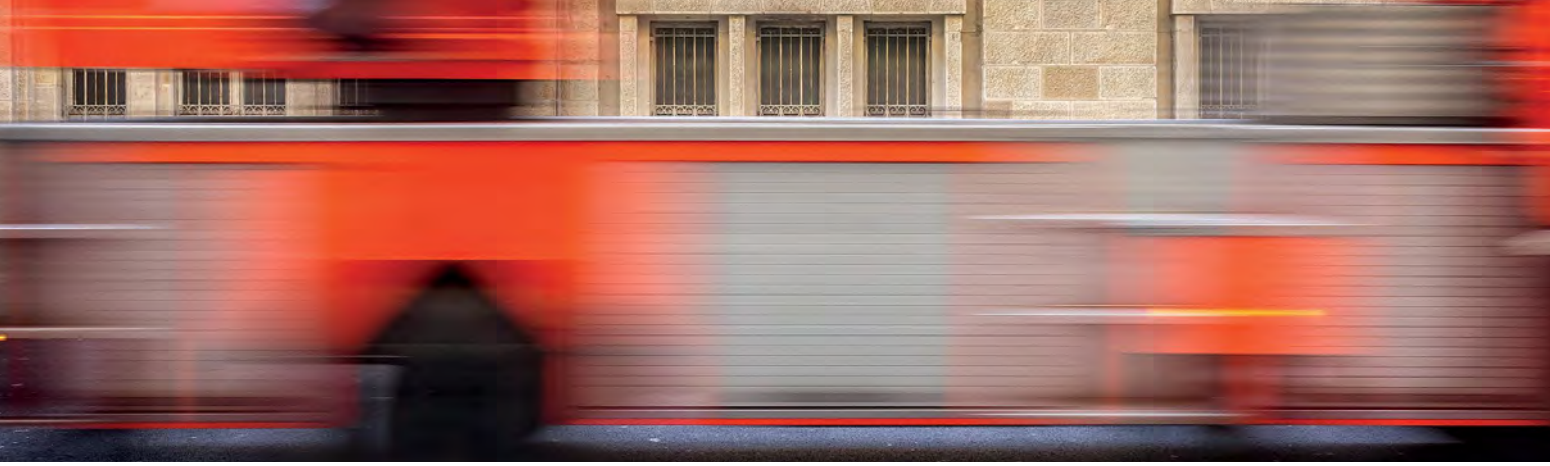

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THE OUTBREAK OF COVID-19 — MEDICAL LEADERSHIP CHALLENGE

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KEY WORDS: COVID-19, outbreak, medical, leadership

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The Corona Virus Disease 2019 (COVID-19) outbreak surprised humanity with its scale and speed. Starting in Wuhan, the capital city of Central China's Hubei province, it rapidly spreads to East Asia, Iran, Europe and the United States of America [1]. So far, only a few countries on earth have not yet been affected by the pandemic. Dealing with an emerging new disease is particularly challenging and requires complex decision making and leadership, of both medical leaders and statesmen. Factors such as logistical and technological capabilities, medical staff training level, operational flexibility and leadership, will determine how well healthcare organizations (and nations) will cope with the challenge. In this paper, we present six major leadership dilemmas and possible solutions, in an attempt to provide tools that will assist in confronting such an extreme event:

WHAT IS THE PRICE WE ARE WILLING TO PAY FOR SAVING LIVES?

Containment and mitigation policies:

Countries of the world can be schematically divided into two main groups according to their choice of how to tackle this outbreak: those who acted resolutely to quickly control the epidemic from the time of its emergence (Singapore, Taiwan, Japan, and South Korea) and those who delayed until the scale and the severity of the outbreak were apparent before taking the appropriate steps (such as Italy, Iran, and Spain). It was soon found that morbidity and mortality rates were significantly lower in countries that adopted strict citizen isolation and closure policies, as well as, massive population testing [2]. Each country has different cultural, social, geopolitical, economic and military characteristics that affect its ability to function in health crises. The structure of the healthcare system, the form of insurance coverage and the regulation of the system also have a decisive influence on the ability of that country to cope with such crises. When confronted with an outbreak, determination, decisiveness and speed of actions by the medical leaders will not only save lives but also reduce the implications of associated effects.

WHAT IS THE STATE'S COMMITMENT TO ITS CITIZENS AND SHOULD IT BE MAINTAINED AT ALL COSTS?

The Diamond Princess dilemma:

Six days after an 80-year-old guest disembarked from this cruise ship on 1st February 2020, he visited

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a local Hong Kong hospital, where he later diagnosed positive for COVID-19 [3]. By the end of February, more than 600 out of the 3.711 passengers and crew were infected with the virus [4]. Among the passengers were 3 Israeli passengers who tested positive for COVID-19 and were sent to a local hospital in Japan for further treatment. On the 17th of February, the Israeli government followed several other nations and decided to bring home the other 10 Israeli passengers from quarantined on the ship. On the 20th of February, they were transported back to Israel and hospitalized in isolated conditions for further examination and treatment. This decision was criticized by the media and the public because, until then, there were no verified COVID-19 cases in Israel. The arrival of these citizens carried the risk of bringing the virus into the country. The Israeli government (and the medical committee) decided that the state's moral commitment to care for its' citizens, overcame the fear and the danger surrounding this decision. The bad taste of possible rejection the return of these citizens would have remained long after the end of the pandemic.

CONTINUE TO PROVIDE ESSENTIAL AND LIFE-SAVING MEDICAL SERVICES, OR REDIRECT ALL RESOURCES TO DEAL WITH THE CURRENT CRISIS?

Sheba Medical Center (SMC) is a leading medical center in Israel with cutting edge clinical and technological capabilities. The Israeli Ministry of Health (MoH) elected SMC for the management and treatment of the first corona patients, include the Israeli returned Diamond Princess' passengers. This, in turn, required both recruiting the most suitable and skilled teams and selecting the most appropriate site (and facility) within the hospital for the hospitalization and treatment of the COVID-19 positive patients. At that time, there was uncertainty as to the optimal model of treatment. It was clear to us that we are committed to continuing to provide essential and life-saving medical services in order to prevent significant harm to citizens' health. Thus, we chose to set up a separate site for the COVID-19 Patients to minimize any impairment of the necessary medical function at the main hospital. Several considerations were taken into account when selecting the site for treatment of these patients: isolation, accessibility, the safety of the medical teams and other hospitalized patients, minimizing disruption of the regular medical activities and lifesaving procedures that are performed at the hospital, the distance from population centers while still relying on some of the capabilities of the hospital. The quickest and most convenient way would have been to assign a hospital ward and tailor it to care for these patients, drawing on existing organic staff and facilities. In order to minimize the danger of exposing patients and staff to the virus and the risk of harming the hospital's essential routine activities, we chose a dedicated, separated facility. This allowed us to deploy and introduce technologies that are not routinely used in the hospital such as telemedicine for in house medical care, wireless sensors, robots etc. Additionally, an institutional multidisciplinary team was formed including medical directors and experts' physicians in the fields of disaster medicine, internal medicine and infectious diseases, public health specialists, technology and logistics personnel, psychologists, spokesperson-public relations and ethics-law experts. Simulators were used to train the teams, familiarize them with the disease characteristics and the new tools. The decision where to place the site to treat the COVID-19 patients depends on the variety of factors and should be considered according to the local conditions. Medical managers need to be involved and lead this important decision that affects the functioning and availability of medical services and the safety of people are hospitalized and medical staff.

TEAM ENDURANCE — THE GREATEST CHALLENGE:

The "big picture" dilemma [5] — how much it should be shared with the team?

Fear of the unknown is an integral part of such a crisis for both the civilians and the medical teams, concerned is not only for their safety but for their families and patients. As always in crisis, in order to minimalize concerns, maintain motivation and morale and avoid dissemination of false rumours, transparency and openness are required. Along with psychological support, this will promote earning the trust from both the employees and the general public.

COMPLEX DECISION MAKING — ETHICAL AND MORAL DILEMMAS:

What if we must choose who gets cared for (and who does not)?

Under such extreme situations, difficult ethical dilemmas may emerge, and clear and uniform policy is required, to guide providers confronted with difficult questions. Preparation of special ethics committees are required, involving ethics experts and senior medical leaders do develop limited resource allocation policies such as protective equipment, expensive drugs and allocation of life-saving technologies such as respirators. These impossible decisions should not be left in the hands of the medical teams but should be pre-determined and clearly communicated to them. Quick decision-making based on situational analysis, knowledge and experience is expected of the medical leadership in extremely difficult situations. Being late and hesitant in decision making can have devastating results.

COLLABORATION AS A STRATEGY:

How important are communication and collaboration?

One of the features of a modern economy is competition and differentiation. In situations when a common threat appears, cooperation in the form of sharing knowledge and experience are required, on both, national and international level. The experience gained by countries where the virus struck earlier could be lifesaving for countries where no mass infection has yet occurred. In crisis situations, working alone is simply not an option. Collaboration in the form of resource and knowledge sharing and transfer of equipment between hospitals and states is difficult in times of crisis, with everyone taking care of themselves, but this is true leadership and should be sought after.

While pandemic events are not often, they result in significant morbidity, mortality, disruption of life and have a major global economic effect. Medical teams and medical directors should be appropriately prepared and trained to face such a challenge. This could allow for controlling such events in the earliest stages possible. Leadership are further challenged between the epidemics, as they are charged with having to influence policy makers to prioritize readiness and create collaborations.

It is not easy to be a leader, but it is the duty of the medical leaders who emerge during a crisis. The way in which we handle medical leadership dilemmas may be of value for the oncoming challenges.

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GOOD PRACTICES IN ASYNCHRONOUS E-LEARNING — A SHORT GUIDELINE DOCUMENT FOR POLISH MEDICAL TEACHERS — A PILOT STUDY

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ABSTRACT

INTRODUCTION: E-learning is gaining popularity also in medical education. It offers students unlimited access to educational materials, helps meet their individual preferences by adapting various learning styles, and is considered to be at least as effective as traditional lectures. However, this can only be true provided that e-learning is of good quality. Short guidelines may be used to familiarise medical teachers with good practices in e-learning, but they should meet the needs of their users, and some areas may require more attention. They should be identified, and medical teachers should be provided with additional resources covering them. This study aimed to develop a short guideline for Polish medical teachers and determine potentially troublesome areas.

MATERIAL AND METHODS: A detailed review of the literature was performed to create a guideline on preparing and conducting e-learning classes. The most important items from it were listed as an evaluation template and pre-tested on a sample of 10 e-learning courses in a search for areas requiring more attention.

RESULTS: Half of the courses did not provide students with a syllabus, and none of them clearly defined intended learning outcomes. Also, adult learning concepts were not introduced satisfactorily. Only seven out of 10 courses used activities at all, and they often tested simple knowledge reproduction, were limited to poorly-written test questions, and placed at the end of lessons.

CONCLUSIONS: In this pilot study three potentially troublesome areas were identified: defining learning outcomes, application of adult learning theory, and choice of activities.

KEY WORDS: e-learning quality, e-learning guidelines, medical teachers

Disaster Emerg Med J 2020; 5(2): 64–72

INTRODUCTION

Growing demand for healthcare specialists in Poland directly translates into increasing numbers of medical students enrolled each year. Simultaneously, no medical school is able to expand its capacity indefinitely. Sooner or later it will have to face problems like limited financial resources and availability of lecture halls, and a shortage of clinical hospitals, patients, or academic teachers and thus risk the quality of medical training. Meanwhile, international studies show many benefits of e-learning methods and their increasing popularity also in medical education

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[1, 2]. E-learning is highly valued by students and is believed to be at least as effective as traditional lectures while offering lower costs and more convenience and flexibility in terms of time and space [2, 3]. What is more, there are also reports suggesting that e-learning may contribute even more efficiently to students' gain in knowledge, skills, and attitudes, and retention thereof, than traditional lectures [4, 5]. Also, the philosophy behind it differs from the traditional approach [4, 6]. After all, just because someone has sat through a lecture, does not mean they have learned anything. According to the andragogy theory proposed by Malcolm Knowles [7, 8], internal motivation is vital in adult learning. In order for e-learning to work, students have to become more active participants of the learning process and assume responsibility for it [4, 9]. This in turn may increase their motivation for learning and help shaping positive habits in terms of continuous professional development [4, 10]. Consequently, one of the most important assets of e-learning is that it offers students unlimited and free access to educational materials that can be viewed by them whenever and wherever they want [11]. It is essential because learning can often be spontaneous, students may at some point just feel like doing it, and providing them with meaningful resources may help to make the best of every single moment like that [4, 12]. Another advantage of e-learning is that it can adapt various learning styles, multimedia, tools, and activities, in order to best match individual preferences of students and maintain their engagement in the learning process [4]. Moreover, it gives students more control over technical and organisational aspects of their learning process. They can tailor the amount of time spent on different tasks to suit their individual needs, rewind, or pause when they feel tired [13, 14].

Obviously, e-learning has certain limitations that have to be acknowledged and analysed before its introduction. Especially in medical education e-learning never can nor never should be seen as substitute for practical training or contact with patients. However, it may serve as an attractive and effective way to provide students with the necessary theoretical knowledge before such activites [6]. Moreover, according to Cook [15], e-learning is not always more cost-effective than traditional learning methods, and its use should be optimised in order to keep it low cost and low tech but still good enough in terms of quality. The success of e-learning methods is also highly dependent on student's self-discipline and time management skills [14]. Its whole concept is based on assumptions that students will be ready to actively participate in it while academic teachers will be ready to adopt more student-centred approach towards learning and lead good-quality e-learning classes [9]. Therefore, it seems reasonable to evaluate attitudes and readiness of both these groups towards e-learning whenever it is introduced on a wider scale at a given institution. Finally, positive outcomes of e-learning can only be observed if it is of good quality [12]. As a result, it seems vital to promote good practices in e-learning among teachers. Despite its popularity in other countries, there is a paucity of reports on its use in Polish settings, and e-learning still constitutes quite a novelty in Polish medical education. Taking all of the above into consideration, this study aimed to develop a guide summarising good practices in designing and teaching e-learning classes, to be used by Polish medical teachers. It is planned to be distributed among academic teachers of the University and to be used independently by them whenever needed (just-in-time learning). However, particular areas may require additional attention, so the secondary aim of this study was to try to identify them in a pilot study in order to best suit the needs of medical teachers. Asynchronous e-learning (where content is available all the time and students display it at their own pace and schedule) was chosen first due to its convenience, lower cost, and high availability for students.

MATERIAL AND METHODS

Study protocol

In order to achieve the aforementioned objectives, the study protocol included three major steps. Firstly, the review of the literature was performed in order to determine good practices in preparing and teaching e-learning classes. The results of the literature search were then used to create a short document on the topic in Polish. Finally, the document was pre-tested on a sample of e-learning courses to determine the aspects that may need increased attention - for example in the form of workshops.

The review

The review aimed to determine good practices and guidelines dedicated to preparing and teaching e-learning classes. A detailed literature review on

the subject was performed in October and November 2018 to identify all studies and guideline documents that concerned quality and good practices in e-learning. For this purpose, PubMed and Google Chrome databases were searched using the keyword 'e-learning' in combination with the following keywords: 'quality', 'good practices', and 'guidelines'. All detected research studies, review articles, and good practice guidelines from 2008 to 2018 were analysed by the first author on the basis of their content. First, a screening of titles and abstracts allowed the exclusion of search results that clearly did not correspond with the aim of the study (e.g. studies on the influence of e-learning on participants' knowledge, skills, or quality of care in different morbidities). In cases of doubt or when abstracts were not provided (guidelines), a cursory analysis of content was performed for inclusion or exclusion criteria. Additionally, reference lists from all eligible studies and guidelines were reviewed to retrieve further sources.

All manuscripts and guidelines obtained as described above were analysed according to identical inclusion and exclusion criteria. They were included when they related to the topic of the study (presented good practices, guidelines, and good tips in e-learning, participants expectations, etc.), were published in English between 2008 and 2018, and full-text could be accessed. Search results were excluded when at least one of the aforementioned conditions was not met. Finally, the literature search produced 30 manuscripts (research studies, review articles, frameworks — Tab. 1) and 32 eligible guideline documents. Manuscripts and guidelines were further analysed in search of specific examples of good practices in e-learning, which was followed by the formulation of a summary document in Polish aimed at helping Polish medical teachers in preparing and conducting e-learning classes.

Table 1. List of manuscripts identified in the literature search

First author name	Year	Reference
Ellaway	2008	[16]
Masters	2008	[17]
Alexander	2010	[18]
Cook	2010	[19]
Cook	2010	[20]
Mayer	2010	[21]
Shortt	2010	[22]
Wong	2010	[23]
Davids	2011	[24]
Issa	2011	[25]
Masoumi	2011	[9]
Bentley	2012	[26]
Boling	2012	[27]
McGee	2012	[28]
Gordon	2013	[29]
Kavadella	2013	[2]
El Mhouti	2013	[30]
Cook	2014	[15]
Davids	2014	[31]
Lau	2014	[32]
Lewis	2014	[10]
Cook	2015	[33]
Giovanis	2015	[34]
McGahan	2015	[35]
de Leeuw	2016	[12]
Reid	2016	[36]
Baldwin	2017	[37]
de Leeuw	2017	[11]
Sinclair	2017	[38]
de Leeuw	2018	[1]

The tool

Despite a long history of e-learning use in many countries, it is still only starting to gain popularity in Poland, especially in medical education. Therefore, some academic teachers may lack experience and remain uncertain how to design, prepare, and lead e-learning classes — problems that were often reported to the authors of this study. As a result, a decision was made to formulate a short document guiding academic teachers step by step through the process. In order to make it more user-friendly, the document was kept relatively short and amounted to 10 pages. It is divided into five chapters, namely: 1) Course planning and creation, 2) Lessons and choice of learning material, 3) Presentation of learning material, 4) Use of multimedia, and 5) Activities, feedback, and evaluation. Each chapter contains one or two pages. Additionally, a checklist was added at the end to help teachers with fast revision of a prepared e-learning course. The initial version of the document was formulated by the first author based on the results of the literature review. It was subsequently discussed with the second and last

authors until consensus was reached. This agreed version was later evaluated using the Delphi method with a panel of three independent experts on the subject of e-learning, which allowed the formation of its final version used in this study.

Study settings

A pilot study was conducted to determine the extent to which individual good practices from the tool are met on a sample of e-learning courses from our University. The most important items from the tool were initially chosen and listed as an evaluation template by the first author. They were later thoroughly discussed by the first, second, and last authors until consensus was reached between them. The final version of the template was used to analyse the e-learning courses. Each item was graded according to a four-point Likert scale from 0 to 3 (where 0 — criterion not met at all, 3 — criterion met fully).

Ten e-learning courses were chosen proportionally in order to form a sample of all e-learning courses taught at the University. When only one e-learning course was taught at a given faculty (e.g. physiotherapy or paramedics) it was also included in the sample. Courses from the same faculties were chosen randomly. All courses were evaluated by the first author in order to ensure consistency.

The study protocol was presented to the local Bioethics Commission. As the study protocol did not involve patients or human participants, a positive opinion of the Bioethics Commission was not necessary under the Polish legal system.

RESULTS

Ten e-learning courses were analysed in this pilot study. Among them, there were four courses dedicated to medicine students, two courses dedicated to nursing students, two courses dedicated to dietetic students, one course dedicated to physiotherapy students, and one dedicated to paramedic students. Given the aims and qualitative character of the study, the courses were analysed collectively because small sample sizes would make any comparisons between the faculties unreliable. Detailed results of the study are presented in **Table 2** as numbers of e-learning courses graded on 0–3 Likert scale for each good practice item. Additionally, the most important findings are described below.

Among the analysed e-learning courses, half of them did not provide students with any syllabus and assessment criteria, and only four e-learning coursed met this criterion fully. What is worse, none of the 10 e-learning courses clearly defined their intended learning outcomes (ILO). As a result, items related to ILO could not be assessed (Tab. 2).

The item 'students have control over their learning' was rated in the following way: 0 means no control; 1 means that students could return to previously viewed slides or lessons, but all newly displayed slides and lessons had to be viewed in a predetermined order with a fixed amount of time spent on each; 2 means that students still had to display slides and lessons in a predetermined order, but they could skip quickly through them; and 3 means full control of students. References to students' previous knowledge and experiences were not included at all in six courses, and only five courses showed at least a small attempt to promote critical thinking, student's reflection, and problem solving. Most courses demonstrated practical application of knowledge, but only two did it moderately well, and none of them showed that this criterion was met fully. Given the usual student's attention span of 25–30 minutes, the time required to complete was also assessed. In five courses no lesson lasted longer than 30 minutes. Proportionally for every lesson exceeding that limit, one point was taken.

Learning material was sorted in order in most of the courses, and most of the slides were limited to only one topic. The text on the slides was predominantly easy to understand. However, occasionally sentences were too long and therefore complicated. No particularly difficult words or unexplained abbreviations were detected. Text was completely free from errors in all examined courses. All courses also achieved maximum scores for using user-friendly colour schemes and appropriate font styles (e.g. utilising Polish diacritical signs) and sizes (comfortable for reading). The layout was also consistent in all presented cases.

All courses utilised the lector's voice. However, only six of them used a friendly, real person's voice - in five out of six cases this voice additionally attempted to encourage students' reflection, and these were also the cases in which the audio material was not distracting. Meanwhile, four studies used a cold, automatic voice that was simply reading the text with no time for reflection. None of the courses used hyperlinks. Multimedia were used in all of the courses to different extents (mainly illustrations and pictures, but also graphs, diagrams, and tables). No animations or videos were present in the analysed material.

Table 2. Numbers of courses that received respective grades for each good practice item

Good practices in e-learning	Likert scale grade				
	0	1	2	3	n/a
Syllabus and assessment criteria are clearly defined	5	1	0	4	-
Learning outcomes are clearly defined	10	0	0	0	-
Learning outcomes are precise, measurable, from the student's perspective	-	-	-	-	10
Possibly diversified learning styles, tools, and multimedia are used	0	5	5	0	-
Learning material (including multimedia) is consistent with learning outcomes	-	-	-	-	10
Students have control over their learning	0	4	6	0	-
References to student's prior knowledge and experiences are made	6	3	1	0	-
Critical thinking, student's reflection, and problem solving are promoted	5	5	0	0	-
Practical application of knowledge is demonstrated	3	5	2	0	-
A single lesson is no longer than 30 minutes	3	0	2	5	-
Learning material is orderly sorted, each slide is related to one topic only	0	1	8	1	-
Text is simple and understandable, rare words or abbreviations are explained	0	0	7	3	-
Text is free from spelling, punctuation, and grammar errors	0	0	0	10	-
Portions of text are of appropriate length (not too long)	0	1	8	1	-
Colour scheme is user-friendly	0	0	0	10	-
Font styles and sizes are comfortable for reading	0	0	0	10	-
Layout is consistent throughout the entire course	0	0	0	10	-
Lector's voice is human, friendly, and gives students time for reflection	4	0	1	5	-
Audio material is consistent with contents of the slide, but not distracting	3	2	0	5	-
Hyperlinks open correctly and are properly marked and named	-	-	-	-	10
Use of multimedia is purposeful and justified	0	4	4	2	-
Multimedia are of good quality	0	0	7	3	-
Videos are of appropriate length and provided with subtitles when needed	-	-	-	-	10
Reference list of all materials used (text and multimedia) is provided	0	8	1	1	-
Active participation of students is enabled (activities)	3	0	0	7	-
Activities correspond with learning outcomes and allow their verification	-	-	-	-	10
Activities are varied, engaging, and use different assessment methods	0	3	2	2	3
Activities are distributed evenly throughout the entire course	0	3	2	2	3
Activities go beyond knowledge reproduction and apply higher-order thinking	4	1	2	0	3
Whenever possible, feedback is automatic and immediate (e.g. correct answer with proper explanation is presented after each activity)	1	2	4	0	3
Test questions are formulated correctly	0	2	3	1	4
Other important information (e.g. teacher contact) is provided and easily accessible	4	1	5	0	-
Forum (or other medium of communication) is available for all students	6	0	0	4	-
Course is intuitive, students can easily orientate what to do next	0	0	6	4	-
Needs of disabled people are acknowledged	1	4	5	0	-
Course is free from stereotypes and uses gender-neutral language	0	0	0	10	-

The multimedia used were generally of good quality, and in most cases they were used purposefully. However, occasionally it was difficult to assess the meaning and purpose of some materials (e.g. a diagram with no information about what the student should pay attention to), and sometimes purely decorative motives were also present. Most courses did not include references in text or in multimedia.

Seven out of 10 courses used activities to engage students, but only in some of them activities were diversified and evenly distributed throughout the entire course. For the remaining courses, activities were mostly placed at the end of lessons and included test questions. Of note, all test questions were formulated correctly in only one course. Most of the activities tested simple knowledge reproduction and only three courses used (to different extent) activities promoting higher-order thinking. Most activities provided instant feedback to students after completion. However, no course could be awarded with the highest grade in this category because none of them provided a full and detailed explanation of correct and false answers.

No course provided all information potentially important for users. In this category the following were included: short content description, welcoming message for participants, teacher contact details, list of lessons with learning outcomes assigned to each of them, estimated amount of time required to complete each lesson, last actualisation date, and technical support contact data. Four courses provided information about a forum assigned to them and invitations for students to visit it. On the other hand, six did not contain any such information and fora remained unexploited. Courses were generally intuitive, and there were no major problems in this area. All of them used gender-neutral language and were free from stereotypes. Most courses tried to acknowledge the needs of disabled people (possibility to increase font size, possibility to read text out loud, avoiding red and green, transcript of lector's voice).

DISCUSSION

To our best knowledge, this is the first Polish study trying to develop a tool promoting good practices in e-learning as well as attempting to assess its quality in search of areas that may require additional attention (e.g. in form of workshops). Since this was only a pilot study on a small sample size, it should not be regarded as detailed assessment of e-learning quality at our university. Its aim was instead to pre-test the guideline document developed earlier in order to determine the exact needs of medical teachers as e-learning content creators. In this context medical teachers should also be considered as adult learners - they learn how to design and lead good quality e-learning classes. Therefore, any intervention (guidelines, workshops) should also apply the andragogy theory described above [7, 8]. To enhance learners' intrinsic motivation, there needs to be a clear indication as to why they are learning something and how is it relevant for them. Guideline documents are useful in terms of their convenience - teachers can use them whenever and wherever they want as a quick and efficient reference source to acquire or systematise basic knowledge, unlike workshops for example. This is especially important in terms of problems with long-term retention of knowledge and busy schedule of medical teachers due to numerous other professional obligations [39]. In order to make any document useful it has to be relatively short because long elaborations may scare off users rather than encourage them to use them. Consequently, there is no need to go into detail with every single point. Only the most crucial and problematic ones should be dealt with in greater attention. They can be described more thoroughly in the document or serve as a topic of a workshop or an e-learning course. If a given institution has adequate financial means, more workshops or e-learning courses can be organised, including less burning issues. In this way a teacher can individually asses which one to attend. However, it still seems a reasonable practice to provide them with a short summary guideline document on the topic and indicate which aspects should be dealt with more caution.

Our pilot study results show that medical teachers at the university had no or few problems with aspects like making text simple and understandable, explaining rare words or abbreviations, keeping text free from spelling, punctuation, and grammar errors, making portions of text not too long, using a balanced colour scheme, comfortable font styles, and sizes, and maintaining a consistent layout throughout the entire course. On the other hand, improvement could be made in regards to providing students with important information, use of forums and activities, as well as applying rules of andragogy theory (giving students control over their learning, providing them with opportunities to use their prior knowledge and experiences, critical thinking, reflection, problem solving, and demonstrating practical application of knowledge). Although, due to lack of data from similar studies in Poland, it is hard to compare our results with the literature, one striking observation can be stipulated. Teachers generally managed well in aspects they were accustomed to while preparing slides for traditional classes, but showed problems in areas

more specific to student-centred education and e-learning. Nevertheless, aspects like the possibility to communicate with the teacher and each other (e.g. on a forum), instant feedback, teacher and technical support, use of different learning styles, interactivity, and values of adult learning principles are still important for students and maintaining their motivation, and therefore their adequate quality should be assured [9, 11]. Furthermore, none of the courses clearly defined its learning outcomes, which is surprising given their role in Polish medical education [40]. It is the learning outcome, not the process of education itself, that should be emphasised. Learning outcomes are useful because they provide a template for a lesson and allow this plan to be adhered to, from the choice of learning material to activities in order to assess whether learning has really occurred [4, 9, 38]. Unfortunately, due to a lack of defined learning outcomes, this process could not be followed in any of the examined courses. Meanwhile, learning outcomes are also extremely important from the learners' point of view because they provide them with aim, guidance, and information about what to focus on [2, 11, 38]. The aim should be clear in order to motivate students, otherwise the whole course is just content [11]. Last but not least, e-learning courses should not be discouraging to their users. They cannot be too long, distracting, or force students to view content they already know [2, 11]. As presented above, these aspects should also be worked on.

Limitations

We acknowledge our study had several limitations. First of all, the sample size was small. However, as mentioned above, this was only supposed to be a pilot study in order improve the guideline document and identify areas that probably require more attention while introducing e-learning on a wider scale at the University. Moreover, for a similar reason, e-learning courses from only one Polish medical university were examined in this study, and therefore further studies are required in order to determine whether similar problems are present at other Polish medical schools. Finally, we are also aware of the risk of selection bias because two faculties were represented by only one course each. However, as emphasised above, the aim of this study was not to determine detailed frequencies of individual deficiencies or flaws. We rather tried to estimate what areas might require additional attention in order to help teachers overcome those difficulties. Therefore, inclusion of at least one existing course from every faculty seemed more important and justified.

CONCLUSIONS

E-learning can only be effective if it is of good quality. Therefore, it seems vital to promote good practices in designing and teaching e-learning classes among teachers. This is especially true in countries like Poland, where e-learning has recently been introduced on a wider scale and awareness of its concepts and quality may be limited. Short documents with guidelines may constitute a meaningful and convenient way of introducing some basic concepts. The guide presented in this study, despite its relative compactness, covers a broad area of course creation, and its popularisation can draw teachers' attention to particular elements they were not aware of before. However, any educational intervention should meet the needs and expectations of their potential users. Particular areas may require more attention, and they should be identified as soon as possible. In the presented study three such areas were identified: defining learning outcomes, application of adult learning theory, and choice of activities. They can be elaborated by providing medical teachers with additional resources in the form of workshops, e-learning courses, or additional reading materials - according to their individual preferences.

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Conflict of interest:

The authors declare that there is no conflict of interest.

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TELETRANSMISSION AS A USEFUL METHOD IN THE CONDUCT OF MEDICAL RESCUE TEAMS

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Abstract

INTRODUCTION: Emergency medical services, during their activities, must diagnose conditions directly threatening the patient's life and health, implement appropriate procedures, secure the patient, and transport them to a place where they can be given more appropriate assistance in the shortest possible time. Performing teletransmission significantly reduces the time to provide the patient with proper, life-saving assistance. In this study the authors undertook an analysis of teletransmissions carried out by the teams of EMS. These data are to be used to assess the MRT activities depending on the hospital to which the patient was transferred.

MATERIAL AND METHODS: The information was obtained based on the analysis of MRT exit cards working in the area of the Sokołowski powiat and the city of Sokołów Podlaski. The author analysed 3804 travel cards of the MRT 04-51, 04-52, 04-54 teams in Sokołów Podlaski and Kosów Lacki in 2018, distinguished 147 cards during which the teams performed teletransmission to the Haemodynamics Centre in Siedlce. Then the exit cards were analysed according to the patient's age, and then the time elapsed from departure to arrival at the place of call and from arrival to the moment of transferring the patient to the hospital, broken down by urgency code of departure: code 1 (C1) and code 2 (C2). $P < 0.05$ was adopted as the significance level.

RESULTS: The average age of teletransmitted patients was 69.8 ± 17 years, and the average age without teletransmission was 65.8 ± 23.6 years ($p = 0.042$). The time elapsed from reaching the patient to the time of transfer in the hospital for patients who were teletransmitted was 49.1 ± 16.1 minutes, and for patients who were not it was 39 ± 22.2 minutes ($p < 0.001$). The average time to reach the patient in the code 1 was 10.9 ± 7.4 minutes, and in the code 2 it was 14.5 ± 17.9 min ($p < 0.001$). It was shown that the patient's age did not affect the time of departure and arrival at the place of call ($r = 0.075$), nor the time of transferring the patient to the hospital ($r = 0.027$).

CONCLUSIONS: 1. The results obtained show the need to perform the teletransmission procedure as soon as possible and to apply appropriate treatment by MRT. This can significantly reduce the time to balloon a clogged vessel or attach a stent.
2. Performing teletransmission extends the time of patient transfer in hospital by nearly 10 minutes
3. Considering the place of patient transfer in ER or ED, both the age of the patients, times from the MRT departure to arrival at the call site, and the time from arrival at the place of call to transfer in hospital turned out to be statistically significant.

KEY WORDS: Emergency Medical Services, teletransmission, Sokołów County, paramedic, electrocardiogram

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INTRODUCTION

Cardiological problems are among the most common reasons for calling emergency medical services (EMS) in the US, Europe, and Poland. Calls due to cardiological problems include chest pain, palpitations, fainting, fainting, shortness of breath, high blood pressure, and sudden cardiac arrest. EMS, during their activities, must make the diagnosis of conditions directly threatening the patient's life and health, implement appropriate procedures, secure the patient, and transport them to a place where they will be given more appropriate assistance in the shortest possible time, in accordance with the "golden hour rule". In Poland, among all deaths, cardiovascular diseases account for 45% [1].

Medical rescue teams (MRT) referring the patient to the emergency room (ER), hospital emergency department (ED), or directly to the haemodynamics centre (to perform percutaneous coronary intervention or fibrinolytic therapy implementation) by coding the diagnosis, most often choose disease entities such as chest pain, acute coronary syndrome (ACS), hypertension, atrial fibrillation, shortness of breath, heart attack, and more. Paramedics, physicians reaching the patient in a state of sudden threat to health as part of their activities, in accordance with medical art and the recommendations of the European and Polish Resuscitation Council, should perform a number of diagnostic tests and procedures to determine and diagnose the patient's problems.

The most commonly used are:

1. Blood pressure measurement (NIMB);
2. Heart rate measurement (HR);
3. Measurement of blood saturation (SpO_2);
4. Performing an electrocardiogram (ECG);
5. Performing ECG teletransmission to the haemodynamics centre;
6. Blood glucose measurement.

Myocardial infarction with ST segment elevation and without ST elevation

The heart muscle consumes about 40% of the body's oxygen demand. If this oxygen is lacking or there is narrowing of the lumen of the coronary vessel (spasm, clogging with atherosclerotic plaque), there is chest pain. The pain that occurs after exercise is caused by a reduced blood flow through the heart muscle vessel and indicates angina pectoris. After cessation of effort, the pain also subsides. In the event that the coronary vessel is completely clogged and the pain does not go away either when exercising is stopped or nitroglycerin (NTG) is taken, we are talking about ACS. When acute coronary syndrome is confirmed by 12-lead ECG and/or cardiac

Teletransmission and proceedings

The primary task of MRT in patients with chest pain is to diagnose STEMI. Travel teams, after conducting an interview, examining a patient, and performing an ECG, evaluate his/her record in order to determine the diagnosis and start proper treatment and transport to the hospital. Medical history may be based on the SAMPLE acronym:

S — symptoms (ailments), e.g. type of pain, how long it lasts, location;
A — allergies, possible allergy to drugs, foods;
M — medications, medications taken so far;
P — past diseases, especially in this case of the heart, circulation;
L — lunch, when and what patient has recently eaten;
E — possibly, what happened and other symptoms, e.g. shortness of breath, oedema [3].

The physical examination most often states the following: pallor of the coatings, sweats, tachycardia, and hypotension. Then perform a 12-lead ECG, preferably up to 10 minutes after arriving at the patient and transfer to a suitable centre. To avoid an error in diagnosis, at the pre-hospital stage it is necessary to support teletransmission of a record to the haemodynamic institution and consultation with a cardiologist, and jointly establish patient management [4]. A member of the MRT, most often the manager, sends a full ECG recording using a telephone connected to the defibrillator, then makes a phone call and notifies the doctor and provides information about the patient's condition (Fig. 1). The receiving physician analyses the record and, in the case of STEMI or recent left bundle branch block, recommends transporting the patient to the haemodynamic laboratory, prescribing pharmacotherapy [4].

A patient qualified to the haemodynamic unit for peripheral reperfusion is subjected to percutaneous coronary angioplasty (PCA) or fibrinolysis [5].

Performing teletransmission significantly reduces the time to provide the patient with proper, life-saving assistance.

In this study the authors undertook an analysis of teletransmissions carried out by the teams of MRT Medical Emergency and Sanitary Transport Station RM "MEDITRANS" in Siedlce and its substation in Sokołów Podlaski. These data are to be used to assess the MRT activities depending on the hospital to which the patient was transferred.

FIGURE 1. Sending ECG by MRT to the Haemodynamics Centre at the Mazowieckie Provincial Hospital in Siedlce

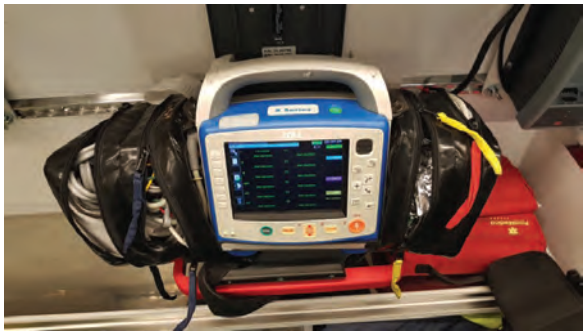

FIGURE 2. ZOLL X series defibrillator equipped with "S" assembly, no. W04-51

FIGURE 3. ZOLL E series defibrillator, included in B-MRT - W04-52 and W04-54 equipment

MATERIAL AND METHODS

The information was obtained based on the analysis of MRT exit cards working in the area of the Sokołowski powiat and the city of Sokołów Podlaski. The consent of the director of SP ZOZ "MEDITRANS" Emergency and Sanitary Transport Station in Siedlce was given for access to exit cards and statistical data. The study conformed to the principles outlined in the Declaration of Helsinki. All data were analysed anonymously with no possibility of identifying individual patients. The acquired data is anonymous in terms of patient data as well as personal data of MRT members. The author analysed 3804 travel cards of the MRT 04–51, 04–52, and 04–54 teams in Sokołów Podlaski and Kosów Lacki in 2018, and distinguished 147 cards during which the teams performed teletransmission to the Haemodynamics Centre in Siedlce.

Then the exit cards were analysed according to the patient's age, and then the time elapsed from departure to arrival at the place of call and from arrival to the moment of transferring the patient to the hospital, broken down by urgency code of departure: code 1 (C1) and code 2 (C2). The next step was analysis in terms of the place of transfer of the patient: ER or ED.

Characteristics of the Sokołów County and the city of Sokołów Podlaski

The Sokołów powiat was inhabited by 54,797 inhabitants, of whom 50.5% were women and 49.5% were men. The average age of residents was 42.2 years, which was comparable to the average age of residents of the Mazowieckie voivodship. In 2016, 49.9% of deaths in the Sokołów County were caused by cardiovascular diseases, 20.3% of deaths were due to cancer, and 9.1% of deaths were caused by respiratory diseases [6].

Characteristics of EMS in the Sokołów County

There are three MRTs operating in the Sokołów County, including one specialist team (S) operating round the clock, which includes a medical doctor, paramedic, and medical rescuer — a driver who is stationed in the city of Sokołów Podlaski, one basic team (B) operating 10.00–22.00, which consists of a paramedic or system nurse, acting as team leader, a paramedic, and a paramedic/driver who is also stationed in the city of Sokołów Podlaski. The last MRT is the B team stationed in Kosów Lacki, operating around the clock, consisting of a paramedic or system nurse, acting as a team leader, as well as a paramedic and paramedic/driver.

The S-MRT team is equipped according to the specifications of the National Health Fund (NHF) with patient monitoring equipment, devices, transport, and teletransmission (ZOLL X-series) — Figure 2. B-MRT teams, also equipped in accordance with the NFZ requirements. Defibrillators also equipped with ZOLL E series defibrillators (Fig. 3, 4)

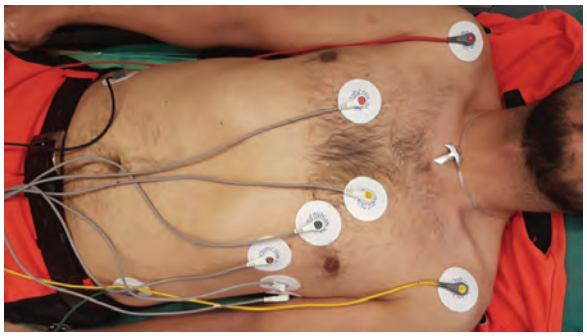

FIGURE 4. Placement of precordial and limb electrodes on the patient's body

Statistical analysis

Results concerning quantitative variables were presented as average values ± standard deviation. Qualitative variables (age, sex) were presented as quantity (n) and percentage values of the whole group (%). Student's t-test was applied to compare the different times and to determine the statistical difference for each group. In the comparative analysis of age and the time of transferring the patient to the hospital, simple linear regression analysis (Spearman) was applied to detect and describe the strength and direction of correlations of clinical data. Statistica 13.3 software (Tibco Inc., Tulsa, USA) was used in the statistical analysis. $P < 0.05$ was adopted as the significance level.

RESULTS

Table 1. presents the results of the comparative analysis of patients with teletransmission. The average age of teletransmitted patients was 69.8 ± 17 years, and the average age without teletransmission was 65.8 ± 23.6 years — a statistically significant difference was shown ($p = 0.042$). In the group of patients who were teletransmitted, the time of commuting to the patient was 13.5 ± 8.7 minutes and the time of arrival to the place of call to patients who were not teletransmitted was also on average 13.5 ± 16.1 minutes — no statistically significant difference was shown ($p = 0.955$). The time elapsed from reaching the patient to the time of transfer in the hospital for patients who were teletransmitted was 49.1 ± 16.1 minutes and for patients who were not it was 39 ± 22.2 minutes, which showed a statistically significant difference ($p < 0.001$).

Table 2. Univariate comparison of patients with urgency code of departure

	Code 1	Code 2	p
	n = 1021	n = 2813	
Age [y]	62.5 ± 26.0	67.3 ± 22.3	< 0.001
Departure Time-Arrival [min]	10.9 ± 7.4	14.5 ± 17.9	< 0.001
Arrival Time-Handover [min]	37.1 ± 19.3	40.9 ± 22.9	< 0.001

Table 2. analyses the data broken down by urgency code 1 and code 2 trips. The average time to reach the patient in C1 was 10.9 ± 7.4 minutes and in C2 14.5 ± 17.9 min — a statistically significant difference was shown ($p < 0.001$). In the C1 code, the average time from the team's arrival to the place of call to the patient's transfer to the hospital was 37.1 ± 19.3 minutes, and in the C2 code the average time was 40.9 ± 22.9 minutes — a statistically significant difference was found ($p < 0.001$). The average age in C1 was 62.45 ± 26.04 years, and in C2 the average age was 67.25 ± 22.25 years — a statistically significant difference was found ($p < 0.001$).

The age of the patients, depending on the place of transfer of the patient to the hospital in which the ER or ED operates, as follows: The average age of the patient transferred to the ER was 67.0 ± 22.5 years and in the ED 62.7 ± 26.7 years ($p < 0.001$). Analysis of the time from the MRT departure to arrival at the call site showed the average time of patients transferred in ER 13.4 ± 9.0 minutes and transferred in ED 14.7 ± 9.3 ($p = 0.014$); the average time from arrival at the place of call to transfer in ER was 38.8 ± 17.0 min; and the mean time to refer in the ED was 64.0 ± 17.4 min ($p < 0.001$) — see Table 3.

Table 1. Univariate comparison of patients with teletransmission

	Without teletransmission	Teletransmission	p
	n = 3682	n = 147	
Age [y]	65.8 ± 23.6	69.8 ± 17.0	0.042
Departure Time-Arrival [min]	13.5 ± 16.1	13.5 ± 8.7	0.955
Arrival Time-Handover [min]	39.5 ± 22.2	49.1 ± 16.1	< 0.001

Table 3. Univariate comparison of transferred patients to Emergency Room or Emergency Department

	ER	ED	p
	n = 2685	n = 296	
Age [y]	67.0 ± 22.5	62.7 ± 26.7	< 0.001
Departure Time-Arrival [min]	13.4 ± 9.0	14.7 ± 9.3	0.014
Arrival Time-Handover [min]	38.8 ± 17.0	64.0 ± 17.4	< 0.001

ER — emergency room; ED — hospital emergency department.

It was shown that the patient's age did not affect the time of departure and arrival at the place of call (r = 0.075) or the time of transferring the patient to the hospital (r = 0.027)

DISCUSSION

For several years, research has been being conducted into the usefulness of early teletransmission by MRT. In the current era of development of technology, the Internet, and electronics, the amount of data transferred directly from the place where the patient is found to specialised treatment centres of particular importance from the point of view of health and life of disease states is growing. Among the most important, Piotrowicz et al. [8] in the article "Telemedicine — changes in the process of providing cardiological services. Possibilities and realities" presented ECG teletransmission, which was introduced as one of the earliest into practice. It is used in patients with suspected ischaemia and arrhythmias, with previously detected arrhythmias, and with a risk of serious arrhythmias including myocardial infarction and fainting. According to the authors of the article, the most important aspect is having the correct diagnosis, but also early therapeutic intervention, which is important for the entire health care system, both temporarily and financially, increasing the chance for adequate treatment.

Also very important from the point of view of sending ECG teletransmission was the study of Karcz et al. [9], which covered the eastern part of the Mazowieckie and northern Lubelskie voivodeships. The study was the result of a management model created in 2003 to reduce the time to perform PPCI bypassing the nearest hospital and transporting patients to the haemodynamics laboratory. The study included 856 patients who had teletransmission, from this group from ED, 267 people were admitted to the Institute of Cardiology in Anin, including 214 from STEMI. It was a pilot program that was to implement MRT to use teletransmission. It was noted that every month the STEMI percentage as a result of ECG transmission was about 30%.

Obłój et al. [10], in a retrospective analysis, analysed 13,534 exit cards of MRT in the Olecki powiat in the years 2012–2015. From among all the trips they separated patients with cardiovascular diseases, and among them patients with acute myocardial infarction were analysed. They showed that 2% of the total number of patients was transported to the invasive cardiology centre. Among people with cardiovascular disease, 64% were men with an average age of 63 years, and the average age of women was 71 years. 58% of patients with cardiovascular disease went to the Centre of Invasive Cardiology with the diagnosis of acute myocardial infarction. The authors showed that the average time from accepting an application to forwarding for invasive cardiology was 63 minutes. In the analysed period, MRT performed 489 ECG teletransmissions.

Stępka [11] analysed 205 ECG teletransmissions performed by the local MRT to the Allenort Cardiology Centre in Kutno, performed from March 2010 to December 2012. It was noticed that the majority of teletransmissions were performed by B-MRT. In the records sent by the B team most often His left bundle branch block (5%) and I ° atrioventricular block (25%) were diagnosed, as well as S syndromes left bundle branch block (19.05%), His bundle branch block (19.05%), and atrioventricular block I ° (19.05%). However, not all teams around Kutno used teletransmission; one of the teams used it in 0.09% of trips and the other in 0.16%.

An analysis of ambulance trips in the Sokołów County shows that teletransmission plays a significant role at work. Over the period considered, 49.9% of deaths were caused by cardiovascular diseases. Therefore, patients with chest pain, shortness of breath, and cardiac history should have teams in the C1 urgency code, especially because the nearest haemodynamic laboratory is located in Siedlce, 28 km away. MRTs from the furthest cities often transport patients to the hospital for more than an hour, adding to this the travel time, an average of 13.5 minutes, and the time to perform teletransmission (10 minutes) is too long, above the "golden hour" waiting time for patients to receive proper help. Certainly, placing an ambulance in places such

as Jabłonna Lacka, Skrzeszew would significantly reduce the travel time to patients. Teletransmission activities could be carried out in an ambulance, especially because in further locations, among the forests, MRT have frequent problems with the range of the telephone network that is used for ECG transmission. This involves a risk to the safety of the ambulance staff, with possible braking when the test persons are not fastened with seat belts.

CONCLUSIONS

1. The results obtained show the need to perform the teletransmission procedure as soon as possible and for the MRT to apply appropriate treatment. This can significantly reduce the time to balloon a clogged vessel or attach a stent.
2. Performing teletransmission extends the time of patient transfer in hospital by nearly 10 minutes.
3. Considering the place of patient transfer in an ER or ED, the age of the patients, time from the MRT departure to arrival at the call site, and the time from arrival at the place of call to transfer in hospital turned out to be statistically significant.
4. The time from the arrival at the place of call to transfer in the Emergency Room was longer by 25.26 minutes compared to the Emergency Room. This is closely related to the fact that ambulances transporting patients to the Emergency Room in Siedlce had a 28 km longer route to travel.
5. The age of the patients to whom ambulances were called in C1 was almost 5 years lower than the age of patients in C2.
6. The travel time in C1 was shorter than in C2, as was the time of transferring the patient to the hospital, in both cases by almost 4 minutes.

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PRE-FILLED SYRINGES WITH ADRENALINE DURING CARDIOPULMONARY RESUSCITATION IN NON-SHOCKABLE RHYTHMS. PILOT RANDOMISED CROSS-OVER SIMULATION STUDY

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ABSTRACT

INTRODUCTION: Pre-filled syringes are increasingly popular in medicine, especially in emergency medicine, where fast intervention is crucial. Additionally, as indicated by numerous studies, the use of drugs in pre-filled syringes reduces the risk of medical errors associated with inadequate preparation of the drug and reduces the risk of contamination as a result of tissue injury due to rupture of a standard ampoule with the drug. The aim of the study was to compare the use of pre-filled syringes with adrenaline and standard adrenaline in ampoules during simulated CPR during simulated cardiopulmonary resuscitation in non-shockable rhythms performed by two-person teams.

MATERIAL AND METHODS: The study was a randomised cross-over study and was based on medical simulation. The study involved 40 paramedics assigned randomly to 20 two-person rescue teams. These teams were to perform 10-minute cardiopulmonary resuscitation in three research scenarios: Scenario A — During CPR, access to the median basilic vein and preparation and administration of adrenaline infusions from generally available ampoules at concentration 1:1000 were required (Adrenaline WZF 0.1%; Polfa, Warsaw, Poland) with a standard syringe; Scenario B — During resuscitation, the median basilic vein was accessed and adrenaline was to be administered from an adrenaline pre-filled syringe (Aguettant Santé, Lyon, France); Scenario C — During CPR, intraosseous tibial vascular access was obtained using a NIO Adult kit, and adrenaline was administered using a pre-filled syringe with adrenaline (Aguettant Santé, Lyon, France). Both the order of resuscitation and medication administration as well as the order of participants were random.

RESULTS: The time to obtain vascular access in the examined scenarios varied and was 240 sec [IQR; 220–265] for Scenario A, 236 sec [IQR; 210–270] for Scenario B, and 165 sec [IQR; 90–180] for Scenario C; A vs. C, ($p < 0.001$), B vs. C ($p < 0.001$). In scenarios A, B, and C, the duration of adrenaline administration varied and was 55 sec [IQR; 50–85] vs. 20 sec [IQR; 18–35] vs. 20 sec [IQR; 20–30] (A vs. B, and A vs. C, $p < 0.001$).

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CONCLUSIONS: A simulation study has shown that paramedics in two-person teams are unable to deliver adrenaline at the time recommended by CPR guidelines. The delay of CPM adrenaline supply compared to PFS adrenaline is statistically significant. In the opinion of paramedics participating in the study, adrenaline during resuscitation should be administered by means of pre-filled syringes, which eliminates the delays in rescue operations resulting from the time needed to prepare drugs as well as limited human resources in rescue teams.

KEY WORDS: cardiopulmonary resuscitation, medical simulation, pre-filled syringe, epinephrine, emergency medical service

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INTRODUCTION

Medical errors are a relatively frequent phenomenon in hospitals, especially related to the preparation and administration of medicines [1, 2]. Numerous studies, including those of Berdot et al. [3], Parshuram et al. [4], and Gokhman et al. [5], indicate that errors in drug preparation concern up to 48% of cases. Double-checking should be conducted, because this could reduce drug administration errors by about 20%, but collaborative efforts between all healthcare professionals are essential [1]. As indicated by Hedlund et al., error types and reported rates vary substantially, including wrong drug (0% to 4.7%), wrong diluent solution (0% to 49.0%), wrong label (0% to 99.0%), wrong dose (0% to 32.6%), wrong concentration (0.3% to 88.6%), wrong diluent volume (0.06% to 49.0%), and inadequate aseptic technique (0% to 92.7%) [6].

The risk of error is all the more important in the aspect of emergency medicine, especially sudden cardiac arrest, where, according to the guidelines for resuscitation published by both the European Resuscitation Council and the American Heart Association, in the case of non-shockable rhythms, adrenaline should be administered as soon as possible after obtaining vascular access [7, 8]. During the cardiopulmonary resuscitation (CPR) there is a need to take quick action, and in the case of two-person emergency teams, therapeutic compromises are to be expected often.

The solution to this problem may be ready-made pre-filled syringes, which eliminate mistakes in the administration of the wrong drug, reduce the risk of the improper dose, and shorten the time to administer drugs [9]. An example of adrenaline in the form of progression-free survival (PFS) is the adrenaline from Aguettant Santé (Lyon, France), which is produced in 10 mL syringes with a standard Luer system, and the adrenaline itself is at a concentration of 1:10,000, which facilitates its supply, especially in the context of paediatric patients, and allows for the infusion of the already diluted drug for both adults and children.

The aim of the study was to determine different methods of adrenaline supply during cardiopulmonary resuscitation in order to follow the adult resuscitation algorithm recommended by the American Heart Association 2015 [8].

MATERIAL AND METHODS

The trial was designed as a randomised cross-over simulation study. The study protocol was approved by the Institutional Review Board of the Polish Society of Disaster Medicine (Approval no. 07.10.2019 IRB). The study included 20 teams of two people composed of paramedics. Each of the study participants, having familiarised themselves with the study objectives, expressed a voluntary desire to participate in the study.

Prior to the study, all participants underwent one hour of theoretical training in adult advanced cardiopulmonary resuscitation based on the American Heart Association 2015 guidelines [8]. Next, training was carried out on how to obtain intraosseous access to the NIO Adult kit (PerSys Medical, USA) and the use of a pre-filled syringe with adrenaline (Aguettant Santé, Lyon, France; Fig. 1).

The order of participants as well as the selection of participants in two-person groups was random; for this purpose the Research Randomizer program was used. The participants were to perform 10-minute adult cardiopulmonary resuscitation based on the cardiopulmonary resuscitation algorithm. The rhythm accompanying cardiac arrest was asystole. The participants performed cardiopulmonary resuscitation in three scenarios:

Scenario A — During CPR, access to the median basilic vein and preparation and administra-

FIGURE 1. Example of pre-filled syringe with adrenaline

tion of adrenaline infusions from generally available ampoules at concentration 1:1000 were required (Adrenaline WZF 0.1%; Polfa, Warsaw, Poland) with a standard syringe.

Scenario B — During resuscitation, the median basilic vein was accessed, and adrenaline was to be administered from an adrenaline pre-filled syringe (Aguettant Santé, Lyon, France).

Scenario C — During CPR, intraosseous tibial vascular access was obtained using a NIO Adult kit, and adrenaline was administered using a pre-filled syringe with adrenaline (Aguettant Santé, Lyon, France).

Vascular access was performed based on the principles of aseptic and antiseptic. In each scenario it was assumed that rescue teams would conduct resuscitation based on the AHA algorithm. According to the above algorithm, adrenaline will be administered in a dose of 1 mg every 3–5 minutes. After a 10-minute CPR procedure, the participants had a one-hour break and then performed CPR based on another scenario. The detailed randomisation procedure is presented in Figure 2.

In each scenario, the time of access, measured from the diagnosis of cardiac arrest and start of resuscitation, and the time of supply of the first dose of adrenaline, measured as the time between

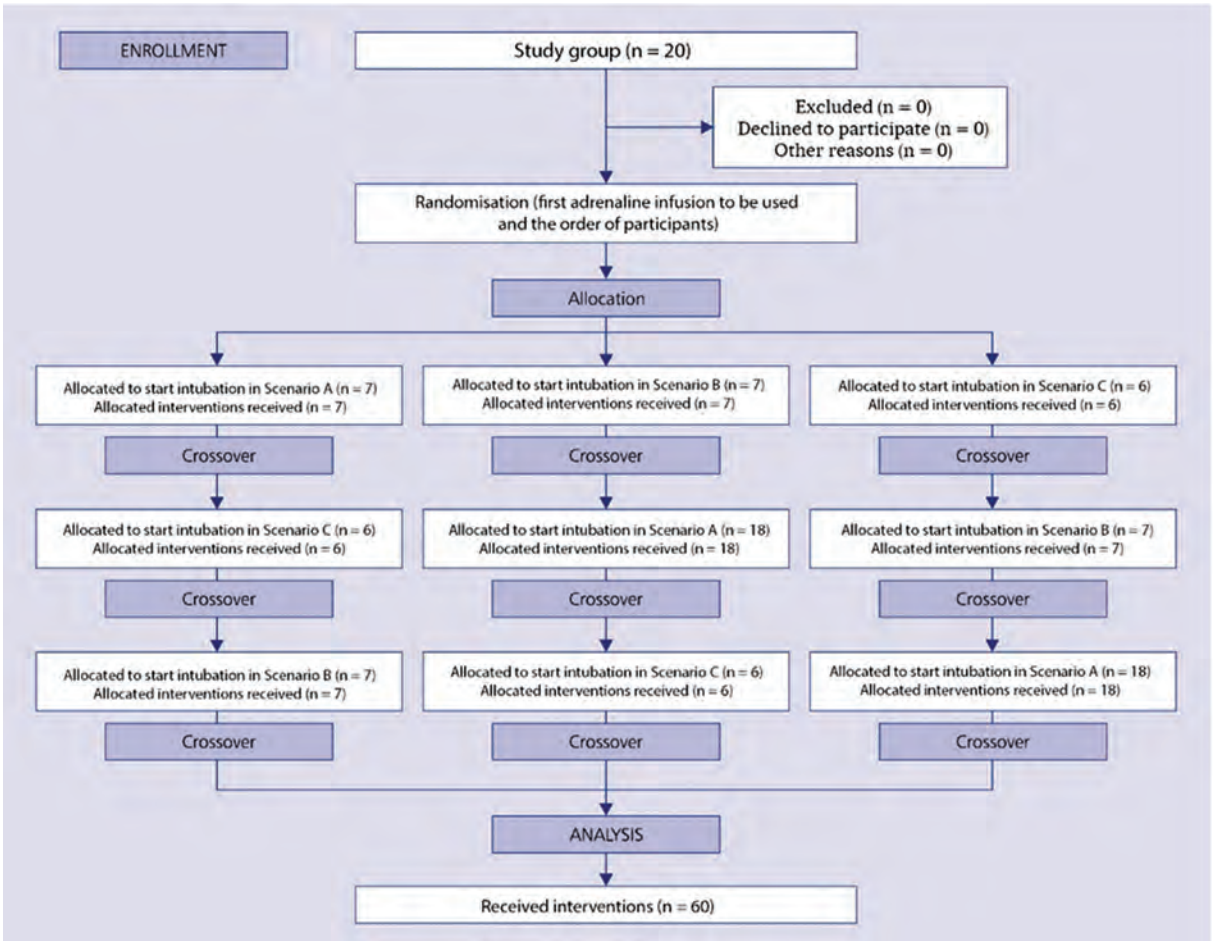

FIGURE 2. Randomisation flow chart

cardiac arrest and the end of 1 mg of adrenaline supply, were assessed. The reference point was the algorithm of advanced resuscitation in adults [8], according to which in non-shockable rhythms adrenaline should be administered as soon as possible. Additionally, after the completion of the study, rescuers were asked to determine the preferences concerning the method of adrenaline administration during resuscitation.

The data were collected by the instructors using a previously prepared study protocol. Statistical analysis was conducted using Statistica 13.3 EN statistical package (Tibco Inc., Tulsa, OK, USA). The results were considered statistically significant at $p < 0.05$.

RESULTS

The study involved 40 paramedics, who formed 20 two-person resuscitation teams. The average age of the study participants was 32.5 ± 4 years, while the average length of service in emergency medicine was 9.6 ± 7.3 years. None of the participants had previously had to deal with pre-filled syringes with adrenaline during CPR. All participants declared clinical experience in cardiopulmonary resuscitation as well as the ability to perform intraosseous access.

Time to obtain vascular access

The time to obtain vascular access in the examined scenarios varied and was 240 sec [IQR; 220–265] for Scenario A, 236 sec [IQR; 210–270] for Scenario B, and 165 sec [IQR; 90–180] for Scenario C. There were significant statistical differences in the time to obtain vascular access between Scenarios A and C ($p < 0.001$), and between Scenarios B and C ($p < 0.001$).

Time of administration of the first dose of adrenaline

The analysis to determine the time of adrenaline administration, measured from the moment of access to the vascular system, through preparation of adrenaline for infusion, to the moment of notification of 1 mg of adrenaline, was performed in each of the examined scenarios. In scenarios A, B and C, the duration of adrenaline administration varied and was 55 sec [IQR; 50–85] vs. 20 sec [IQR; 18–35] vs. 20 sec [IQR; 20–30], respectively. Statistically significant differences were noted between scenarios A and B ($p < 0.001$), as well as between scenarios A and C ($p < 0.001$).

Self-assessment

The study participants unanimously stated that the first dose of adrenaline during CPR should be administered with a pre-filled syringe. At the same time, all participants of the study also stated that the optimal method of accessing the vascular system during CPR is an intraosseous access.

DISCUSSION

Rapid implementation of advanced resuscitation procedures, including vascular access and adrenaline administration, is one of the key elements in the context of non-shockable rhythms. As indicated by the CPR guidelines for asystole or pulseless electrical activity (PEA), rapid adrenaline administration is one of the key elements of management. The main focus of the study was to compare the duration of PFS adrenaline and CPM adrenaline; the time parameters of intraosseous and intravenous access under simulated cardiopulmonary resuscitation were also examined.

Currently, many drugs in the form of pre-filled syringes are available on the medical market. They are particularly appreciated in anaesthesia. As indicated by Saliba et al. [10], the use of pre-filled saline syringes significantly reduced peripheral venous catheter failure and increased catheter dwell time. In turn, in research by Jenson et al., in a review of 80 incidents, use of PFS with thiopental was shown to result in fewer dose and substitutional errors [11]. Benhamou et al. carried out an analysis in which they compared the cost and occurrence of medical errors between the use of atropine in standard ampoules and PFS atropine [12]. Preliminary results showed that atropine CMP is much more expensive than atropine PFS. This relationship applies to all drugs in the form of PFS. However, Benhamou points out that if medical errors and overall preparation of the drug for administration are also taken into account, it turns out that PFS adrenaline can reduce hospital costs. Saving would mainly relate to a reduced number of medication errors and the elimination of wastage in concentration with atropine syringes prepared in advance. Also, Larmené-Beld et al., in their analysis of the cost of medicines, showed that the use of PFS compared to CPM leads to a significant cost reduction,

which results in an improvement of the medical unit's budget [13]. The cost reduction, as in the Benhamou et al. study, is related to reductions in the number of medication errors and contaminations of parenteral medications.

In the simulation study, preparation of the drug was much shorter in the case of adrenaline in the form of PFS compared to CPM adrenaline. This may affect the change of rhythm during CPR in real-life conditions. [14, 15]. Another key element that was also shown in the study was the fact that an intraosseous access is a much faster method of obtaining a vascular access than an intravenous one.

Baert et al. suggest that intraosseous access is a comparably effective alternative to peripheral intravenous access for treating OHCA patients in matched populations [16]. Therefore, CPR drugs can be administered both by the intraosseous access and intravenously with the same efficacy, but the key element is the time taken to gain vascular access. In this regard, intraosseous access is the quickest method of obtaining vascular access [17], and is recommended especially for cardiopulmonary resuscitation [18] or hypovolaemic shock when the vascular bed is collapsed [19–21]. Holloway et al. indicated that humerus intraosseous versus intravenous provides rapid and reliable access to administer life-saving medications during cardiac arrest [22]. In turn, Rose et al., in the setting of out-of-hospital cardiac arrest, showed that the time to administer the first dose of epinephrine was faster in the IO access group when compared to the peripheral intravenous access group [18].

Among the limitations of the study, one can specify the fact that the study was conducted under medical simulation conditions and not under real (clinical) resuscitation; however, it is the medical simulation that allows for full standardisation of the obtained procedure conditions. Additionally, by means of medical simulation, medical procedures can be performed many times without potential harm to the patient. The possibility of measurements was an additional aspect that supported the use of medical simulation in the study. Another limitation was to carry out the study only in relation to paramedics; however, such a procedure was also purposeful and dictated by the fact that paramedics working in two-person teams in pre-hospital conditions must have technical solutions which will optimise the performance of the resuscitation.

CONCLUSIONS

A simulation study has shown that paramedics in two-person teams are unable to deliver adrenaline at the time recommended by CPR guidelines. The delay of CPM adrenaline supply compared to PFS adrenaline is statistically significant. In the opinion of the paramedics participating in the study, adrenaline during resuscitation should be administered by means of pre-filled syringes, which eliminates the delays in rescue operations resulting from the time needed to prepare drugs and from limited human resources in rescue teams.

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VIDEO LARYNGOSCOPY FOR ENDOTRACHEAL INTUBATION OF ADULT PATIENTS WITH SUSPECTED/CONFIRMED COVID-19. A SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

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ABSTRACT

INTRODUCTION: During a pandemic, medical personnel while in contact with patients with suspected/confirmed COVID-19 should wear full personal protective equipment (PPE) for aerosol-generating procedures to reduce the risk of infection. Most studies of intubation in level C PPE conditions have been relatively small. Our aim is to quantify the available data on success rates in order to provide an evidence-based benchmark to gauge performance in the published literature.

MATERIAL AND METHODS: A structured literature search was performed with PubMed, Scopus, Embase, Web of Science, and Cochrane databases. The electronic database search was supplemented by searching Google Scholar and by back-searching the reference lists of identified studies for suitable articles. Data were evaluated and extracted by two independent reviewers on the basis of qualitative and quantitative variables of interest. Q statistic and I^2 statistics were used to assess the heterogeneity between the studies.

RESULTS: Fifteen randomized controlled trials were included. The use of PPE during intubation as compared with intubation without PPE reduced intubation efficacy (90.0% vs. 97.9%; RR = 0.94; 95% CI: 0.90–0.99; $p < 0.001$) and increased the procedure time (MD = 7.73; 95% CI: 4.98–10.47; $p < 0.001$). Direct laryngoscopy compared with video laryngoscopes offered similar intubation success rate (93.6% vs. 92.3%; RR = 0.99; 95% CI: 0.97–1.02; $p = 0.66$) and shorter intubation time (MD = 63; 95% CI: –0.77–12.03; $p = 0.08$). However, subgroup analysis showed that intubation with Macintosh blade video laryngoscopes was more effective than that with direct laryngoscopes (98.1% vs. 96.4%; RR = 1.00; 95% CI: 0.97–1.03; $p = 0.90$).

CONCLUSIONS: Our meta-analysis suggests that PPE reduces the effectiveness of endotracheal intubation. The use of direct laryngoscopy for intubating patients with suspected/confirmed COVID-19 by an intubator wearing level C PPE is associated with overall intubation time reduction and an increase in intubation success rate compared with video laryngoscopes. However, the findings suggest that Macintosh blade video

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laryngoscopes during endotracheal intubation with PPE may be an alternative to direct laryngoscopes. Video laryngoscopy can be helpful for less experienced personnel.

KEY WORDS: endotracheal intubation, laryngoscope, infected patient, COVID-19, personal protective equipment, meta-analysis

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INTRODUCTION

Endotracheal intubation is the gold standard for airway management in many clinical situations [1, 2]. Direct laryngoscopy with a Macintosh laryngoscope is still commonly performed in endotracheal intubation. Unsuccessful or prolonged endotracheal intubation can be associated with many serious complications, such as desaturation, sympathetic stimulation leading to hypertension and tachycardia and even hypoxemic cardiac arrest causing permanent neurological sequel or even death [3]. In light of this, intubation with video laryngoscopes has become more commonly performed. It has been reported that video laryngoscopes can provide improved laryngeal visualization as well as increased intubation success rate, especially in difficult airway patients [4, 5].

In the current SARS-CoV-2 pandemic, each patient under emergency medical conditions should be considered potentially infected. Therefore, medical personnel should wear specialist personal protective equipment (PPE), including full PPE for aerosol-generating procedures, respiratory protection preferably with an FFP3 filter, goggles, face shield, and gloves [6]. The need for this protection of medical personnel at high risk of contact with suspected/confirmed COVID-19 patients results from the fact that the new coronavirus SARS-CoV-2 spreads via droplets, contact, and natural aerosols from human to human [7]. Moreover, the coronavirus is highly infectious, as verified by recent epidemiological data. As of April 10, 2020, the reported number of confirmed infection cases equaled 1,777,612. COVID-19 mortality is 6.1% and turns out lower than that in SARS or MERS, but the disease dynamics is very high. Patients with COVID-19, in severe cases, can progress rapidly and develop acute respiratory distress syndrome, septic shock, metabolic acidosis, and coagulopathy [8, 9]. In any case of patient deterioration and acute respiratory distress syndrome development, intubation should be performed and mechanical ventilation implemented [10]. Endotracheal intubation and advanced resuscitation should also be applied in the case of sudden cardiac arrest in such a patient [11]. It is therefore clear that the use of full PPE may reduce the risk of virus transmission [9]. However, research shows that the effectiveness of medical procedures performed with a PPE suit may be reduced [12]. This also refers to endotracheal intubation. It is thus reasonable to evaluate the available studies concerning various methods of endotracheal intubation in order to search for the most effective method of airway management in patients with suspected/confirmed COVID-19.

Recently, several studies have evaluated the effect of video laryngoscopy compared with direct laryngoscopy performed in infectious patients by operators wearing level C PPE. With the aid of the increased power of meta-analytic methods, the goal of the present study was to review the relevant and available published randomized controlled trials (RCTs) to test the hypothesis that compared with direct laryngoscopy, the use of video laryngoscopy in infectious patients would increase the intubation success rate.

MATERIAL AND METHODS

The manuscript followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [13]. Before commencing the study, we agreed on the analysis methods and the inclusion and exclusion criteria to be applied. The protocol of this meta-analysis study has not been registered.

1. Inclusion and exclusion criteria

Studies were included if they met the following criteria: (1) RCT; (2) clinical, cadaver, or simulation trial; (3) intubation of an adult patient or a simulator; (4) comparison of intubation with different laryngoscopes with/without level C PPE; (5) reporting any of the following outcomes: intubation success rate, time to intubation, glottis visualization. Articles available only in abstract form and meeting reports were excluded. Studies in English were included.

2. Search strategy

A comprehensive literature search was performed with PubMed, Scopus, Embase, Web of Science, and

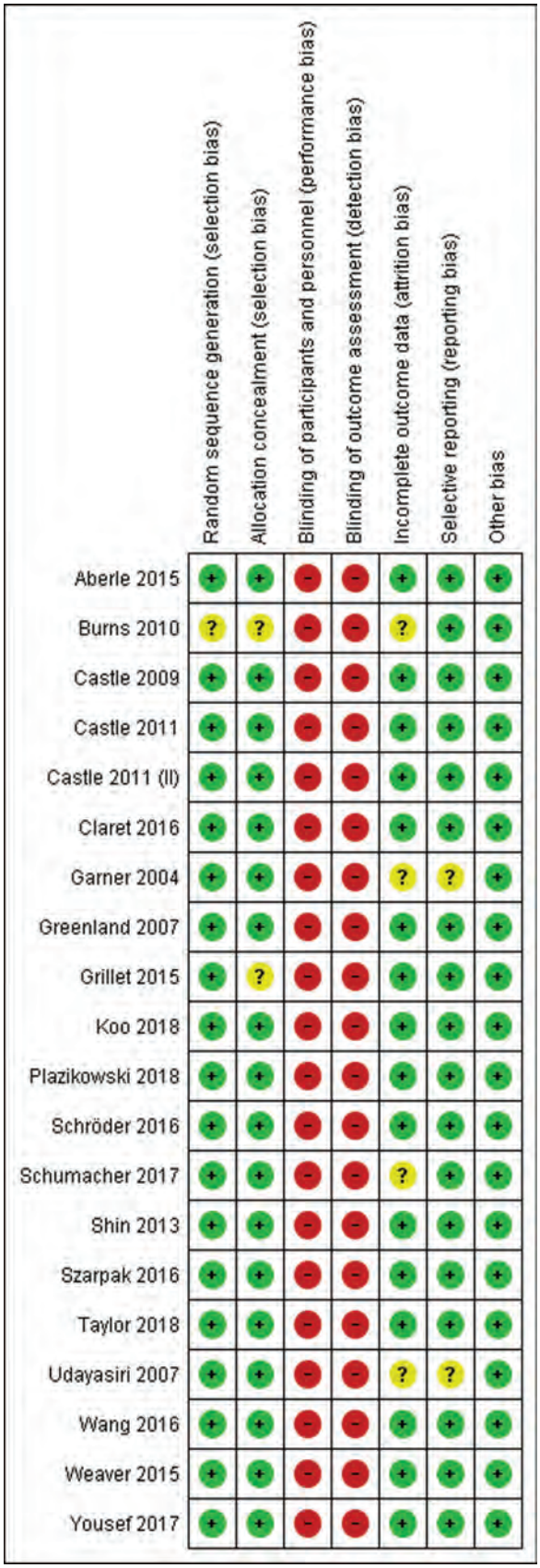
Cochrane databases, from the inception of each database up to March 30, 2020. The following terms were used: "Macintosh laryngoscope" or "Miller laryngoscopes" or "laryngoscope" or "video laryngoscopy" or "endotracheal intubation" or "tracheal intubation" or "airway management" and "PPE" or "personal protective equipment" or "HazMat" or "Level C protective" or "CBRN" or "Chemical" or "toxic" or "infectious patient". The electronic database search was supplemented by searching Google Scholar and by back-searching the reference lists of identified studies for suitable articles.

3. Data extraction

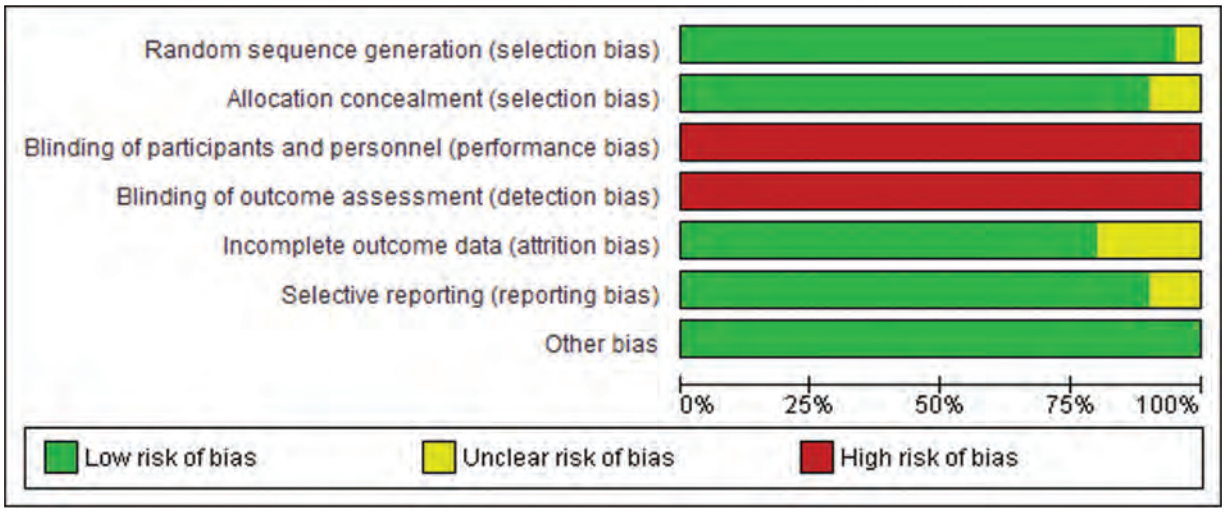
Two authors (K.L. and J.S.) independently assessed each article to determine whether or not it met the criteria for inclusion. Disagreements between the authors regarding values or analysis assignments were resolved through discussion with a third researcher (L.S.), and the decision was taken by the majority of the researchers. The agreement with respect to study inclusion was assessed by using the Cohen kappa statistics [14]. We were careful to avoid the inclusion of data from duplicate publications. In any case of suspected data discrepancies, we contacted the relevant author directly. Each author also performed independent data abstraction using standardized data collection forms. Data extracted from eligible studies included the following characteristics: study and year, country, type of participants, a number of participants, type of devices applied for intubation, intubation with/without PPE, intubation time, and success of intubation. If outcomes were reported for more than one follow-up period, we used data for the longest follow-up in each trial.

4. Quality assessment

The quality of eligible trials was assessed by using the "risk of bias" tool in accordance with the Review Manager software, version 5.3 (RevMan; Cochrane Collaboration, Oxford, UK). Two authors (L.S. and K.J.F.) estimated the risk of bias in the following methodological domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, others bias [15]. Each was graded "yes", "no", or "unclear", which reflected a high risk of bias, low risk of bias, and uncertain bias, respectively (Suppl. digital content 1). The review authors' judgments about each risk of bias item are provided in Suppl. digital content 2.



SUPPLEMENT 1. The risk of bias (Suppl. digital content 1)



SUPPLEMENT 2. The review author's judgments about each risk of bias (Suppl. digital content 2)

5. Data analysis

For statistical analyses, we used the Review Manager (RevMan) software, version 5.3. Because there may be differences in the treatment effect between trials, especially those using different devices, we assumed a random-effects model. We employed the inverse-variance method for the continuous outcomes and the Mantel-Haenszel models for all dichotomous outcomes. We calculated mean differences (MD) for continuous measurements (time to intubation) and risk ratios (RR) for dichotomous outcomes (intubation success rate). All statistical variables were determined with 95% confidence interval (CI) to estimate the range of plausible treatment effects. When the continuous outcome was reported in a study as median, range, and interquartile range, we estimated means and standard deviations using the formula described by Hozo et al. [16]. We quantified heterogeneity in each analysis by the tau-squared and I-squared statistics. Studies were subgrouped by the type of intubation devices. Heterogeneity was detected with the chi-squared test with n–1 degree of freedom, which was expressed as I^2. Values of $I^2 > 50\%$ and $> 75\%$ were considered to indicate moderate and significant heterogeneity among studies, respectively [16]. All p-values were tailed and considered statistically significant if $p < 0.05$.

RESULTS

1. Trial identification and characteristics

Initially, 297 articles were identified for review based on our search of the electronic databases. Of these, 133 were excluded because they were not relevant.

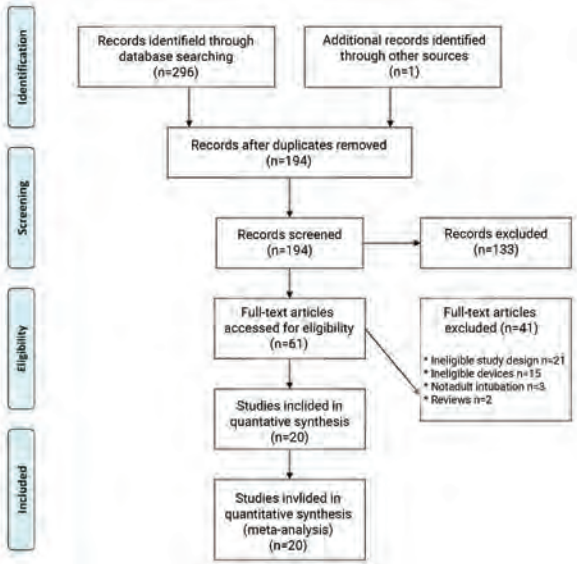


FIGURE 1. 20 studies with the inclusion criteria for data

The remaining 61 articles were carefully examined for meeting the inclusion criteria. Of those, 41 studies were excluded because they were not RCTs comparing direct laryngoscopy with video laryngoscopy (n = 21), provided comparisons between unrelated airway management devices (n = 15), did not refer to adult intubation (n = 3), were review articles (n = 2). Ultimately, 20 studies that met the inclusion criteria and contained the necessary data for the planned comparison were identified (Fig. 1). The details of the selected trials are summarized in Table 1. Among the 20 mentioned studies, two were cadaver studies [17, 18] and the others were simulation trials [12, 19–35].

Table 1. Characteristics of included studies.

Study	n	Study design	Intubated object	Studied devices	Intubation conditions	Operators	Definition of intubation time	Definition of intubation success rate
Aberle 2015	23	RCT	Manikin	GLS and ML	With PPE	Emergency Medicine residents	From blade pass the lips until the first breath was administered	Successful endotracheal tube placement was confirmed using lung expansion monitoring
Burns 2010	47	RCT	Manikin	ML	With/without PPE	EMS personnel	From picking up the laryngoscope until the first breath was administered	symmetrical chest rise with manual ventilation
Castle 2009	64	RCT	Manikin	ML	With/without PPE	6 resuscitation officers (RO), 14 paramedics, 15 anaesthetists and 25 emergency physicians	from when the laryngoscope was picked-up until tube placement was confirmed by simulated use of an esophageal detection device and colorimetric end-tidal CO2	Not specified
Castle 2011	48	RCT	Manikin	ML	With/without PPE	final year paramedic students	from when the laryngoscope was picked-up and stopped when the ETT was placed within the manikin and simulated confirmation of ETT placement	confirmed visually by a researcher
Castle 2011	66	RCT	Manikin	ATQ and ML	With/without PPE	final year paramedic students	From picking up the laryngoscope until the first breath was administered	utilising an oesophageal tube check (Positube) and colorimetric EtCO
Claret 2016	30	RCT	Manikin	ATQ and ML	With PPE	Emergency physicians	From picking up the laryngoscope until the first breath was administered	symmetrical chest rise with manual ventilation
Garner 2004	8	RCT	Manikin	ML	With/without PPE	Mixed prehospital medical personnel: three paramedics; three emergency physicians; and two anaesthetists	From picking up the laryngoscope until the first breath was administered	Successful lung expansion
Grillet 2015	13	RCT Letter	Manikin	ML	With/without PPE	Senior ICU physicians	Not specified	Not specified
Greenland 2007	18	RCT	Manikin	ML	With/without PPE	4 consultant anaesthetists and 14 anaesthetic trainees	confirmed by observation from the bottom of the manikin of the inflated tracheal tube cuff in the trachea in addition to successful inflation of the lung	successful inflation of the lungs
Koo 2018	29	RCT	Cadaver	ML	With/without PPE	24 emergency medicine residents and 5 emergency medicine physician assistants	From the time the participant picked up the laryngoscope to the time the participant believed the endotracheal balloon went past the vocal cords	confirmed visually by a researcher
Plazikowski 2018	30	RCT	Manikin	ATQ and ML and FSC	With/without PPE	anesthesiologists working in EMS	from stopping bag-mask ventilation until the first visible effective ventilation of the mannequin	Not specified

Table 1. Characteristics of included studies.

Study	n	Study design	Intubated object	Studied devices	Intubation conditions	Operators	Definition of intubation time	Definition of intubation success rate
Schroder 2016	42	RCT	Manikin	ATQ and GLS and APA and ML	With PPE	anesthesiologists	From the entrance of each laryngoscope through the mouth until the moment of chest extension by the first ventilation	Not specified
Schumacher 2017	30	RCT	Manikin	ML	With PPE	anesthesiologists	From picking up the laryngoscope until the first breath was administered	Not specified
Shin 2013	31	RCT	Manikin	AWS and ML	With PPE	medical doctors who had passed the national board examination, which includes performing ETI on a manikin using the ML	from grasping each device to the end of the procedure when the participants were deemed to have correctly positioned the tracheal tube	visible chest rise after bagging with the Bag-Valve-Mask device
Szarpak 2016	43	RCT Letter	Manikin	AWS and ML	With PPE	paramedics	Not specified	Not specified
Taylor 2018	15	RCT	Cadaver	MCG and ML	With/without PPE	emergency medicine residents and EMS personnel	Not specified	determined when two ventilations were given to the cadaveric model
Udayasiri 2007		RCT	Manikin			Seven emergency doctors and 11 ED nurses	Not specified	Not specified
Wang 2016	40	RCT	Manikin	ML	With/without PPE	emergency physicians with 1–4 years of residency experience participated	from the moment the physician first grasped the laryngoscope successful ventilation was achieved	satisfactory placement of the device on the basis of adequate symmetric expansion of the mannequin's lung
Weaver 2015	37	RCT	Manikin	GLS and ML	With/without PPE	Emergency medicine residents	From picking up the laryngoscope until the two successful ventilations was administered	Not specified
Yousif 2017	20	RCT	Manikin	GLS and KV and ML	With PPE	18 paramedics and 2Emergency Medical Technicians-Cardiac	time from insertion of the device in the mouth to a clearly visible chest rise of the manikin when ventilated	confirmed visually by a researcher

ML — Macintosh laryngoscope; GVL — GlideScocope; FSC — Ambu® fiberoptic aScopeTM; APA — AP Advance video laryngoscope; ETI — endotracheal intubation; AWS — The Pentax-Airwayscope; EMS — emergency medical service; MCG — McGarth video laryngoscope; KV — King Vision video laryngoscope

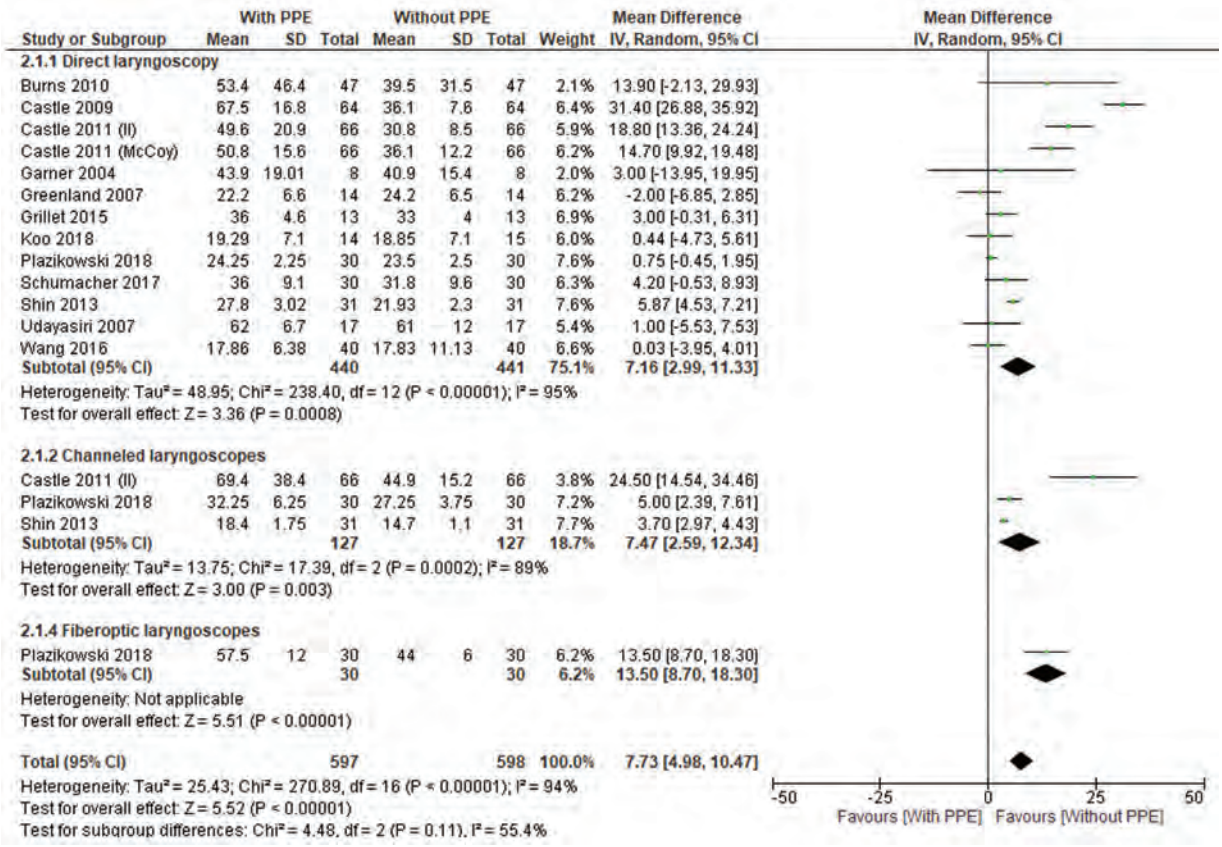


FIGURE 2. Time to intubation without PPE compared with PPE conditions

2. Personal protective equipment impact on endotracheal intubation

Thirteen studies with 1109 intubations reported impact of level C PPE on the duration of endotracheal intubation [12, 17, 20–22, 24–27, 29, 30, 32, 33]. Overall, time to intubation was shorter without PPE compared with PPE conditions (MD = 7,33; 95% CI: 4.98–10.47; $p < 0.001$) (Fig. 2).

Subgroup analysis showed that the use of PPE extended all intubation techniques, including those applying direct laryngoscopes (MD = 7.16; 95% CI: 2.99–11.33; $p < 0.001$), channeled laryngoscopes (MD = 7.47; 95% CI: 2.59–12.34; $p = 0.003$), as well as fiberoptic laryngoscopes (MD = 13.50; 95% CI: 8.70–18.30; $p < 0.001$).

The impact of PPE on endotracheal intubation success rate was recorded in eight studies [12, 17, 18, 21, 22, 25, 27, 30], and intubation without PPE was found to be superior to intubation with PPE in this regard (97.9% vs. 90.0%; RR = 0.94; 95% CI: 0.90–0.99; $p < 0.001$) (Fig. 3).

In subgroup analysis, intubation without PPE was superior to intubation with PPE for all laryngoscope types: direct laryngoscopes (98.3% vs. 89.3%; RR = 0.93; 95% CI: 0.88–1.00; $p = 0.04$), channeled laryngoscopes (96.1% vs. 92.9%; RR = 0.98; 95% CI: 0.94–1.03; $p = 0.49$), Macintosh blade laryngoscopes (100% vs. 73.3; RR = 0.74; 95% CI: 0.54–1.02; $p = 0.07$), and fiberoptic laryngoscopes (100% vs. 93.3%; RR = 0.93; 95% CI: 0.83–1.05; $p = 0.24$).

3. Direct laryngoscopy versus video laryngoscopy in personal protective equipment conditions

Ten studies compared Macintosh laryngoscope with other laryngoscopes in PPE conditions [18, 19, 21, 23, 27, 28, 30, 31, 34, 35]. Overall, intubation with direct laryngoscopes was shorter than that with video laryngoscopes (MD = 5.63; 95% CI: –0.77–12.03), although the difference was not statistically significant ($p = 0.08$) (Fig. 4). The subanalysis revealed that intubation with direct laryngoscopes was slightly faster than with Macintosh blade video laryngoscopes (MD = –0.14; 95% CI: –5.61–5.33). For comparison of direct laryngoscopes with channelled laryngoscopes, faster intubation procedure was observed with direct laryngoscopy (MD = 6.41; 95% CI: –2.41–15.24). However, the above differences were not statistically significant ($p = 0.96$ and

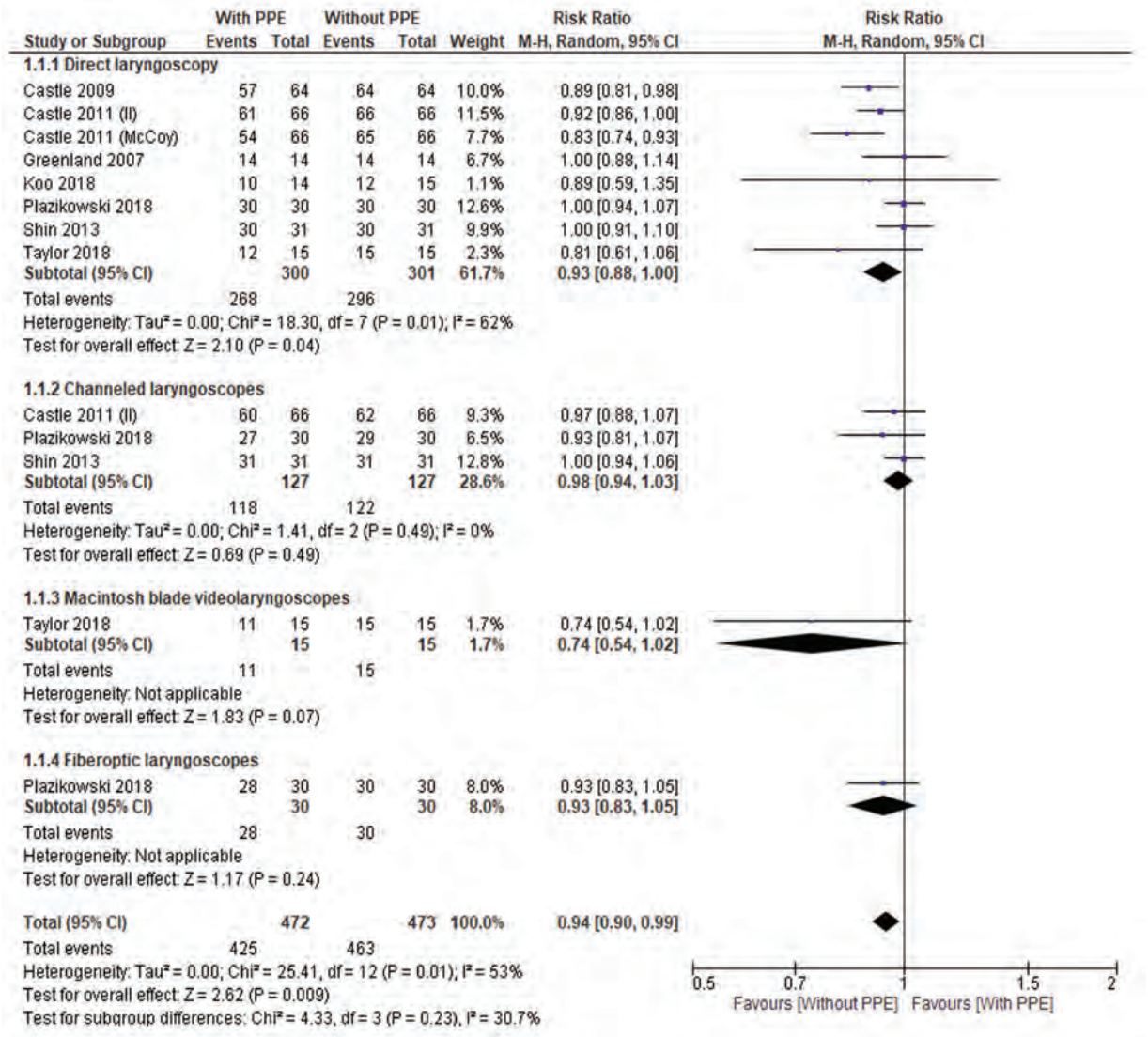


FIGURE 3. The impact of PPE on endotracheal intubation

p = 0.15, respectively). In the case of fiberoptic laryngoscopes intubation, the duration of the procedure was statistically significantly longer than that of direct laryngoscopy (MD = 32.90; 95% CI: 28.53–37.27; p < 0.001).

The intubation success rate for direct laryngoscopes versus other laryngoscopes in PPE conditions was reported in ten RCTs [18, 19, 21, 23, 27, 28, 30, 31, 34, 35]. The effectiveness of intubation was comparable between direct laryngoscopes and video laryngoscopes (93.6% vs. 92.3%; RR = 0.99; 95% CI: 0.96–1.02; p = 0.66) (Fig. 5). Subgroup analysis showed that intubation with Macintosh blade video laryngoscopes was more effective than that with direct laryngoscopes (98.1% vs. 96.4%; RR = 1.00; 95% CI: 0.97–1.03), although the difference was not statistically significant (p = 0.90). On the other hand, direct laryngoscope intubation was associated with higher efficiency as compared with channeled laryngoscopes (88.5% vs. 91.2%; RR = 0.99; 95% CI: 0.93–1.05; p = 0.74) and fiberoptic laryngoscopes (100% vs. 93.3%; RR = 0.93; 95% CI: 0.83–1.05; p = 0.24).

Additional subanalysis with the division of operators into "Anesthesiology staff", "Emergency medicine staff", or "Mixed staff" revealed that in the first two groups, video laryngoscopy was associated with a longer procedure duration than direct laryngoscopy, while in the "Mixed staff" group, the opposite trend was observed (Tab. 2). Moreover, the analysis showed higher efficacy of direct laryngoscopy compared with video laryngoscopy (100% vs. 96.8%; RR = 0.97; 95% CI: 0.89–1.06; p = 0.50) (Tab. 3). For the "Emergency medicine staff", the efficacy

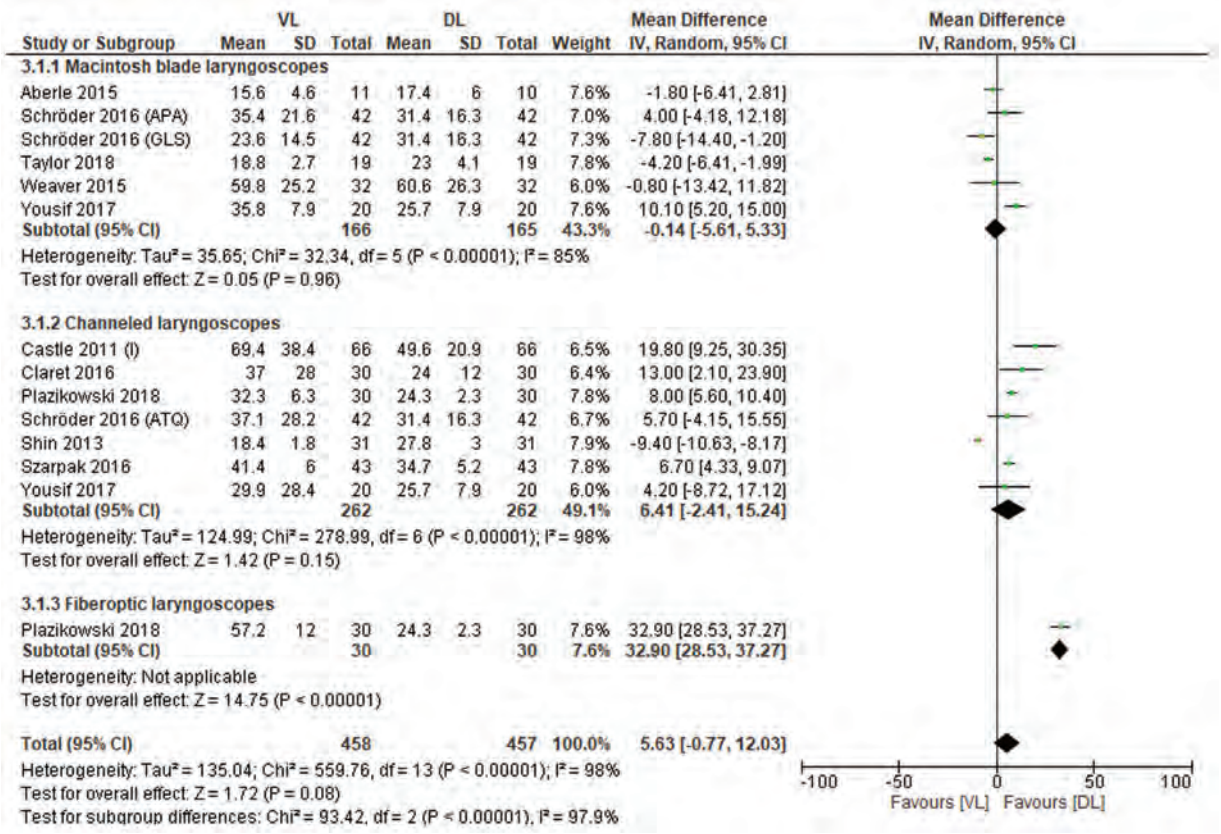


FIGURE 4. Intubation with direct laryngoscopes versus video laryngoscopes

with video laryngoscopy equalled 87.7% and was higher than that for direct laryngoscopy (87.3%) (RR = 1.02; 95% CI: 0.93–1.12). Among the "Mixed staff", the efficacy of direct laryngoscopy and video laryngoscopy intubation was 94.7% vs. 93.8% respectively.

4. Risk of bias

The risk of bias in the included studies is outlined in Supplementary digital content 1 and 2. All the 20 studies clearly described random sequence generation [12, 17–35]. The risk of bias in the RCTs was assessed as either low or moderate across all domains, apart from the blinding of participants and personnel where blinding was clearly not possible.

Limitations

Our meta-analysis has some limitations. First, all the included studies were small and are at a high risk of bias as neither the operator nor the outcome assessor was blinded for obvious technical reasons. The second limitation is the influence of methodological heterogeneity from variations in the design of the original studies, such as involvement of diverse "patients" or different skill levels of operators; this heterogeneity should be perceived as an inherent limitation of meta-analysis. Third, not all studies reported intubation time and intubation success rate at the same time. Fourth, most of the studies included in the meta-analysis were simulation studies; however, owing to the risk of infection of medical personnel and the need to secure the airway as soon as possible, it would be impossible to conduct such studies in clinical conditions.

DISCUSSION

Endotracheal intubation is considered to be one of the basic procedures in the scope of emergency medicine and medical rescue, as well as during cardiopulmonary resuscitation. The comparison of endotracheal intubation with direct laryngoscopy and other intubation methods, including video laryngoscopy, has been widely studied and meta-analyzed. However, both the more common epidemics, including SARS and MERS, and the risk of infection with other dangerous pathogens, especially during

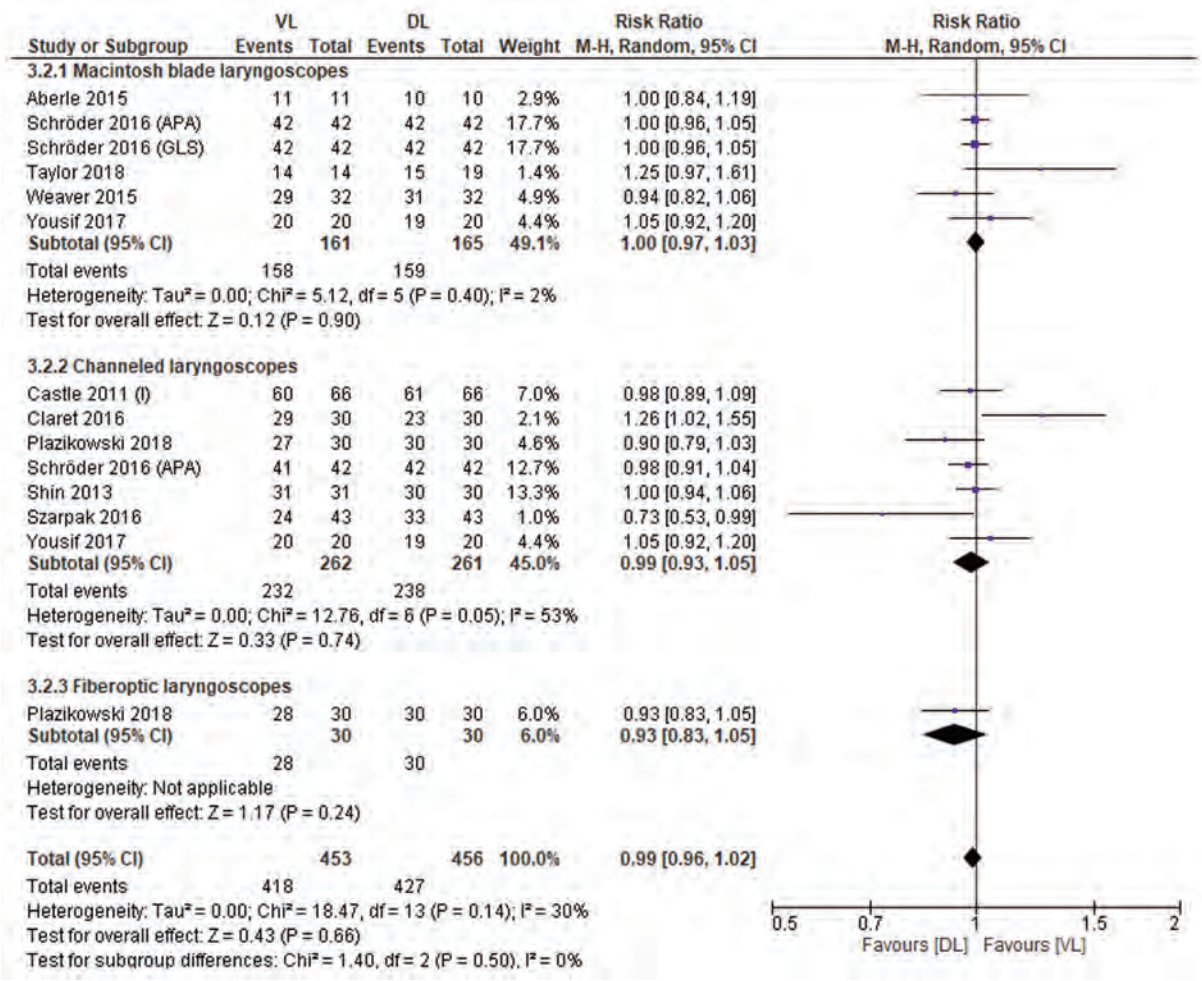


FIGURE 5. The effectiveness of intubation between direct laryngoscopes and video laryngoscopes

Table 2. Compared the video laryngoscopes with the Macintosh laryngoscope intubation time in subgroup analysis

	Number of trials	MD (95% CI)	P value	I^2 statistic, %
Anesthesiology staff	2	10.27 (0.44, 20.11)	0.04	97%
Emergency staff	6	3.64 (-1.99, 9.26)	0.20	90%
Mixed staff	2	4.71 (-23.89, 33.31)	0.75	97%

MD — mean differences; N/A — not applicable

the current COVID-19 pandemic, suggest studies on the performance of medical procedures, also with reference to respiratory protective devices.

The number of available studies on respiratory protection under such conditions is limited and there are no meta-analyses of pooled data.

According to our knowledge, this was the first meta-analysis comparing Macintosh laryngoscope with video laryngoscopes in level C PPE conditions. We performed *a priori* subgroup analyses in order to investigate [1] the effect of PPE on intubation time and overall intubation success rate while

Table 3. Compared the video laryngoscopes with the Macintosh laryngoscope intubation success rate in subgroup analysis

	Number of trials	Effectiveness VL	Effectiveness DL	RR (95% CI)	P value	I2 statistic, %
Anesthesiology staff	2	96.8%	100%	0.97 (0.89, 1.06)	0.50	71%
Emergency staff	4	87.7%	87.3%	1.02 (0.93, 1.12)	0.65	57%
Mixed staff	2	93.8%	94.7%	1.00 (0.94, 1.05)	0.87	0%

N/A — not applicable; RR — risk ratios

using different types of laryngoscopes; [2] the effect of video laryngoscopy compared with direct laryngoscopy on intubation success rate and intubation time by type of video laryngoscopes under PPE conditions; [3] the influence of the type of operator on success rate and intubation time. Our study suggests that intubation with class C protective suits has a statistically significant effect on prolonging the duration of the procedure and reducing its effectiveness. Moreover, the use of video laryngoscopes did not improve the overall success rate of endotracheal intubation when operators were wearing full PPE; on the contrary, video laryngoscopy intubation was associated with longer endotracheal intubation time and slightly lower efficacy compared with direct laryngoscopy. The analysis in subgroups showed only a slight advantage of Macintosh blade video laryngoscopes over direct laryngoscopy regarding the efficacy of intubation. Video laryngoscopes display the glottis on an external monitor by using a camera attached to the device blade without alignment of the oral-pharyngeal-tracheal axes.

Direct laryngoscopy also requires optimal head and neck positioning, proper insertion of the laryngoscope into the mouth, and glottis visibility, which demands a high level of operator experience [36]. Since video laryngoscopes — especially in conditions of difficult airways or difficult access to the patient — may offer better glottis visualization compared with direct laryngoscopes [37], they can facilitate endotracheal intubation, especially for less experienced staff.

The above relationships seem to be confirmed by numerous studies [39, 40]. Additionally, as research indicates, the learning curve for video laryngoscopes is significantly shorter than for Macintosh or Miller laryngoscopes, which allows for effective endotracheal intubation by using video laryngoscopes after a short training [41, 42]. The subanalysis of the study material showed that in the subgroup of "Emergency medicine staff", video laryngoscopy was associated with higher efficacy in comparison with direct laryngoscopy, but this difference was not statistically significant. Therefore, it may be inferred that for this professional group, including emergency physicians, paramedics, or emergency nurses, video laryngoscopy may be a good alternative to direct laryngoscopy for intubation under difficult conditions, which undoubtedly comprises intubation in full PPE.

A number of prospective and observational studies reveal that in emergency medicine conditions, the effectiveness of direct laryngoscopy intubation is insufficient [36, 43]. As indicated in the study by Hoshijima et al. [44], another aspect that supports the use of video laryngoscopy, apart from the fact that it improves the visibility of the glottis, is that it significantly reduces the incidence of soft tissue bleeding compared with the Macintosh laryngoscope. Multiple attempts to intubate a patient may lead to desaturation and then intensify soft tissue bleeding and glottis edema, which in turn may result in a situation described by the Difficult Airway Society as "can't intubate, can't ventilate" [45]. Video laryngoscopes, owing to better visibility of the glottis compared with direct laryngoscopes, can reduce the risk of esophageal intubation in emergency and intensive care patients [46, 47].

CONCLUSIONS

Our meta-analysis suggests that PPE reduces the effectiveness of endotracheal intubation. The use of direct laryngoscopy for intubating patients with suspected/confirmed COVID-19 by an intubator wearing level C PPE is associated with overall intubation time reduction and an increase in intubation success rate compared with video laryngoscopes. However, the findings suggest that Macintosh blade video laryngoscopes during endotracheal intubation with PPE may be an alternative to direct laryngoscopes. Video laryngoscopy can be helpful for less experienced personnel.

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HISTORY OF THE STATE MEDICAL RESCUE SERVICE IN POLAND

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ABSTRACT

The State Medical Rescue Service in Poland dates back to 1891, when the first ambulance service was established in Cracow. Over 129 years, the system has been fully transformed, starting with medical staff, through numbers, equipment, and modern information and communication systems for emergency calls and assistance during interventions, and medical records. Emergency medical services in Poland had their breakthrough when the current Act of 8 September 2006 on the National Medical Rescue Service was introduced, which is the foundation for the modern organisation of medical rescue and emergency medicine in Poland. According to the Ministry of Health, the total number of Emergency Medical Services Teams operating in 2019 was 1585, including those operating on a seasonal basis.

KEY WORDS: history of medical rescue, Poland, National Medical Rescue Service

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INTRODUCTION

The organisation of emergency medical services is one of the most important issues in terms of the strategy of each country in the world. Although a variety of levels of such activities are noted, it should undoubtedly be stressed that this always concerns the health and life of people living in given administrative areas. Medical rescue (although at that time it probably did not bear such a name) has its roots in the beginning of mankind, where in the case of e.g. personal injury or sudden illness, another person brought help. Since the very beginning of history, people have been struggling with the forces of nature, trying to prevent diseases, trying to treat the injuries they suffered during hunting and while fighting enemies. The first ways to help with damage were to observe the natural world. With the development of humanity, the nature of threats has changed [1]. The modern form of this discipline is fully professional in nature and has thus become an aspect attributed to almost every field in medicine and health sciences. The contemporary organised medical rescue system in Poland is called the National Medical Rescue Service. It should be stressed, however, that its current appearance has been evaluated over many years, and the experience of the past has made it possible to organise an efficient and professional system that brings together specialists and professional equipment, including education and IT systems.

1891-1948

The first ambulance service in Poland was established in 1891 in Cracow, and the organisers of the first ambulance service in Europe, the Vienna ambulance service in 1883, contributed to its creation. The Cracow ambulance service was located in the building

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of the fire brigade, where the then granted premises included the ambulance, waiting room, and a room for the students of the Jagiellonian University Medical Faculty, who were on duty here. The Krakow Voluntary Rescue Society was equipped with one ambulance, which was pulled by two horses, together with five stretchers for the patients. The symbol of the Society was a white cross on a blue background. Since 1904, the first duty was introduced and paid for, but it was not until 1911 that physicians, and not volunteers, were included. In 1908 the ambulance was equipped with four ambulances, a folding armchair, seven trunks used for accidents, and four pairs of stretchers. In 1950, the Krakow Voluntary Rescue Society ceased its activities, but a few months later it resettled in the Health House, where it remained until 1977. Then the Ambulance Service changed its location again, but this time to its own building, where it remains to this day [2]. Shortly after the Krakow ambulance service was established, ambulance stations were also established in Lvov (1893), Warsaw (1897), Łódź (1899), Lublin (1917), and Poznań (1928) [3–7]. On 27 November 1902, an ambulance service was established within the structure of the Fire Department in Bydgoszcz [8]. All established ambulances were independent, had legal personality, and were financed by social contributions, social insurance fees, donations made to them, their own resources, and city grants. These forms provided round-the-clock and free-of-charge assistance in all emergencies. In 1919 the Polish Red Cross Society was established. Its members provided assistance to people injured in warfare and ran medical facilities and ambulance stations. At that time, rescue teams were also established, sanitary training was conducted, and missing persons were sought. After World War II, specifically in the years 1948–1951, the health care infrastructure, consisting of 30 hospitals, 280 health clinics, and 177 ambulance stations, was taken over by the government from the Polish Red Cross and handed over to the Ministry of Health [9]. The administrative authorities divided the ambulance stations, taking into account the territorial division of Poland into urban, powiat, and provincial, with exit teams as well as outpatient ambulatories.

1950–1999

In 1951, the Minister of Health issued the first document after the war, in which the principles of the operation and functioning of sanitary transport were defined [10]. After the administrative reform of the country in 1976, a new provision was created concerning the framework organisation of Provincial Sanitary Transport Columns [11], established as independent budgetary units created in each voivodship, and subject to the administrative competence of the voivodship. In the years 1990–1999 they were still units of a budgetary nature and a voivodship range. These organisational units ensured the fulfilment of transport needs for the entire health service. Their budget was determined for a given year in accordance with the Budget Act, and transport tasks were carried out within these measures. In 1992, the Ministry of Health purchased 80 modern ambulances, which were transferred free of charge to the Voivodship Sanitary Transport Columns located in individual voivodships. Since then, rescue operations could be carried out while the patient was being transported to hospital. In the years 1989–1999, due to the lack of legal regulations and limited financial resources, the functioning of those units left much to be desired. Thus, it can be unequivocally and critically stated that in those years there was no compact medical rescue system in Poland that would guarantee the provision of specialist assistance necessary to save life and health.

The 1950s also saw the arrival of sanitary aviation in Poland. In 1955, by decision of the Ministry of Health and Social Welfare, sanitary aviation was established for the benefit of the health service. Its organisation was entrusted by the then Minister of Health Rajmund Barański to an outstanding pilot, AK soldier, and Warsaw insurgent, Tadeusz Więckowski. Fifteen Sanitary Aviation Teams and the Central Sanitary Aviation Team in Warsaw were established. The teams were deployed in such a way as to cover the whole country. The tasks of the Sanitary Aviation Teams included transportation of the sick and wounded as well as medicines, blood, vaccines, and medical equipment. The Sanitary Air Force also performed flights to relocate consultant physicians to carry out complex medical procedures in distant hospitals in urgent cases of threat to human life or health. The basic crew of the airplanes and helicopters at the time were such people as a pilot and a feldsher or a nurse, and if a helicopter was used, an additional aviation mechanic. Later, during the transport of patients in very severe condition, the sick on board were cared for by physicians from local ambulance services or hospitals [12].

1999–2006

The modern system of the State Medical Rescue has had a multi-stage process of creation. The concept of the present system dates back to the 1990s. Poland, based on the experience of other countries, has cyclically implemented legal and systemic solutions, which were to result in the creation of a modern and coherent emergency medical system with a state dimension. In 1999, a health policy program called "Integrated Medical Rescue" entered into force, which was planned for the years 1999–2003. The fundamental goal of the program was to simultaneously prepare qualified medical personnel dedicated to this field of rescue, as well as the entire infrastructure, and to develop and implement procedures for the proper functioning of the emergency medical system throughout the country. In 2001 the programme was divided into six task packages. The main items to be coherently created by the State Medical Rescue included the creation of emergency call centres and hospital emergency wards, as well as a comprehensive and normatively equipped ambulances. A huge breakthrough in the creation of the State Medical Rescue was the first Act on the State Medical Rescue passed on 25 July 2001 [13]. Its provisions created the outline of the system, even though it regulated many issues only briefly. This act became the direction and foundation for the development of medical rescue in Poland at that time. However, it soon transpired that work was required to improve some of its solutions. The changes in its provisions, as well as the legislative process, lasted until 6 September 2006, while on 12 October the President of the Republic of Poland signed the amended act on medical rescue. According to the amended Act of 8 September 2006 on the State Medical Rescue Service, the system includes wheeled and air medical rescue teams, as well as hospital emergency departments, medical dispatcher's centres, and units cooperating with the system, including trauma centres for children and adults, thus creating a modern emergency medicine system [14].

On 3 March 2003, the Minister of Health withdrew the Central Sanitary Aviation Group, which was located in Warsaw at 5 Księżycowa Street, appointed by the Minister of Health on 3 September 1958 [15]. At the same time, a new formation was created, which in a comprehensive and coherent way organised the air medical rescue, called the Independent Public Health Care Institution — Helicopter Emergency Medical Service. For this purpose, the existing medical airborne medical units were transformed into 15 helicopter medical rescue bases. Moreover, the scope of service was extended because helicopters now also fly to emergencies and illnesses. In this way, the medical transport units were transformed into emergency medical teams, and this process was completed on 16 January 2001 [16]. In November 2016, the Independent Public Health Care Facility LPR changed its name to the Polish Medical Air Rescue and now has 21 permanent and one temporary base(s).

NATIONAL EMERGENCY MEDICAL SERVICE IN 2020

The current organisation of the State Medical Rescue System is based on a law that was created in 2006 and entered into force on 1 January 2007 [17]. The Act sets out the principles of organisation, operation, and financing of the system and the principles of providing education in the field of first aid. The final and effective version was announced in the Notice of the Marshal of the Sejm of the Republic of Poland of 25 April 2019 on the announcement of the consolidated text of the Act on the State Medical Emergency Service [18]. The aim of this act is to introduce the functioning of the medical rescue system, both through high level provision of health services based on the current standards of Western countries and through providing required solutions in the area of notification of emergencies [19]. The law is the foundation for a number of regulations that specify its provisions in detail. The State Medical Rescue Service has been marked in a consistent manner and closely associated with this formation, adopting the graphic design of the State Medical Rescue system. The ordinance issued for this purpose specifies the way of marking the units of the system, the person in charge of the medical action, persons performing medical rescue operations, and rescuers from the units cooperating with the system, referred to in art. 15 section 1 item 9 of the Act of 8 September 2006 on the State Medical Rescue, as well as the requirements concerning uniforms of the members of medical rescue teams [20].

Modern medical rescue also includes dedicated medical staff, who have become its integral part. Apart from the previous professions of physician and nurse, the Act has given a fixation to a relatively

young profession, i.e. the paramedic. Currently, according to its provisions, it is a person who, completing the process of pre-diploma education, must have a higher education, undergo a six-month adaptation internship, and pass the State Medical Rescue Examination. This is one of the few professional groups for which a separate and standardised standard of education has been created, as is the case with physicians [21]. This professional group has also experienced independence and a certain autonomy in the performance of professional activities. Under the Regulation, in addition to performing medical rescue activities independently (basic medical rescue team) or under the supervision of a physician (specialist medical rescue team, emergency department), a paramedic has the right to perform his/her professional work in the so-called units cooperating with the system, i.e. the State and the Voluntary Fire Brigade, Army, Police, and mountain, sea, or water rescue. These activities have been called health services other than medical rescue operations, which can be provided by a paramedic, and an individual document has been created in the form of an individual paramedic's card, which is used to keep medical records while providing these services [22]. Since 1 January 2020, medical rescuers have been brought under the supervision of voivodeships, where they carry out and document the course of post-graduate training, which in their professional development is a period of five years, during which they must obtain 200 educational points in various forms of education [23]. Qualified First Aid is also a statutory solution, which has unified the standard of education for people on duty, employed, or being members of units cooperating with the system and not having the education of a physician, paramedic, or nurse. Under the relevant regulations, a 66-hour course in this field, after passing theoretical and practical exams, ends with the title of rescuer, which is used by the above persons for three years [24,25]. The rescue system also includes emergency notification and medical dispatchers. The current solutions have made it possible to create Emergency Notification Centres where operators of emergency numbers work, and medical dispatchers are based on standardised rules for receiving notifications and responding in a manner consistent for the whole country. The performance of the tasks of a medical dispatcher constitutes the provision of health services within the meaning of Article 2 section 1 point 10 of the Act of 15 April 2011 on Medical Activity [26–28]. A great breakthrough in the history of medical rescue in Poland is its computerisation, which took place in order to unify management in a uniform way for the whole country. The creation, development, and implementation of the System of Command Support of the State Medical Rescue is aimed at accepting emergency notifications transmitted from the emergency call centres referred to in Article 3 section 2 of the Act of 22 November 2013 on the Emergency Call System (Journal of Laws of 2019, item 1077) and notifications of incidents addressed to the medical dispatch centre referred to in Article 3 section 14a of the Act of 8 September 2006 on the State Medical Rescue.

CONCLUSIONS

The medical rescue service has undergone a number of key changes and reforms since the beginning of the first such formation in Poland. The organisation of ground and air medical teams has significantly increased the possibility of survival through the speed of reaching the injured person and effective rescue operations. Creation of professional medical staff, including paramedics and medical dispatchers, is important for the proper functioning of the system in practice. Creation of Emergency Notification Centres and standardisation of accepting emergency calls significantly shortens the time from the moment of the event to the moment of medical intervention. The system aims at optimising and maintaining the standards of the golden hour rules. The functioning of the system should be continuously analysed in order to optimise it, avoid mistakes, and work out the most effective form of assistance. On the basis of the data and information collected, checks should be carried out and their mechanisms introduced in order to improve the quality of services provided by the State Medical Rescue Service and units cooperating with it.

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VIA MEDICA

LETTER TO THE EDITOR

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MODERN MEDICINE IN THE COVID-19 ERA

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Coronaviral infections have been known for a long time; these viruses cause a number of diseases, not only in humans but also in animals. The current SARS-CoV-2 pandemic started in 2019 in China [1, 2]. Discussions are ongoing about the timing of the first case, but there is no doubt that it was during the last quarter of 2019. The virus infection can be non-specific and asymptomatic, mildly symptomatic, and can cause severe pneumonia and acute respiratory distress syndrome (ARDS) requiring mechanical ventilation, as well as septic shock and multiorgan failure.

Because modern medicine has not dealt so far with such a large number of infections that are dangerous for health care workers, conclusions should be drawn from the experience of other countries — at present, mainly China and Italy. The experience of physicians from these countries indicates the necessity of suitable organisation and management of patients with diagnosed or suspected SARS-CoV-2 infection [1]. It is essential to take appropriate preventive measures and reduce the risk of infection. Sensible management of personal protective equipment and its correct use, as well as medical personnel training and proper work organisation, are crucial. We should remember that by following current recommendations we protect not only our patients but also ourselves and our families.

The preventive measures taken by medical personnel should be a priority because health care workers, especially physicians and nursing personnel experienced in caring for patients in a critical condition, constitute a key element in the fight against COVID-19 [3, 4]. A ventilator can be manufactured relatively quickly, but educating a physician, a nurse, a paramedic, or a physiotherapist takes much longer. Wherever possible, infectious disease departments or hospitals (hospitals transformed into infectious single units) should be located in separate buildings or separate parts of buildings, with attention paid to communication routes.

Rapid identification and isolation of people suspected of SARS-CoV-2 infection is essential. Many authorities and organisations, including the world health organization (WHO), point out the crucial importance of performing as many tests as possible for early diagnosis of the infection in asymptomatic people or in those with only minor symptoms, in order to protect healthy people [3]. The 'stay at home' campaign is being undertaken on a large scale to reduce the risk of infection and thus the number of cases requiring to be addressed by the health care system. Regardless of how large a proportion of the population will recover from the infection and hopefully gain immunity against re-infection until an effective treatment and/or vaccine is developed, this will protect health care units from a dramatic increase in the number of COVID-19 patients requiring intensive treatment.

A typical image that may be encountered by a paramedic, physician, or nurse in the prehospital setting or emergency department is a patient who develops flu-like symptoms within 14 days of exposure. In particular, coughing, fever, headache, and muscular pains occur, and patients with a loss of smell and taste are also increasingly reported. It should be noted that some patients do not present dyspnoea at very low SpO_2 values, often below 80%; in the emergency department, the suspicion of COVID-19 is raised when carrying out imaging

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tests, even not directly on the lung tissue, for example in cases of orthopaedic injuries to the clavicle or shoulder. The characteristic radiological picture of the lungs or chest computed tomography (CT) indicates the suspicion of SARS-CoV-2 infection with very sparse clinical symptoms. The risk of myocarditis as a result of SARS-CoV-2 infection should also be noted.

Numerous individuals infected with SARS-CoV-2, up to 80%, may have mild symptoms or be asymptomatic [1, 5]. Medical personnel should pay special attention to pulsoxymetry — the measurement of arterial blood saturation, a reliable, fast, and non-invasive method. The role of pulsoxymetry cannot be overestimated, especially if the radiological picture of the lungs does not fully correlate with the patient's clinical condition and the physical examination reveals minor signs during lung auscultation. Oxygen therapy is essential to achieve satisfactory arterial blood saturation in the absence of significant hypercapnia. For emergency teams, it is important that passive oxygen therapy maintains SpO_2 at a level of at least 90%, and 92–95% in pregnant patients.

In the case of pneumonia, there are symptoms indicating damage to lung tissue. In some patients, the virus may induce an excessive immune response, which is manifested by increased cytokine concentrations and the so-called cytokine storm, leading to ARDS and severe respiratory failure.

It is particularly important to reduce the number of patients requiring mechanical ventilation. It should be emphasised that the problem does not only concern the number of ventilators, but also the capabilities of intensive care units. It is often forgotten that the ventilator itself does not solve the problem: a patient with severe respiratory failure requires intensive treatment, other equipment, and, above all, experienced medical staff. Therefore, the provision of an adequate number of intensive care unit (ICU) beds and medical personnel is crucial.

Some patients with severe respiratory failure require endotracheal intubation and mechanical ventilation. Quick tracheostomy is increasingly being suggested. The patient may also demand advanced renal replacement therapy, treatment with catecholamines, and targeted antibiotic therapy of coexisting infections. In cases of extremely severe respiratory failure, extracorporeal membrane oxygenation (ECMO) can be used, but because of the enormous workload involved in starting and continuing the treatment, with limited human resources and a limited number of patients in whom ECMO can be applied, the method is rarely utilised in patients with COVID-19.

Work is ongoing on the possibility of using antivirals, malaria drugs, as well as steroids, immunoglobulins, and cytokine storm blockers.

Over the past few months, the pandemic has changed the lives of most people in Europe and around the world, causing hundreds of thousands of cases of the disease, and deaths counted in tens of thousands [1, 6, 7]. The pandemic is leading to enormous damage to the economy; millions of people are at risk of losing their jobs. This affects the political and economic situation as well as stability in the countries involved in the coronavirus pandemic. Many governments have taken protective measures to stabilise the economic situation and ensure stability, including, above all, health security [8, 9].

From the point of view of the health care system, particularly rescue and emergency medicine workers, the primary goal is treating and rescuing patients but also ensuring the safety of health care staff [5]. Information on procedures should be sought primarily from official announcements of the Ministry of Health; the medical press should be followed, and conclusions drawn from the observation of countries with a similar demographic and social structure and comparable economic and organisational health care system capacity in which the number of infections has been exceptionally high.

At this point, as we need to listen to our Chinese colleagues, who managed the first wave of the pandemic. It might be important to cite George Gao, director-general of the Chinese Centre for Disease Control and Prevention, interviewed by Sciencemag.org, on March 27th, 2020. He said: "The big mistake in the U.S. and Europe, in my opinion, is that people aren't wearing masks. This virus is transmitted by droplets and close contact. Droplets play a very important role — you've got to wear a mask, because when you speak, there are always droplets coming out of your mouth. Many people have asymptomatic or presymptomatic infections. If they are wearing face masks, it can prevent droplets that carry the virus from escaping and infecting others" [10]. Paramedics and all the other medical staff, at this stage of the pandemic, should spread this message.

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THE COVID-19 PANDEMIC — A VIEW OF THE CURRENT STATE OF THE PROBLEM

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KEY WORDS: SARS-SoV-2, COVID-19, medicine, pandemic, health care

The current pandemic has raised great global public health concern. The disease name was subsequently recommended as COVID-19 by the World Health Organisation (WHO) [1, 2]. Meanwhile, 2019-nCoV was renamed SARS-CoV-2 by the International Committee on Taxonomy of Viruses. SARS-CoV-2 is considered highly contagious. As of April 1, 2020, more than 883,255 confirmed cases, including more than 44,156 deaths, have been reported worldwide, affecting almost the whole world. The distribution of countries with confirmed cases of the newly identified coronavirus SARS-CoV-2 infection as of 1 April 2020 is presented in Figure 1. Originally the epicentre of this ongoing outbreak was located in the city of Wuhan in Hubei Province of central China, and the Huanan seafood wholesale

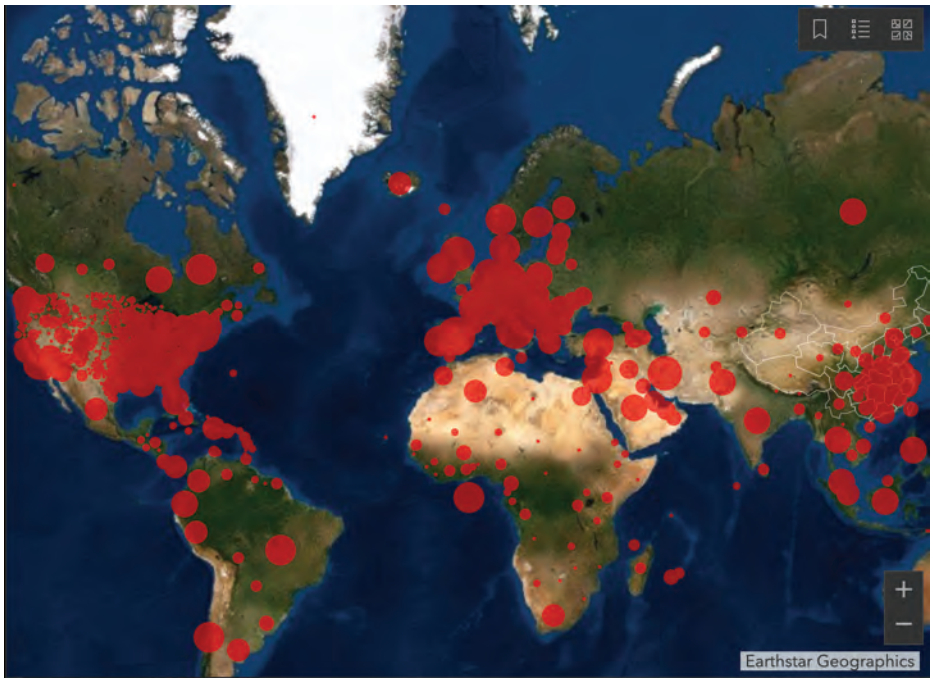

FIGURE 1. Distribution of countries with confirmed cases of the newly identified coronavirus SARS-CoV-2 infection as of 1 April 2020 according to the gisanddata.maps.arcgis.com

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market was thought to be at least one of the places where SARS-CoV-2, from an unknown animal source, might have crossed the species barrier to infect humans. Italy and Spain are now considered the European epicentre of COVID-19; as of 1 April 2020, the number of cases in these countries is as follows: 105,792 and 102,136 confirmed infections, and 9,053 and 3,523 deaths, respectively. In the USA, the number of confirmed infections exceeds 189,753 cases. The SARS-CoV-2 coronavirus spreads mainly through respiratory droplets. COVID-19 is similar to SARS and MERS in some clinical manifestations. In COVID-19 patients, fever, cough, and myalgia are the most common symptoms, followed by chest distress and shortness of breath. However, upper respiratory tract symptoms (e.g. nasal congestion, nasal discharge, and sore throat) and gastrointestinal symptoms (e.g. abdominal pain and diarrhoea) are relatively rare. Fever occurs in 98–100% of SARS or MERS patients, compared to 81.3% of COVID-19 patients in this study [3]. Analysis of numerous studies [1, 4–12], covering 1991 patients, identified the most common signs and symptoms at admission to hospital. These symptoms include: dry cough (63.9%), fever (61.7%), fatigue and muscle ache (36.9%), anorexia (27.1%), dyspnoea (21.9%), headache (13.2%), sore throat (12.0%), chest pain (6.4%), confusion (6.1%), rhinorrhoea (6.0%), nausea and vomiting (5.8%), and diarrhoea (5.3%). As we can observe, the clinical picture of people infected with COVID-19 may present itself in a variety of ways; however, special attention should be paid to patients with such symptoms, and they should be subjected to screening and isolation until the results are obtained [13, 14]. At the same time, it is worth emphasising that, as well as searching for a vaccine, it is crucial to constantly analyse the existing symptoms in order to verify new ones that may be reported by patients and which have not yet been taken into account in the clinical picture of the patient.

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NONSTEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS) IN COVID-19 PATIENT

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KEY WORDS: COVID-19, SARS-CoV-2, treatment; fever, nonsteroidal anti-inflammatory drugs, NSAIDs

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I read the article written by Smereka et al. [1] with great interest. The authors briefly and accessibly point out the problems of the current SARS-CoV-2 coronavirus pandemic. One of the main symptoms indicated by patients with COVID-19 is high fever. Excessive fatigue and muscle pain are also indicated [2, 3]. Therefore, one of the key questions arising in the context of COVID-19 is whether and, if so which non-steroidal anti-inflammatory drugs to use.

Opinions on the impact of non-steroidal anti-inflammatory drugs on the clinical course of COVID-19 caused by the new SARS-CoV-2 coronavirus are divided.

On 11 March 2020, "The Lancet Respiratory Medicine" published a publication indirectly addressing the impact of ibuprofen on the course of infection. The coronaviruses of acute respiratory syndrome SARS-CoV and SARS-CoV-2 bind to target cells by the angiotensin 2-converting enzyme (ACE 2), which is produced by epithelial cells of the lungs, intestines, kidneys and blood vessels. The expression of ACE 2 is significantly increased in type 1 or type 2 diabetic patients who are treated with ACE inhibitors and type II angiotensin receptor blockers (ARB). They also are used in the treatment of hypertension, which increases the secretion of ACE 2. ACE 2 can be increased by ibuprofen, among others. Increased expression of this enzyme facilitates COVID-19 infection. Therefore, the hypothesis has been raised that the treatment of diabetes and hypertension with ACE2 stimulant drugs increases the risk of development of severe and fatal COVID-19.ACE2itselfisaveryimportantprotein.Unfortunately, SARS-CoV-2 coronavirus binds to it and uses it to enter the cells where it multiplies. [4, 5]

According to the European Medicines Agency (EMA), there is currently no scientific evidence to confirm the link between NSAIDs and the deterioration of COVID-19. Healthcare personnel should consider all available treatment options, including paracetamol and NSAID-19, if a fever occurs in patients with COVID-19. It is recommended that these drugs are used in the lowest effective dose and for the shortest possible period. There is, therefore, no reason for patients taking ibuprofen to discontinue treatment. This is particularly important for patients receiving ibuprofen or NSAIDs due to chronic diseases [6].

On 19 March 2020, the World Health Organisation (WHO) issued an official statement in which it stated that the WHO is not against the use of ibuprofen based on existing data. However, it is aware of concerns about its use in the treatment of fever in people with COVID-19. It has been informed that physicians are being consulted and that it has not been informed of any negative effects beyond the usual side effects that limit the use of ibuprofen in some cases [7].

To summarize, there are no studies confirming higher mortality of COVID-19 when ibuprofen is used in the treatment. However, in doubtful cases, the use of paracetamol instead of ibuprofen is recommended but this refers only to its use without a physician's prescription [8].

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LETTER TO THE EDITOR

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SARS-COV-2 AS A REAL THREAT FOR HEALTHCARE WORKERS

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KEY WORDS: SARS-CoV-2, COVID-19, coronavirus, pandemic, healthcare worker, infection

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SARS-CoV-2 belongs to the *Coronaviridae* family, and it was probably initially transmitted from wild animals to humans [1]. Since the outbreak of the COVID-19 epidemic in December 2019 in Wuhan, China, the whole world is fighting an ever-growing pandemic, which becomes a global threat. The number of confirmed cases constantly increases and amounts to almost 1 500 000, however, the number of infected people is increasing continuously, although at present the number of daily COVID-19 deaths is decreasing in some European countries, including Spain and Italy. With droplet transmission, virus released in the respiratory secretions when a person with infection coughs, sneezes or talks can infect another person if it makes direct contact with the mucous membranes [2]. The available research results show that the virus is a single-stranded RNA virus that belongs to the genus Beta-coronavirus, and in its sequence uses the receptor for convertase-2-angiotensin (ACE-2). This enzyme serves as the entry point into cells for SARS-CoV-2 and may result in increased expression of proteins that cause damage to the lung alveolar system [3]. Based on analyzed cases, COVID-19 causes many symptoms including fever, dry cough, but more serious problem is bronchitis, pneumonia and ARDS. It was observed that younger patient can show severe disease symptoms, which is caused by non-educated immune system [4]. Elderly people and people with pre-existing medical conditions like hypertension, diabetes or cancer are more likely to become infected with a higher risk of severe COVID-19 and virus-related death [5]. The World Health Organization (WHO) published guidelines on how to avoid SARS-CoV-2 infection. Observing the rules of hygiene, reducing contact with other people the spread of the virus can be reduced. This is especially important because there are currently no medications or vaccines that can help avoid infection or cure its effects. The biggest problem is that we do not have enough knowledge about SARS-CoV-2. It is a new pathogen that is highly transmittable and should be seen as a real threat. We should not refer to other diseases caused by other viruses but build knowledge based on constantly collected data. The most common clinical features at the onset of illness were: fever (87.9%), dry cough (67.7%), fatigue (38.1%), sputum production (33.4%), shortness of breath (18.6%) and sore throat (13.9%). Signs and symptoms are developed about 5–6 days after infection [6]. This is a huge threat to healthcare professionals. This means that infected patients with non-specific symptoms can easily infect during physical examination. Healthcare workers are in constant contact with them and after infection, they spread the virus to other co-workers before they develop symptoms. This is evidenced by the fact that 3.5% of infected people are healthcare workers [7]. In a case series of 138 patients treated in a Wuhan hospital, 40 patients (29% of cases) were HCWs (31 (77.5%) worked on general wards, 7 (17.5%) in the emergency department, and 2 (5%) in the intensive care unit)[2]. What is worst, they can infect other sick patients in hospital who are the most vulnerable group that had a case fatality rate of 10.5% for cardiovascular disease, 7.3% for diabetes, 6.3% for chronic respiratory disease, 6.0% for hypertension and 5.6% for cancer

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[3, 8]. This means that we can expect an increase in the mortality of patients whose lives could be saved before the pandemic. Acute respiratory distress syndrome (ARDS) is a major complication. Common complications of COVID-19-related ARDS include acute kidney injury (AKI), elevated liver enzymes, and cardiac injury including cardiomyopathy, pericarditis, pericardial effusion, arrhythmia, and sudden cardiac death [8]. Protection against this virus as well as against any other infectious disease consists primarily in preventive measures. Maintaining hygiene and maintaining adequate distance from the patient. This includes maintaining a minimum distance of 1.5 m (however, this distance should probably be increased), frequent hand washing minimum 30 s, disinfecting hands, not touching the face with hands, hygiene of the upper respiratory tract, wearing a mask with FFP2 filter, using PPE, disinfecting things and rooms [9].

In many countries, healthcare workers are particularly exposed to SARS-CoV-2 and account for a significant proportion of the infected population. However, the experience of the Chinese and Italian hospitals shows that infections of healthcare workers can be significantly reduced by strictly following the recommendations for the use of personal protective equipment and proper workplace management, including the limitation of working time to a maximum of 6 hours. Of course, testing for SARS-CoV-2 and the availability of personal protective equipment and disinfectants are essential.

Conflict of interest: We have no conflict of interest.

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LETTER TO THE EDITOR

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THE SCHEME OF TREATMENT WITH AN INFECTED PATIENT WITH COVID-19

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KEY WORDS: SARS-CoV-2, COVID-19, pathogen, healthcare workers, hospital, communication route, pandemic, management, infection control

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To the Editor,

SARS-CoV-2, also referred to as CoV-19, can cause severe acute respiratory diseases (COVID-19), with a serious infection of the lower respiratory tract followed by bronchitis, pneumonia and fibrosis [1]. The severity of the disease depends on the efficiency of the immune system which, if it is weak, cannot stem the infection and its symptoms [2]. Health workers are at the front line of the COVID-19 outbreak response and as such are exposed to hazards that put them at risk of infection. Hazards include pathogen exposure, long working hours, psychological distress, fatigue, occupational burnout [3]. Data from China's National Health Commission show that more than 3300 healthcare workers have been infected as of early March and, according to local media, by the end of February at least 22 had died. In Italy, 20% of responding health-care workers were infected, and some have died [4].

The most susceptible to infection are those forming the medical sector, especially healthcare workers, i.e. physicians, nurses or administration staff. Thus, they should be aware of the necessity of correct segregation of possibly infected patient with COVID-19 (triage) to reduce the number of contacts. This segregation could be performed remotely, by telephone or online, which may effectively enable to pre-assess symptoms of patients and to identify those of COVID-19. Such an assessment may allow for the correct preparation of both medical staff and others for the possible infectious contact.

Getting the hospital ready to receive patients is crucial. The flow must be carried out in accordance with the principle of "three zones and two passage". Which in practice means unilateral entry and exit, and between them should be taken into account contaminated zone, potentially contaminated and clean. The communication route should also include the research room, laboratory, observation room and resuscitation room in turn [5].

In order to protect workers and patients, correct assessment of the risk of the likelihood of COVID-19 infection, including the clinical review, epidemiological and travel history needs to be completed. It would allow for evaluation of the risk of infection, basing on signs and symptoms [6]. Basing on current knowledge on the transmission of how COVID-19 spreads. Therefore, medical staff should wear personal protective equipment and treat every patient as potentially infectious — especially in emergency medical conditions.

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LETTER TO THE EDITOR

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USING ECMO VV IN THE COVID-19 PANDEMIC

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KEY WORDS: ecmo, COVID-19, VV

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The procedure for the techniques of extracorporeal support of vital functions (Extracorporeal Membrane Oxygenation) can be an effective therapeutic tool for critically ill patients [1]. The application of this method within the COVID-19 pandemic, however, is only possible with adequate medical personnel and equipment [2]. COVID-19 is a disease caused by the new SARS-CoV-2 virus that appeared in December 2019 and has now become a worldwide pandemic with rapid spread [3]. On April 21, there were 2.497.000 confirmed cases with 656.051 recovered patients and, unfortunately, 171.245 deaths. In Poland, which has more than 38 million inhabitants, there were 9.737 confirmed cases and 385 deaths, and the USA with 328 million inhabitants with confirmed 793.000 cases, 42.518 deaths, and 72.390 recovered patients [4–6]. The spectrum of the SARS-CoV-2 associated pneumonia is mild to life-threatening critical situations and requiring critical treatment. Reports indicate that most COVID-19 patients have moderate symptoms (fever, cough and fatigue) and recover quickly, however, group of patients develop severe respiratory failure and acute respiratory distress syndrome (ARDS) necessitating intensive care. Unfortunately, the death rate of COVID-19 requiring mechanical ventilation is high. ECMO can be a life-saving measure for patients with severe ARDS or refractory cardiovascular disease [7–9].

ECMO is a method of extracorporeal membrane blood oxygenation implemented via an oxygenator responsible for gas exchange and pumps for blood circulation. Depending on the technique, the device is connected to the patient's vessels, and used to support the insufficient respiratory system — ECMO VV venous-venous or the insufficient circulatory and respiratory systems — ECMO VA — venous-arterial. The ECMO is not treatment but support technique, it offers the prospect of prolonging the time of therapy and regeneration of insufficient systems [10, 11].

ECMO is an invasive therapy with a high risk of sudden and severe life-threatening complications (disconnection of the system, dislocation of cannulas, air embolism). For this reason, a constant presence of at least two medical personnel trained in ECMO therapy is necessary. When planning the care for a patient with suspected or confirmed infection with the SARS-CoV-2 virus, the balance between the potential benefits of ECMO and the available personnel (with appropriate experience and training) as well as hospital equipment (including personal protective equipment) and infrastructure should be explicitly secure [2, 8, 12]. The risk to medical personnel and the need to care for other critically ill patients should also be taken into account. This is particularly essential, as it becomes challenging to work in complicated and advanced PPE for the personnel of Intensive Care Units, who are required to spend prolonged periods with a patient connected to the ECMO device [13].

In critical patients, mechanical ventilation is the primary method of supportive therapy. In the case of

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SARS, a vital element of the procedure is additionally the low-pressure ventilation schemes with low tidal volume ventilation (Vt) (Vt 4–8 mL/kg of predicted body weight) and pressure plateau orientation (Pplat) < 30 cm H2O and a higher positive end pressure strategy exhaust. This is utilized to minimize lung damage caused by respiratory therapy [14]. To minimize the potential for lung damage, and when there is a lack of available ventilation equipment, ECMO becomes useful in the treatment of COVID-19 patients [15]. The ELSO report shows that during the advancement of the pandemic there was an increase in the use of the ECMO therapy, and at the time of writing this letter, 901 patients were supported by ECMO (average age is 52 years, 95% VV ECMO, 5% VA ECMO and other configurations) [3].

Currently, in Poland, five centers have been selected to meet the challenges of using ECMO VV for COVID-19 patients. The application of ECMO therapy during the COVID-19 pandemic is challenging yet achievable, offering a high chance of patient survival.

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STUDY PROTOCOL

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RATIONALE OF CARDIOPULMONARY RESUSCITATION TRAINING AS AN ELEMENT OF MULTILEVEL EDUCATIONAL AND MOTIVATIONAL PROJECT (MEDMOTION)

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Abstract

Patients after acute coronary syndrome (ACS) are of increased risk of out-of-hospital cardiac arrest (OHCA). Therefore, education of patients' family members within the Multilevel EDucational and MOtivational intervention in patients after myocardial infarcTION (MEDMOTION) project includes practical cardiopulmonary resuscitation (CPR) skills training.

The aim of this part of the MEDMOTION project is to assess the efficacy of CPR training.

Methods The MEDMOTION project is designed as a multicenter, two-phase study with a 2-year follow-up. In phase 1 (the observational, prospective, multicentre study), patients in all centres will be treated, educated and motivated according to the current practice adopted in these centres. In phase 2 (the randomized, open-label, multicentre study), the participating centres will be randomized (1:1) to active group (multi-level educational and motivational interventions) or to control group (continuation of the previous strategy).

In the active group, the relatives cohabitating with the patient will be encouraged to participate in CPR classes and hands-on training supported with CPR dedicated MEDMOTION brochure. To convince persons emotionally close to the patient to participate in the proposed activities, we plan to conduct motivational conversations highlighting the importance of increased patient safety and family responsibility.

The analysis of CPR education and training efficacy is planned — assessment of knowledge retention and registration of CPRs outcome conducted by trained persons based on phone contact at 2 years after training.

KEY WORDS: resuscitation training, education, motivation

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INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is burdened with extremely high mortality. In the United States approximately 92% of persons who experience an OHCA event die [1, 2]. Bystander cardiopulmonary resuscitation (CPR) is pivotal for survival improvement in this critical setting; nevertheless, it is still unlikely to receive efficient and timely intervention even if OHCA events are witnessed [1, 3]. Patients discharged from hospital after acute coronary syndrome (ACS) are of increased risk of OHCA comparing to the general population [4]. OHCA occurs often at home and it is witnessed by family members of the patient [5]. The CPR training of the next

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of kin of at-risk patients is thus potentially highly beneficial.

Therefore we have designed the **M**ultilevel **ED**ucational and **MO**tivational intervention in patients after myocardial infarc**TION** (MEDMOTION) project aimed to improve the knowledge and practical skills of not only patients after acute coronary syndrome but also their cohabitating family members. We assumed that individualized, complex health education started during hospitalisation and continued after discharge, explaining the pathophysiology and symptoms of the disease, elucidating goals and potential benefits of treatment, and highlighting the risk of premature termination of therapy, with the use of additional methods helping patients to remember the treatment schedule will enhance adherence to treatment [6]. Education of family members, in addition to the knowledge necessary to understand patients' needs and to provide them with adequate support, includes also practical CPR skills.

The project also includes a comprehensive, multistage evaluation of patients and their family members to improve the quality of medical care by personalizing educational and therapeutic interventions after ACS [7–9].

The aim of this part the MEDMOTION project is to assess the efficacy of CPR training based on British Heart Foundation course *Heartstart*.

METHODS

Study design

The MEDMOTION project is designed as a multicenter, two-phase study with a 2-year follow-up. In phase 1 (the observational, prospective, multicentre study), patients in all centres will be treated, educated and motivated according to a current practice adopted in these centres. The duration of phase 1 is arbitrarily assumed to be 6 months. In phase 2 (the randomized, open-label, multicentre study), the participating centres will be randomized (1:1) to:

- Active group (implementing multi-level educational and motivational interventions)
- Control group (continuing existing strategy)

The MEDMOTION project will apply multilevel, standardized, personalized educational and motivational interventions for patients after myocardial infarction and their cohabitating relatives. There are three project levels planned: Level I — in-hospital education and motivation; Level II — early post-discharge motivation (up to follow-up visit after the first year); Level III — late personalized educational and motivational activities depending on the patient needs (up to the end of the second year). To make the large-scale project feasible educational and motivational activities will be standardized using the same tools (the MEDMOTION brochures, scenarios and scales), however, all activities within the project will be personalized by using tools selected according to personal needs.

The relatives or other persons cohabitating with patient (indicated by patient) will be encouraged to participate in CPR classes and hands-on training supported with CPR dedicated MEDMOTION brochure. The CPR education program is based on the British Heart Foundation course "Heartstart" aimed to teach basic emergency life-saving skills applying six steps strategy (https://www.bhf.org.uk/how-you-can-help/how-to-save-a-life/how-to-do-cpr):

- Step 1: Shake and shout
- Step 2: Check for normal breathing
- Step 3: Call 112
- Step 4: Give 30 chest compressions
- Step 5: Give two rescue breaths
- Step 6: Repeat until an ambulance arrives

Every quarter, the 6-point CPR strategy will be reminded by email. To convince persons emotionally close to the patient to participate in the proposed activities, we plan to conduct motivational conversations highlighting the importance of increased patient safety and family responsibility.

This research is supported by the Collegium Medicum of Nicolaus Copernicus University [NCU CM grant for the emerging field "civilization diseases"]. The project will be registered at https://clinicaltrials.gov and implemented after obtaining the approval of the bioethical committee.

Inclusion/exclusion criteria

The MEDMOTION project will include all consecutive patients filling the following inclusion criteria:

- hospitalization for a heart attack (STEMI or NSTEMI)
- age above 18 years
- consent to participate in the study

The following exclusion criteria were defined:

- no consent to participate in the study
- incapacitated persons
- prisoners
- relatives or dependent on researchers
- mental condition preventing participation in educational and motivational activities.

Study endpoints

The primary clinical endpoint of the MEDMOTION trial encompasses death from any cause, acute coronary syndrome, stroke, re-hospitalization for the cardiovascular cause.

The principal secondary endpoint is defined as the number of selected risk factors in which therapeutic target is achieved.

Additional secondary endpoints are defined as all selected risk factors alone and results of diagnostic scales: the Readiness for Hospital Discharge after Myocardial Infarction

Scale (RHD-MIS) [10], the Adherence in Chronic Diseases Scale (ACDS) [11, 12] and the Functioning in Chronic Illness Scale (FCIS) [13, 14].

A separate analysis of CPR education and training efficacy is planned — a questionnaire-based assessment of knowledge retention will be performed every year. The questionnaire contains 6 open questions referring to the six steps CPR strategy.

Moreover, registration of CPRs including clinical outcome, conducted by persons trained in MEDMOTION trial based on phone contact 2 years after training will be performed.

Study population

The interim analysis will be performed as soon as 6-month follow-up observations will be available for 1,000 patients included in phase 2. The analysis will be carried out to calculate the final study population needed to power the study with regard to the primary endpoint. We hypothesized that enrolment of 4,000 patients (about 2,000 in each group) will be necessary.

DISCUSSION

A 30-day survival after OHCA reported in the French National Cardiac Arrest Registry was 5.11% in the absence of CPR, 8.86% with bystander's cardiac CPR and 7.35% when CPR was initiated by the Dispatch Centre ($p < 0.001$) [15]. According to the data from the Cardiac Arrest Registry to Enhance Survival (CARES) the OHCA survival rate to hospital admission was 26.3%, and the overall survival rate to hospital discharge was 9.6%. The overall survival in subjects who received bystander CPR was significantly higher (11.2%) than in those who did not (7.0%) ($p < 0.001$). Moreover, in persons who are witnessed to collapse by a bystander and found in a shockable rhythm the survival to discharge was 30.1% [1].

It has been shown that optimised 'chain of survival' for patients with OHCA with CPR started by bystanders, police and/or first responders in 72% of patients and use of an automated external defibrillator (AED) in 63% of patients resulted in even better results with return of spontaneous circulation (ROSC) in 49% of the cases and a 1-year-survival rate of 27% in the studied population [16].

The comparison of these data proves that there are huge opportunities for improvement [1, 16], however, adequate practical training and education including previously reported concerns and fears related to performing bystander CPR (mainly recognition of cardiac arrest, causing additional harm and lack of skills) is necessary [15, 17–19].

Training of family members of patients at risk for sudden cardiac death in basic life support (BLS) has been shown to be useful, as their baseline skills were poor [20]. Moreover, CPR hands-on training improved participants' skill retention and confidence to perform a BLS [19, 21–23]. These observations confirm the desirability of our decision to include CPR training of patients' family members into the MEDMOTION project.

In the study published by Schmid et al. [19] 74% participants declared that they would perform CPR on an adult stranger, however, only 55% stated that they would "likely" participate in a CPR training. Previous CPR training (OR: 2.6; 95% CI, 1.6–4.3) and a prior witnessed cardiac arrest (OR: 2.0; 95% CI, 1.1–3.5) were associated with CPR class enrollment [19].

Motivational interventions are an integral part of the MEDMOTION project [24, 25]. Sense of security and family responsibility were previously identified as motivations producing high-engagement behaviours of family members to learn CPR [26–28]. Therefore, to improve the participation of family members in CPR training we planned to apply motivation interventions that meet the needs of family members. Such a targeted intervention may be an effective training strategy to improve bystander CPR rates [29–31]. We believe that training relatives of patients after ACS will prove to be particularly valuable and effective because the probability of practical application of acquired BLS skills is particularly high.

Conflict of interest: I declare no conflict of interest.

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