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MEDICAL SIMULATION CENTER ACTIVITY AND KNOWLEDGE TRANSFER DURING THE COVID-19 PANDEMIC

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ABSTRACT

INTRODUCTION: The Medical Simulation Center (MSC) of Poznan University of Medical Sciences was established in 2010 as the educational university center. In 2020, the COVID-19 pandemic faced new challenges, which forced multi-pronged new activities of this unit to increase the patient's safety in the region. The purpose of this study was to assess the multi-profile activity performed in the Medical Simulation Center during the COVID-19 pandemic.

MATERIAL AND METHODS: Authors except the primary educational activity realized in epidemiological conditions from March 2020 to March 2022, identified 6 new areas and projects that were prepared on the initiative of the MSC, using its premises, technical, and know-how resources.

RESULTS: In the results, authors quantify the redistributed equipment resources and the completed training and normal education activity adapted to epidemiological restrictions. Basic courses and vaccination courses resulted in the creation of a significant group of volunteers prepared to work in destructive consequences of the pandemic COVID-19 including 24 months of activity of point of screening and testing. In Extracorporeal Membrane Oxygenation (ECMO) training in the cognitive, behavioral, technical, and knowledge assessment significant improvement was observed. Moreover, the upgraded trainers' skills provoke to prepare the complex nursing procedures for ECMO patients with COVID-19.

CONCLUSIONS: The multifaceted activity of the MSC confirms the great potential of this type of training unit based on medical simulation techniques as an educational tool, especially in the face of the real threat of a global epidemiological crisis. MSC can be an education center creating new procedures, standards of care, and best practices.

KEYWORDS: coronavirus; COVID-19; medical simulation; Medical Simulation Center

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INTRODUCTION

The Medical Simulation Center (MSC) at Poznan University of Medical Sciences was established in 2010, the originally occupied area was 90 m^2, and 2 simulation rooms with a control room and a debriefing room. Since 2018, the area has been over 2700 m^2, which includes, among an ambulance simulator, a delivery room, an emergency room, an ICU, an operating room, low and high-fidelity nursing rooms, technical rooms, rooms for classes with simulated patients, and Objective Structured Clinical Examination — OSCE exams. Equipment and instructor training are financed by EU support under the Operational Project Knowledge Education Development, the main objective of which is to support the medical, nursing, and midwifery faculties.

The primary educational tasks are carried out in low-intermediate and high-fidelity classrooms. A novelty is classes with the participation of Standardized Patients in specially designed rooms. "Patients" have both acting skills, developed under the supervision of the director, and the ability to evaluate the student's conduct and provide him with feedback, which has a huge impact on the proper course of the education process and allows for simultaneous teaching of both appropriate communication (taking an interview, educating the patient, providing unfavorable information, *etc.*) and a wide range of practical skills (physical examination, selected medical procedures) [1–3].

In 2019 in MSC to reach high standards of patient care, the first of its kind in Poland, the National Education Centre for Artificial Life Support (NEC-ALS) was created. The role of the Center is to test and promote novel or commonly used procedures as well as to develop staff skills in the management of patients needing ECMO. This event preceded the COVID-19 pandemic, which the whole world had to face since the beginning of 2020 [4, 5].

The rapid widespread of the SARS-CoV-2 virus in early 2020 caused global chaos. In the initial period, a lack of knowledge of epidemiology and viral contamination, as well as no availability of either causal treatment or preventive vaccination, resulted in a global lockdown and preparing global crisis [6–9].

Overnight, new multi-track activities appeared in front of the MSC, aimed at trying to continue educational activities, as well as other forms of activities that could become socially useful in a deep epidemiological crisis. The multi-profile activities of the MSC during the COVID-19 pandemic provided the opportunity to use the unit's resources to conduct several trainings and initiatives [10, 11]. Their implementation had a significant share in the activities of units conducting activities related to direct contact with potentially ill people, and in the subsequent phases of the pandemic, the actions taken led to the expansion of access to vaccinations [11–13].

MATERIAL AND METHODS

The main aim of this study is to present the retrospective report of multi-profile activities of the MSC during the COVID-19 pandemic.

The authors collected and summarized all MSC activities during the COVID-19 pandemic between March 2020 and March 2022. Seven areas of activity were identified and for every area, the methodology was individually defined and presented in a chronological timeline:

1. Medical equipment;
2. Basic medical training;
3. Extracorporeal techniques medical training;
4. Nursing Standard Operating Procedure applicable to ECMO patients with COVID-19;
5. Point of screening and testing (POST);
6. Vaccination training;
7. University education activity.

RESULTS

Medical equipment

The medical equipment was relocated during the first wave in February 2020 from the Medical Simulation Center PUMS for the clinical area. All equipment was inventoried, moreover the final location was identified. In the first wave of the pandemic from 20th March 2020, in accordance with the regulation of the Ministry of Health, a state of epidemic was in force in Poland. During the first 48 hours of that state, a technical review was carried out to confirm the full usefulness of the equipment available for clinical use in the possession of MSC. In the next 2 days collected in Table 1 equipment was delivered to the Multiprofile Clinical Hospital USK PUMS. In April for the next 3 months due to the parallel increase in demand for the use of extracorporeal circulation techniques, a decision was made to immediately support units with ECMO devices. In response to the needs of society, the device was handed over via the Air Ambulance Service to the Intensive Care Unit at the University Clinical Hospital in Opole to provide equipment support (Tab. 1).

Table 1. Equipment delivered to the Multiprofile Clinical Hospital USK PUMS in the first wave COVID-19 pandemic

Type/name of equipment	Amount of equipment	Previous use of equipment in MSC	Using equipment to save citizens' health and lives	Information on people it can help
CARESCAPE R860 stationary ventilator with accessories	3	Oxygen therapies with advanced patient simulators	Yes	Due to the growing risk of patient volume, the equipment was intended to secure the increased number of patients and procedures at the Department of Anesthesiology and Intensive Care
Cerdiomonitor GE B40	3	Learning how to connect electrodes to the patient and simulators	Yes	
Volumetric Infusion Pump	22	Therapies with the use of infusion pumps	Yes	
Syringe Infusion Pump	14	Therapies with the use of infusion pumps	Yes	
Ventilator System Kit	50	Single use equipment	Yes	
Cardiohelp ECMO console	1	Artificial Life Support with ECMO Course	Yes	Air Ambulance Service (HEMS) to the University Clinical Hospital in Opole for Intensive Care Unit support

Table 2. Equipment was delivered to the Temporary Hospital of the University Clinical Hospital of the PUMS in the first wave COVID-19 pandemic

Type/name of equipment	Amount of equipment	Previous use of equipment in CSM	Using equipment to save citizens' health and lives	Information on people it can help
Defibrillator Lifepak 15	2	Advanced Life Support procedures	Yes	Basic medical activity for patients of the temporary hospital
Anesthesia trolleys	10	Storage of medical disposable equipment	Yes	

In the middle of 2020 in the first wave of the pandemic in connection with the commencement of the creation of the Temporary Hospital, which operated within the structures of the University Clinical Hospital of the PUMS, the following equipment from Table 2 was donated.

Basic medical training

An innovative and adaptive training plan for students of various medical faculties was designed for all years of study — medicine, nursing, and midwifery [11]. The offer was addressed to volunteers who can support the work at the newly created PUMS Temporary Hospital. In the first wave of the pandemic, only volunteers with a negative COVID-19 test were allowed to attend classes, and vaccinated participants were included in subsequent waves. In the beginning for staff and students' safety medical and technical staff prepared workshops for every member: proper hand disinfection, full and partial PPE dressing, and undressing techniques. Moreover, the easy cartoon legend was prepared for every educational station.

Educational training for medical students was based on two pillars. The first one was an 8-hour module (e-learning), which included gaining knowledge in the field of anatomy and physiology, principles of oxygen therapy and blood gas assessment, principles of sedation, maintaining airway patency, and the basics of theoretical ventilation and personal protective equipment. The practical part was designed and carried out at the MSC under a strict sanitary regime during a two-day training course — 22 hours — Table 3. Each student and the teacher were required to wear protective masks, in addition, the group was divided into non-rotating parts, the number of which did not exceed 4 people.

For nursing and midwifery students, a 1-day 7-hour module was prepared in the field of recognizing life-threatening conditions, the principles

Table 3. Basic course program for physician students		
Number of hours	COURSE PROGRAM	SIMULATION TECHNIQUES
DAY 1		
8	Theoretical background — e-learning	
DAY 2		
2	ALS	Low/high fidelity
1	Artery, venous cannulation	Low fidelity
1	Imagination	Hybrid simulation
1	Sedation	Workshops
1	Oxygen therapy	Workshops
1	Airways — Supraglottic devices, Intubation	Low fidelity
1	Personal Protective Equipment	High fidelity
2	Transportation	High fidelity
2	Ventilation	High fidelity
DAY 3		
1	Respirators — devices	Low fidelity
3	Respiratory therapy	Middle fidelity
1	Respiratory toilet	High fidelity
1	Monitoring	High fidelity
4	Mechanical ventilation	High fidelity

Table 4. Basic course program for nurse and midwife students		
Number of hours	COURSE PROGRAM	SIMULATION TECHNIQUES
DAY 1		
1	Personal Protective Equipment	High fidelity
2	Airways and respiratory efficiency	Middle fidelity
1	Respiratory toilet	High fidelity
1	Oxygen therapy	High fidelity
2	Mechanical ventilation — Nursing management	High fidelity

Table 5. Total number of students who participated in MSC training, number of active volunteers in temporary hospital, and percentage rate

Students	Total	Active volunteers in TH	% rate
Medicine	293	195	66.5 %
Nurse	45	37	82.2 %
Midwives	13	10	76.9 %

of using modern methods of oxygen therapy, or monitoring the condition of a patient treated with oxygen — Table 4.

293 medical students, 45 nurses, and 13 midwives responded to the training offer, which ensured the creation of a buffer of people with dedicated training to work in the Temporary Hospital (TH) PUMS. No additional results are available except the recruitment rate to that hospital presented in Table 5.

Extracorporeal techniques medical training

In years 2020–2022, 23 approved and endorsed by Extracorporeal Life Support Organization (ELSO)

courses of "Artificial Life Support with ECMO" were organized. The project was awarded in 2018 funding from a POWER competitive national grant (POWR.05.04.00-IP.05-00-006/18) by the Polish Ministry of Health for a total of 2.750.000 USD (PLN 10.974.708.60).

Physicians participated in the three-day high-fidelity simulation-based training that was adapted to abide by the social distancing norms of the COVID-19 pandemic — one course for 12 participants per month. The course was provided in created in 2019 "Center of Artificial Life Support and Patient Safety" in the Medical Simulation Center at the PUMS. The postgraduate education was formulated in a 3-day course, where 50% of educational hours were implemented in the form of workshops and classes in simulated conditions — 25 didactic hours spread over three days during a one-weekend meeting (one month apart). All course details were presented by Ziemak et al. [4] and Puslecki et al. [5]. The relationship number of students for participants was changed during the COVID-19 pandemic: there were a maximum 4 people per room and 1 instructor in the theoretical part and 2 instructors (both with content expertise) for every 2 participants in ECMO technical skills and 2 (one with formal debriefing training and other with content expertise) for 4 during simulations in separated rooms. It was possible thanks to simultaneous simulations and debriefings in three 4-person subgroups with innovative audio-visual solutions.

Knowledge as well as crucial cognitive, behavioral, and technical aspects (on a 5-point Likert scale) of management on ECMO were assessed before and after course completion.

The group of 276 physicians participated in 23 editions of the ECMO course in the period March 2020 — March 2022 — specialists and residents in anesthesiology and intensive care, cardiology, cardiac surgery, thoracic surgery, vascular surgery, transplantology, and emergency medicine. The recruitment was voluntary and open to all physicians in Poland, and after accepting the application, each candidate completed a study participation form and written consent. In total project was finalized in 2023 after 34 courses and 405 participants.

There were 276 participants (60% men) predominantly in the age of 30–40 years. The majority of them (65%) were anesthesiologists or intensivists with more than 5-year clinical experience, but 58% had no previous ECMO experience. There was significant improvement after the course in all cognitive, behavioral, and technical self-assessments. Among aspects of management with ECMO that all increased significantly following the course, the most pronounced was related to the technical one (from approximately 1.0 to more than 4.0 points). Knowledge scores significantly increased post-course from 11.6 ± SD to 13 ± SD (out of 15 points). The statistical significance of the results is comparable with previously presented publications by Puslecki et al. and Ziemak et al. [4, 5]. Detailed results for that group are presented in Figure 1.

Nursing Standard Operating Procedure applicable to ECMO patients with COVID-19

A high-fidelity translational simulation scenario was developed to create the SOP for nursing management with COVID-19 patients supported with ECMO. It included practicing safe and proper personal protective equipment (PPE) donning and doffing during work organization, ECMO cannulation and ECMO-related procedures, and routine daily nursing care and management of patients on ECMO over nine hours. Supplementary constructive debriefing with the assistance of international expert consultation and narrative literature research were performed. All details were presented by Puslecki et al. [14].

Results of high-fidelity ECMO patient scenarios performed in MSC were collected in three parts — proposal of nursing standardized operating procedures. They provide work organization, workload references, competencies, and infrastructural conditions. Additionally, the cannulation equipment checklist proposal and daily routine nursing algorithm with other procedures during extracorporeal support were created. Practical results were presented in the publication by Puslecki et al. [14] and a dedicated chapter in the Polish language book dedicated to Nursing Management [15].

Point of screening and testing (POST)

MSC was the initiator and creator of the Poznan University of Medical Sciences (PUMS) COVID-19 drive-through testing point. Initially, a small drive-through site extended to a large modern laboratory point of screening and testing (POST) system for maximal high volume of patients. PUMS POST activity lasted 24 months and developed significantly. The detailed organization and reorganization of POST PUMS with point model efficiency during all COVID-19 waves were presented by Ziemak et al. [16].

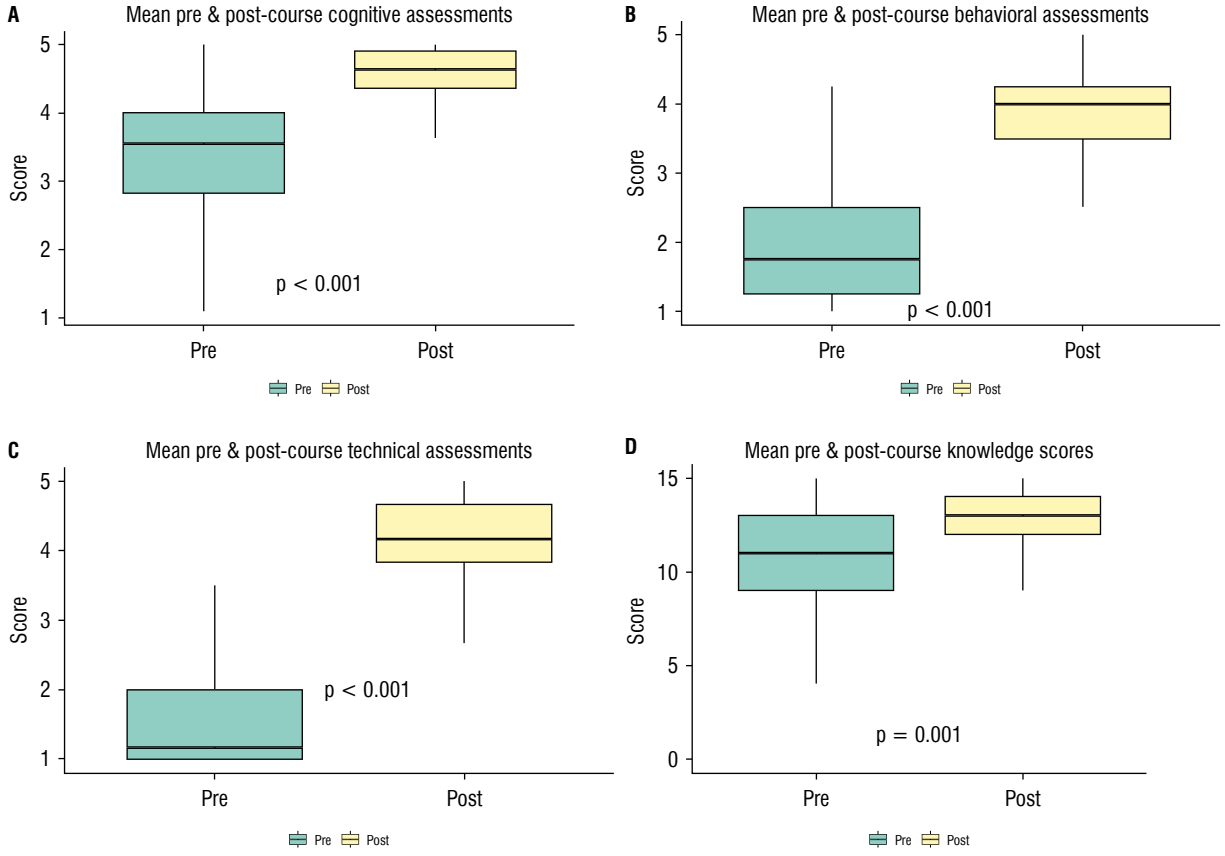

FIGURE 1. Detailed results for pre and post-course cognitive (A), behavioral (B), technical (C), and knowledge (D) assessment

MSC was the initiator and creator of Poznan University of Medical Sciences (PUMS) COVID-19 drive-through testing point for 3.5 million inhabitants in the Greater Poland Region during the 1st through 4th coronavirus pandemic waves. Development of the POST model phases and assessment of simulation education effectiveness developed for 103 volunteers including authorship tele-screening and qualification center were presented in the publication [16]. The main results were reported in a decreased median time of PPE wear and statistically significant improvement in the median time of swab collection and the total number of swabs in one-hour activity between waves.

Vaccination training

In response to the needs of the public and the plan to increase the vaccination rate, the Medical Centre for Postgraduate Education has taken the initiative to Polish Medical Universities to organize training for physiotherapists, pharmacists, and laboratory diagnosticians who will be able to obtain qualifications to carry out preventive vaccinations against COVID-19. The theoretical module covered topics related to the e-referral system, vaccination qualification, and the pre-vaccination screening interview questionnaire. The Medical Simulation Centre of PUMS undertook the organization of one of the largest training courses for the above-mentioned medical professions. The original training project assumed two required modules: a part related to the management of patients in life-threatening conditions and a module related to the practical side of preparing various types of vaccines and administering them to the patient through learning on specially prepared trainers — Table 6.

To ensure the quality, the trainers conducted training in subgroups of up to 12 people. The intensity of the classes required full coordination of the technical staff, who, in addition to replenishing the stations with disposable medical equipment, created simulating vaccines on an ongoing basis and ensured the uninterrupted operation of the injection trainers. The wear and tear of the equipment, combined with the difficult availability of interchangeable elements of the trainers, forced the development of modern remedial methods, which consisted of original casts of tissues simulating hu-

Table 6. Vaccination training program and prepared equipment	
COVID-19 vaccination course	
Preparation of the vaccine and intramuscular injection — 2 hours	Rules for providing first aid to patients undergoing COVID-19 vaccination — 2h
Equipment	
Trainer for injections Simulated vaccine solution A set of disposable materials: insulin syringes, 21G, 5 mL, and 10 mL 0.9% NaCl needles, alcohol swabs to disinfect the vial and each injection site, dry gauze pads to protect the injection site, injection patches, gloves, non-woven apron, kidney bowl, tray, a rigid container for medical sharps, medical waste bin, bins for segregating other waste (paper, plastic, mixed waste)	BLS Trainer AED Training Defibrillator Telephone Self-expanding bag Pocket mask Pulse Oximeter Epipen Adrenaline Training Syringes A set of consumable disposable materials such as gloves, masks, and disinfectant

FIGURE 2. Stations and trainers at MCS for vaccination training

man tissues. Their creation was possible thanks to the use of special silicones for castings with dedicated hardness and chemical properties — Figure 2.

In the first days after the launch of the courses, the readiness to carry out 126 courses was reported, finally reaching the number of trained people: 1785 people, of which 53% were pharmacists, 40% physiotherapists, and 7% laboratory diagnosticians.

University education activity

The authors assessed how the COVID-19 pandemic affected the organization of academic classes, what steps were taken to reduce the epidemiological threat, and how classes at the MSC were continued. The decision to completely suspend classes at the Medical Simulation Center took place on 12.03.2020 and, in accordance with the Regulation of the Minister of Health of the Polish Republic, the university's activities had to be limited until May 24. The lack of developed response schemes forced the shift of classes from standard mode to remote tools such as Teams or Moodle. As part of e-learning in teaching basic activities with the use of medical equipment, instructional videos were recorded for paramedics and nurses, used in learning specific subjects such as basic and advanced life support.

MSC staff during the first 3 days of onsite staff activity at MSC, patient simulators, trainers, and audio-video systems were adequately prepared for downtime, the length of which was not predetermined. During their remote work, simulation technicians were tasked with cataloging the Center's equipment, which trainers used to evaluate during their classes. In addition, workstation instructions were created, such as an instruction manual for the audio-video system workstation or instructions for creating simulation scenarios in one of several dedicated programs. The employees also took care of introducing dozens of simulation scenarios into the database, which were periodically created based on the work of academic teachers. Their programming to the two leading systems in the unit allowed us to

expand the case database to 320 ready-made automatic simulation scenarios.

Since June 2020, there has been a gradual unfreezing and classes began to return to face-to-face classes, including in the MSC and only to a minimal extent in teaching PUMS Clinical Hospitals. To ensure the safety of the organization of classes at the MSC, several systemic tasks were undertaken to maximize the safety of the activities carried out.

Starting with the employees of the unit – simulation techniques: two absolutely non-interchangeable shifts were created (morning and afternoon shifts). Common employee rooms were abolished, and each technician was given a separate work room to minimize common contact. The functioning of social rooms has been maintained, but a limit on the presence of only one employee has been introduced. In addition, the Medical University provided all employees with masks with a filter (FFP2, FFP3), which were to increase the safety of employees.

Student groups were introduced only in the regime of exercise category C (*i.e.* 6 students in the exercise subgroup). There was no rotation between group members, so it was not possible to make up for individual classes with another subgroup. Limitations in the functioning of teaching in clinical hospitals have increased the importance of the simulation environment, which has been adapted to conduct activities such as diploma examinations (Objective Structured Clinical Examination — OSCE). In 2020, the first standardized OSCE exams were held for nursing and midwifery faculties, which were unable to perform all the required procedures in contact with a patient in a hospital. Exams for 250 students were conducted in a repeatable, absolutely objective manner and with a full sanitary regime.

Classes with simulated patients were suspended until the end of the 2020/2021 academic year and then continued with their remote participation. Ultimately, contact classes with simulated patients returned in 2021 and took place under the sanitary regime.

DISCUSSION

The Medical Simulation Centre, as a unit where simulation classes for students are conducted using low, intermediate, and high-fidelity methods, is equipped with several pieces of medical equipment, which, in addition to its didactic value, has a therapeutic value – it is a full-fledged medical device adapted to work

FIGURE 3. Equipment of MCS prepared for University Clinical Hospital PUMS

with patients. In the first phase of the pandemic, in response to social uncertainty and several questions arising on the subject of the appropriate preparation of infrastructure resources to fight COVID-19, a decision was made to provide priority and direct transfer of medical devices to the University Clinical Hospitals in Poznan and Opole and the Temporary Hospital PUMS – Figure 3. The hospitals also received several disposable materials, which in the first days of operation were used as protection for the start-up of the equipment (including disposable sets for ventilators or sets for infusion fluids). Each piece of equipment was surface disinfected with an alcohol-based agent before returning to the MSC: Ethanol with concentrations ranging from 62% to 80% with exposure ≥ 15 s. Isopropanol 60–70% exposed on surfaces for at least 15 s [17]. Upon return to the MSC, equipment was quarantined for 7 days in an isolated room. Then it was again disinfected with an alcohol-based agent and a dedicated Aerodesin preparation (MediLab, Bialystok, Poland). After such preparation, the equipment was put again into use at MSC.

The PUMS Temporary Hospital (TH) was designed in the halls of the Poznan International Fair (MTP). In the first wave initially, 4 wards, every with 30 beds were launched, and they reached their maximum capacity in 8 wards, every with 30 beds, including the Intensive Care Unit. The urgent need to recruit employees for the Temporary Hospital accelerated the educational process at MCS, specially dedicated training for volunteer medical students. The training organized at the MSC was conducted using low, intermediate, and high-fidelity methods [11]. The cre-

FIGURE 4. High-fidelity training in full PPE

ation of a comprehensive course program allowed the participants to familiarize themselves with the full spectrum of duties to which they were to be delegated. The low-fidelity simulation was used to carry out technical procedures such as airway protection, intubation, and venous cannulation. Intermediate-fidelity simulation was based on simulators for transport exercises, and high-fidelity simulation methods were adapted for imaging and sedation exercises. In the initial phase, the trainers were recruited from medical professions, representing departments that had suspended the admission of patients during the pandemic lockdown. In the first place, qualified simulation trainers who had completed a 2-day PUMS Simulation Facilitator Course in previous years were used. After the launch of the TH, the medical staff delegated to work in this unit in the breaks between shifts were also included in the education sessions of volunteers.

Personal protective equipment necessary for full protection, reflecting the highest fidelity and difficult conditions of working with the patient, was provided for each student, which allowed to minimize the number of emergencies in later functioning during on-call duty — Figure 4. Practical improvement of skills and their transfer to the educational level brought measurable benefits related to the shortening of on-the-job training and increased awareness of the correct conduct in contact with an infected patient in a life-threatening condition. The training provided an increase in practical knowledge through clinical simulations using high-fidelity simulation tools. Patient simulators and trainers were tailored to the training needs and patients in different clinical conditions. Make-up and costumes adapted to individual cases were prepared, which increased the realism of the activities carried out. Students of the Faculty of Health Sciences, nurses, and midwives, were trained in recognizing life-threatening conditions, the principles of using modern oxygen therapy methods, or monitoring the condition of patients treated with oxygen. The conditions of the MCS and specially prepared equipment allowed for the implementation of all procedures necessary to practice, including proper communication, the care of the endotracheal and tracheotomy tubes, preparations for the implementation of invasive mechanical ventilation, including the performance of the device test [11].

The results of the ECMO course confirmed that simulation as an educational approach is invaluable not only in training and testing of novel or commonly used procedures, and skills upgrading but also in practicing very rare cases. According to information from ELSO in 2020 and 2021, the present study center was the only one in the world, despite the COVID-19 pandemic, doing courses in the stationary model. The implementation of the education program during the COVID-19 pandemic reached the whole country for ECMO centers and teams including mobile ones with valuable contributions to the development of highly qualified personnel and filling the gap in the field of extracorporeal techniques in Poland. 15 of the participants represented the national HEMS which, with the weak specialist transport systems from ECMO, created a system of air transportation for patients with ECMO support [4, 5].

Managing a patient with COVID-19 patients requiring ECMO support provokes the nonnatural changes in critical care. That situation shifted the burden of care and immediate intervention in crises to the nursing staff working in the contaminated zones of the ICU and required additional multidisciplinary staff with expertise in managing ECMO. The developing pandemic forced modifying common standards related to the use of PPE, and the increased patient workload. Optimization, maintenance, and adherence to isolation specific to

COVID-19 were necessary to reduce the risk of transmission of infection to the highly specialized ECMO team. The creation of SOPs in this area is one of the most important achievements of the MSC with a global reach, confirmed by numerous worldwide downloads of the published manuscript [14,15].

The drive-through POST system at PUMS, which operated as a unified and self-sufficient point was a pioneering solution in Poland. Using MSC resources, including simulation trainers and simulation techniques, allowed the preparation of the first team of employees of the point as a response to epidemiological demand. Presented in publication [16] POST model can be implemented worldwide in future epidemiological threats.

Since the beginning of 2021, after the introduction of vaccinations available to the general public, there has been a problem of a shortage of medical staff who have been involved in the work in additional wards as part of the fight against COVID-19. The response of the Medical Simulation Center in Poznan and giving special priorities to maximize accessibility was a very big challenge. The vaccination program against the SARS-CoV-2 coronavirus gives hope for a return to normality. For the extinction of the epidemic to become realistic, the threshold of herd immunity had to reach about 70 percent. This means that in the case of Poland, at least 26.8 million people should have coronavirus immunity. The number of trained people in 3 months reached an additional 1785 people, which can be assessed as a significant contribution of MCS for the population of the Greater Poland macroregion.

The decision to suspend classes at the Medical Simulation Center took place on 12.03.2020. The planned classes were canceled due to the growing threat related to the potential effects of the spread of the COVID-19 virus and were moved from the standard mode to remote tools. The downtime in classes at MSC forced organizational activities carried out on-site. The simulators were cleaned and disconnected from battery power sources, which lost their life with each day of standby. The trainers have been cleaned and disinfected with an emphasis on rubber tissues that become brittle and mold grow during non-use — e.g. trainers for intravenous, intradermal, and central injections. Audio systems and servers were shut down in accordance with the manufacturer's instructions to reduce wear and tear. During their remote work, simulation technicians were tasked with cataloging the Center's equipment, which teachers used to evaluate and use the equipment during their classes. The employees also took care of entering dozens of simulation scenarios into the database, which enriched the existing database of cases with another 320 ready-made automatic scenarios.

After the lockdown was lifted, face-to-face classes began to return first, including at the Medical Simulation Centre, and its role in the education of students of all faculties became crucial. Limitations in the functioning of teaching hospitals have increased the importance of the simulation environment, which has been adapted to conduct activities such as clinical activities based on simulation scenarios and diploma examinations (OSCE). At the end of 2021, some clinical classes were carried out in contact with simulated patients. To avoid possible accusations regarding the lack of implementation of specific procedures in the MSC by students and equally required during the exam, information videos were created on the organization, path of conduct, and functioning in the simulation environment, and the scope of verified procedures was confirmed with the learning outcomes that students obtained in the course of education.

The Covid-19 pandemic has caused an increase in interest in conducting classes at the Medical Simulation Centre. There was an increase in inquiries about the equipment and infrastructure capabilities to conduct new subjects. In the first place, classes using high-fidelity simulations, i.m.in e. internal medicine, internal medicine, professionalism, communication, and pediatrics, returned after the restrictions were eased, and classes with simulated patients returned in 2021 and were held under a sanitary regime [9–11].

Strengths and limitations

The presented work is a collection of chronologically executed multi-track activities implemented in the Medical Simulation Center during the ongoing COVID-19 pandemic. To the authors' knowledge, this is the first world comprehensive report of MSC activities during the pandemic time. Although the presentation of methodologies and results is difficult to assess qualitatively the impact on patient safety, it is a comprehensive report of non-statutory activities carried out at the MSC. Most of them were grassroots initiatives based on the enthusiasm of MSC employees, good preparation of medical simulation

trainers, as well as a spontaneous and understandable response to the epidemiological threat. It can be an excellent inspiration for the possibilities of using the know-how, humans, and hardware of training centers based on medical simulation techniques for future threats of a wide range. The multidirectional organizational and educational activities highlighted by the authors as a multi-profile activity of the MSC during the pandemic COVID-19 confirm the strength of the modern simulation center, especially in the flexibility in adapting to urgent health needs.

CONCLUSIONS

The multifaceted activity of the MSC confirms the great potential of this type of training unit based on medical simulation techniques as an educational tool, especially in the face of the real threat of a global epidemiological crisis. Although the long-term evaluation of results is difficult to estimate, the enormity of the completed tasks indicates a high adaptation and reorganization profile allowing for measurable results based on the unit's own resources. MSC can be an education center creating new procedures, standards of care, and best practices in difficult pandemic times.

Article information and declarations

Data availability statement

The data used to support the findings of this study are available from the corresponding author upon request.

Ethics statement

Not applicable.

Author contributions

PZ, MP, MD, RM identified all presented activities. PZ, MP, MD, AD, BP, prepared SOP for ECMO and nursing management and ECMO courses curriculum. PZ, MD, AD, RM prepared POST structure and dedicated educational programs for volunteers and vaccination project. All authors PZ, MP, MD, AD, BP, RM read and approved the final manuscript.

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Conflict of interest

The authors declare no conflict of interest.

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