Mass Training In Situ During COVID-19 Pandemic

Enhancing Efficiency and Minimizing Sick Leaves

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Introduction: Avoiding coronavirus disease 2019 (COVID-19) work-related infection in frontline healthcare workers is a major challenge. A massive training program was launched in our university hospital for anesthesia/intensive care unit and operating room staff, aiming at upskilling 2249 healthcare workers for COVID-19 patients' management. We hypothesized that such a massive training was feasible in a 2-week time frame and efficient in avoiding sick leaves.
Methods: We performed a retrospective observational study. Training focused on personal protective equipment donning/doffing and airway management in a COVID-19 simulated patient. The educational models used were in situ procedural and immersive simulation, peer-teaching, and rapid cycle deliberate practice. Self-learning organization principles were used for trainers' management. Ordinary disease quantity in full-time equivalent in March and April 2020 were compared with the same period in 2017, 2018, and 2019.
Results: A total of 1668 healthcare workers were trained (74.2% of the target population) in 99 training sessions over 11 days. The median number of learners per session was 16 (interquartile range = 9–25). In the first 5 days, the median number of people trained per weekday was 311 (interquartile range = 124–385). Sick leaves did not increase in March to April 2020 compared with the same period in the 3 preceding years.
Conclusions: Massive training for COVID-19 patient management in frontline healthcare workers is feasible in a very short time and efficient in limiting the rate of sick leave. This experience could be used in the anticipation of new COVID-19 waves or for rapidly preparing hospital staff for an unexpected major health crisis.
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The present work, as it reports data of common workplace educational interventions and Human Resource Management that does not involve any individual data, does not need ethics approval or consent to participate.

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The coronavirus disease 2019 (COVID-19) pandemic has spread globally and disrupted many healthcare systems. On March 5, 2020, the European Society of Intensive Care Medicine issued a statement from the Italian Intensive Care Unit network, warning European countries to actively prepare and restructure to face the massive flow of COVID-19 patients requiring intensive care unit (ICU).[1] Our university hospital is a tertiary referral center located in an agglomeration of 1.4 million people. It employs more than 15,000 people. For the anesthesiology, operating rooms, and critical care departments, 2249 persons may have to work in the frontline of COVID-19, including senior physicians, residents, nurses, and physiotherapists.

Frontline healthcare workers are particularly exposed to COVID-19 cross-contamination. In Italy, it has been reported that 9% to 10% of the COVID-19 cases were healthcare providers, representing more than 20,000 people by April 27.[2] Preventing intrahospital infection and transmission of COVID-19 among healthcare workers is therefore of major importance.[3] The COVID-19 contamination and negative psychological impact[4] in healthcare workers could result in a surge of sick leaves causing the collapse of healthcare systems.

Removal of personal protective equipment and intubation in COVID-19 settings have been shown to be particularly at risk of contamination, even in professionals used to surgical/interventional procedures.[5,6] Those skills must be learned quickly by all professionals, requiring the use of new training approaches.

By March 9, 2020, our hospital engaged in restructuring its activities to face the COVID-19 pandemic, including canceling elective surgeries and consultations, shifting to telehealth, increasing ICU capacity, and converting postanesthesia care units into ICU. Regarding our hospital, a minimum of 200 ICU-requiring COVID-19 patients from March 23 to April 7 was forecast.[7] On March 16, a massive training program was launched aiming at training ICU, anesthesia, and operating room staff for personal protective equipment (PPE) donning/doffing and COVID-19 airway/ventilation management in a very short time frame (2 weeks). We hypothesized that such training was feasible and that training the frontline staff for COVID-19–related activities could dampen the rate of sick leaves, by reducing cross-contamination and fostering staff's coping strategies. Our primary objective was to measure the feasibility of this massive training. Our secondary objectives were to measure the efficacy of such massive training in avoiding sick leaves in healthcare workers and to share educational insights from it.

METHODS

Type of Study

We performed a retrospective observational study. The institutional Ethic Committee confirmed that the French law on biomedical researches (Article L.1121-¯1 and Articles R.1121-¯1 and R.1121-¯2 of the public health code) does not apply to this retrospective and observational study. Written consent was therefore not required.

Settings

The Toulouse University Hospital is a 2980-bed university hospital, welcoming approximately 60,000 surgical interventions per year, counting 65 operating rooms, 83 ventilator-equipped ICU beds, and a level 3 maternity with 5200 births per year.

Population of Learners

Healthcare workers from the frontline ICU and operating rooms potentially caring for COVID-19 patients were the target population to be trained, including all senior and junior anesthesia and critical care physicians, ICU or postanesthesia care unit nurses and assistant nurses, certified registered nurse anesthetists (CRNAs), operating room nurses, and physiotherapists of those departments. The total trainable population was 2249, including 332 physicians and 1917 paramedical staff.

Facilitators

Our team of trainers initially included facilitators from our institution's simulation center (physicians, ICU nurses, CRNAs) trained for simulation-based learning. New trainers were encouraged to integrate the team if they showed interest for teaching and exhibited key behavioral markers: focusing on learning goals and exhibiting a no-blame attitude.[8]

Learning Goals

The following goals and subgoals were prioritized by the leadership:

- PPE donning and doffing for COVID-19
  - Properly choose the right equipment for the right care, perform PPE donning and doffing, and check for the fitting of FFP2/N95 masks
  - Ensure surveillance of other staff during donning/doffing
- Airway management for a COVID-19 patient
  - Clearly plan (including supplies to be taken in the room), communicate, and perform an intubation in a COVID-19 patient while minimizing the risk of droplets aerosolization from the airway

Educative Methods

The taxonomy of Chiniara et al[9] was chosen as a framework. Because of the defined learning goals, the rapid spread of COVID-19 in France, and the potential severe consequences in case of failure of personal protection, simulation was identified as a valuable educative tool as the desired skills located in the high-acuity, low-opportunity zone of the Chiniara's matrix. Explanatory videos on PPE donning and doffing and/or e-learning as an online prerequisite and reminder support were used, followed by procedural in situ simulation using the 5-step model for psychomotor skill training[10] and peer teaching.[11] The 5-step model for psychomotor skill training focuses on demonstrating the expected skill, providing explications of the different parts of the skills to walk the learner through the mental model and then make them practice while receiving direct feedback. We focused on using educational techniques requiring little preparation that were mobile, easy to learn, and rapidly transferable to new staff. We chose not to use video recording because of the unfavorable cost/benefit ratio of this technology in such a context.

We had at our disposal torso mannequins (Deluxe Difficult Airway Trainer, Laerdal) and adequate disinfecting material. Airway material, gowns, gloves, goggles, and masks were taken from the clinical units' supply with parsimony because of potential supply shortage. We chose not to organize formal evaluations because of the huge number of people to train. Learners' feedback was researched through informal discussions at the end of the session and shared across the trainers' group, but it was not standardized.

Two types of sessions were organized. The level 1 session, lasting 1 hour, covered hand disinfection, donning, and doffing procedures. The level 2 session was 1.5 hours and covered, in addition to the level 1 elements, simulation-based team training of intubation and extubation in COVID-19 patients.

Organizational Principles

Because of a severe time constraint, flat hierarchy principles and rapid iteration method were used to seize the opportunity to unleash collective intelligence. To do so, WhatsApp groups and Google Drive were used as open communication channels. People were invited to test the educative resources in real-world situations, modify them, and give feedback to the group. The director of the simulation center acted as a moderator and curator of educative content to ensure consistency with institution guidelines, as they were to change rapidly as the COVID situation evolved.

Measure of Effect on Employee Sick Leaves

Our hospital human resource (HR) department allows 6 categories of sick leaves: workplace injuries, long-time disease, work-related diseases, maternity leaves, ordinary diseases, and other absences. In our institution, all healthcare workers presenting with signs matching with COVID-19 infection were quarantined until being tested with nasopharyngeal Reverse Transcriptase - Polymerase Chain Reaction for COVID-19. In case of positivity, a minimum 14-day quarantine was applied. As no specific category has yet been created for COVID-19–related sick leaves, they were placed into the ordinary disease category.

We hypothesized that an efficient training program would lead to a reduction of the healthcare workers' contaminations and negative emotions after the beginning of the training, thus reducing the number of ordinary sick leaves during this period. To better reflect the impact of workplace, anesthesia/ICU and operating room departments were analyzed separately. Ordinary disease quantity in full-time equivalents (FTEs) in March and April 2020 were compared with the same period of the 3 preceding years.

Data Collection and Statistical Analysis

The type of session, number of learners trained, and their units and occupation were collected daily. The target number of people to train, as described previously, was calculated based on HR data. The involvement of usual and new trainers was documented through the learners' inscription forms at each session. The data regarding sick leaves, in FTE, were obtained from the HR department. After verifying that the years 2017, 2018, and 2019 were comparable in terms of sick leave quantity, the "ordinary disease" quantity in FTE from March to April was compared between 2017, 2018, and 2019 (concatenated) and 2020 using a Wilcoxon nonparametric test. Data are presented in median and interquartile range or mean and standard error when appropriate. A P value of less than 0.05 was required for statistical significance. Data analysis was performed using Python 3.7.4 (Python Software Foundation. Python Language Reference, Version 2.7. Available at http://www.python.org).

RESULTS

Training

The support of the hospital administration was very strong. The training program was endorsed by the hospital COVID-19 crisis unit and by the anesthesiology and critical care department before starting the course. The vast majority of the training was done during work hours and organized with the support of the unit managers. The first training session was launched on March 16 afternoon, using personnel already in the hospital for clinical duties. By Friday, March 20 (day 5), 1312 healthcare workers had been trained. By Friday, March 27 (day 10), 1602 healthcare workers had been trained. The total number of people trained was 1668, representing 74.2% of the target population, at the end of the training program by April 2 after 99 training sessions. The program was stopped afterward because of priority given to patient care. Within-unit training continuation was also encouraged. Detailed results are presented in Table 1 and Figure 1.

Overall, 43 level 1 sessions and 56 level 2 sessions were organized. Fourteen units participated in the program. The median number of training sessions per unit was 6 [interquartile range (IQR) = 1–12]. The median cumulative duration of training per unit was 9 hours (IQR = 1–15). The median number of people trained per unit was 128 (IQR = 21–163). The median number of learners per session was 16 (IQR = 9–25). The median number of sessions per weekday was 9 (IQR = 5–16), and the median number of people trained per weekday was 78 (IQR = 50–222). Considering the first week only, the median of people trained per weekday was 311 (IQR = 124–385).

Population of Trainers

Twenty-one facilitators (12 physicians, 4 CRNAs, 5 nurses) and 1 simulation technician from our simulation center engaged in the program. Over the first 4 days, 11 new trainers were enrolled, allowing for a rapid increase in training capacity. Those new trainers were also invited to continue training their own units once the institution training program was over.

TABLE 1. Duration of Training and Number of Healthcare Workers Trained During the Program According to Their Occupation

Date	Duration, H	Medical, n	Paramedical, n	Daily Number	Cumulative Number	% of Total Trainable
Day 1	3	15	46	61	61	2.7
Day 2	8.5	14	110	124	185	8.2
Day 3	22	61	324	385	570	25.3
Day 4	31.5	97	334	431	1001	44.5
Day 5	25.5	66	245	311	1312	58.3
Day 6	9.5	21	111	132	1444	64.2
Day 7	6	13	27	40	1484	66.0
Day 8	8.5	11	67	78	1562	69.5
Day 9	5	14	11	25	1587	70.6
Day 10	2.5	8	7	15	1602	71.2
Day 11	5	15	51	66	1668	74.2
Total	127	335	1333	1668		

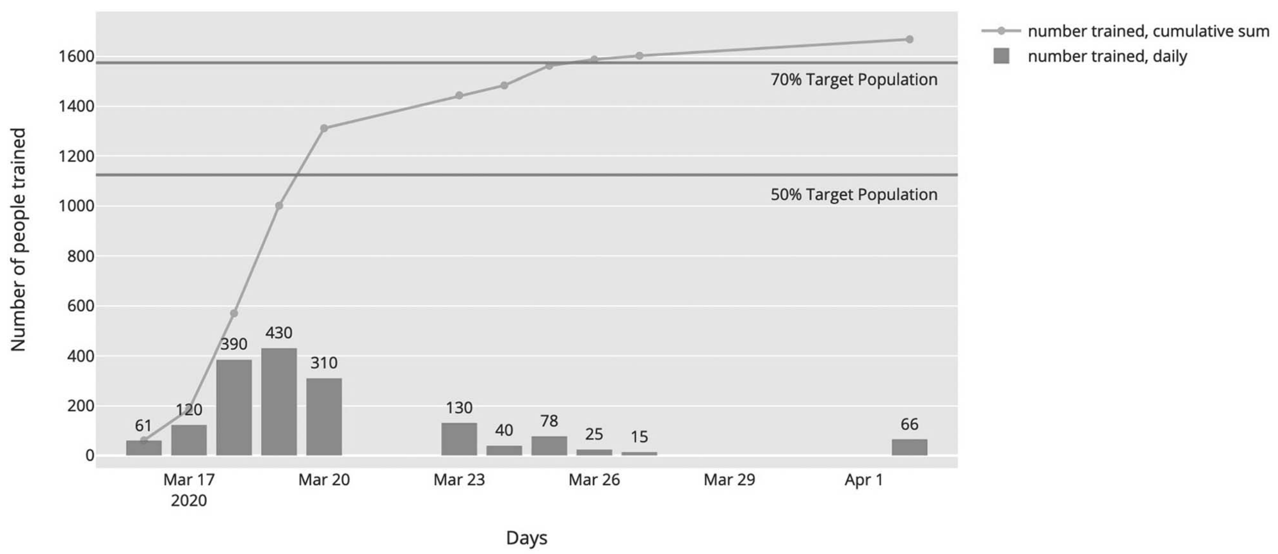

FIGURE 1. Number of people trained, daily (histogram), and cumulatively (line), during the COVID-19 training program.

Admissions of COVID-19 Patients in March to April 2020

In March and April 2020, 131 proven COVID-19 patients have been admitted in ICU and 45 in the operating room.

Healthcare Worker Sick Leaves

The quantity of ordinary disease sick leaves in March and April 2020 did not differ from 2017 to 2019 in the anesthesia/ICU department (22.3 ± 7.6 FTE vs. 28.3 ± 3.7 FTE, $P = 0.15$) and in the operating room department (22.9 ± 7.5 FTE vs. 24.8 ± 4.3 FTE, $P = 0.66$). Data are presented in Table 2 and Figure 2.

A Learning and Agile Organization

The first training day, involving 31 medical and paramedical staff from operating rooms and anesthesiology, was based on procedural simulation and peer teaching for donning, doffing, and intubation procedure. In the following hours, we used informal communication channels to spread educational material as they were created on the go. By the next morning (day 2), a checklist for training material, a modulable training plan to be delivered by less-experienced trainers (see Text, Supplemental Digital Content 1, http://links.lww.com/SIH/A629, which provides a basic trainer's guide for COVID-19 training, and Text, Supplemental Digital Content 2, http://links.lww.com/SIH/A630, which provides a practical trainer's guide to the management of participants' flow and to the application of educational principles proposed for COVID-19 training such as the 5-step model for psychomotor skills[10]), educational posters (see Images, Supplemental Digital Content 3, http://links.lww.com/SIH/A631, and 4, http://links.lww.com/SIH/A632, which present the donning/doffing procedure and the proper use of a FFP2/N95 respirator), a participation form template to track the number of learners, and a precourse e-learning module defining the expected skills through video clips were available (see Table, Supplemental Digital Content 5, http://links.lww.com/SIH/A633, which provides the URL of the video clips of donning/doffing, intubation and extubation procedures that were used during the training).

By day 3, as teachers' feedback indicated anxiety due to learners' questions unrelated to the training goals, we developed a prebriefing guide aiming at setting the learning expectations while addressing questions unrelated to the learning goals as worthy of being collectively discussed at the end of the session. We suggested that one of the trainers be dedicated to time management and detection of potential instructors. We integrated some principles of *deliberate practice* for the COVID-19–specific intubation and ventilation skills,[12,13] because of its potential interest compared to more traditional educational models.[14,15] We invited facilitators to favor subskill-specific training by suggesting the following: chunking skills in specific subskills, training subskills repeatedly while making mental representations explicit by adopting the *taking deliberate action* principle of Marquet et al,[16] and giving learners direct feedback to accelerate mastery.

TABLE 2. Comparison of the Quantity of "Ordinary Disease" Sick Leaves in March and April in 2017, 2018, 2019, and 2020 in the Anesthesia/Intensive Care and Operating Rooms Department, in Full-Time Equivalent

	2017	2018	2019	Concatenated 2017–2019	2020	*P* (2020 vs. Concatenated)
			Anesthesia/intensive care department			
March	29.6	27.4	33.6	30.2	27.6	
April	25.3	23.3	30.4	26.3	16.9	
Mean (SD)	27.5 (3.0)	25.4 (2.9)	32.0 (2.3)	28.3 (3.7)	22.3 (7.6)	0.15
			Operating room department			
March	32.8	24.2	24.4	27.1	28.2	
April	21.5	20.5	25.1	22.4	17.6	
Mean (SD)	27.2 (8.0)	22.4 (2.6)	24.8 (0.5)	24.8 (4.3)	22.9 (7.5)	0.66

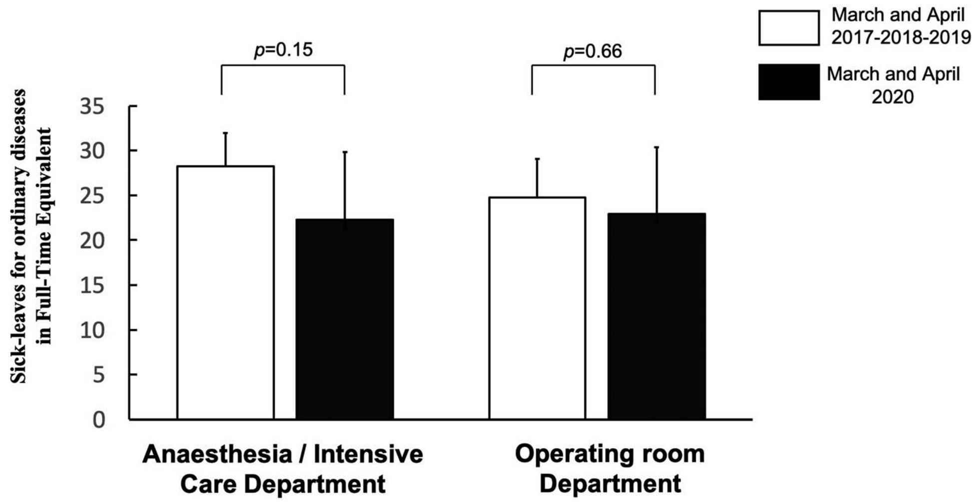

FIGURE 2. Quantity of ordinary disease sick leaves, in full-time equivalent in March and April 2017–2019 concatenated and 2020. Data are depicted for the anesthesia/intensive care department and the operating rooms department.

The principle of *taking deliberate action* allowed for situational awareness and cross-checking by other team members.[16] Every day, the involved training teams used WhatsApp instant messaging to give feedback to the community about what worked, what did not, and what should be changed.

Harnessing Collective Intelligence

At the end of day 1, a document compiling the questions arising from the training but not relative to the learning goals (organizational issues, supply chain…) was shared to be updated by every trainer. The end of each training sessions was a moment to collectively reflect about the organizational issues induced by the upcoming pandemic. The suggestions of organizational change were passed to the training community and the leadership for validation. Unanswered questions were discussed until we found a suggested protocol to pass to leadership. As a result, in 5 days, our staff created 10 COVID-19–related procedures. As examples of the direct consequences of the training, PPE supplies, video laryngoscope provision, and availability have been increased in ICU and operating rooms. The ergonomic, disposition, and storage of "COVID-19 rooms," as well as patient's route, have been modified in ICU and operating rooms.

DISCUSSION

We report here our experience in organizing a massive training program for COVID-19 patient management in an university hospital. More than 1600 learners have been trained in 11 days to acquire key skills needed to ensure their protection while taking care of COVID-19 patients. The efficacy of this training was measured in terms of sick leaves, considered as a surrogate marker of psychological impact and COVID-19 contamination in healthcare workers.

Our data show that a massive training of approximately 75% of COVID-19 frontline staff is feasible in a short time, while using hands-on training methods, in situ simulation, and keeping the number of learners per training session small enough to allow for each of them to practice. An organization-wide coordination allowed for rapid upscaling of training schedule, leading to a median of 311 learners trained per day during the first week. Our data show that healthcare workers have not experienced an increase in the number of ordinary sick leave.

This crisis preparation period also yielded valuable insights relative to workplace education. Safety procedures for caregivers are of paramount importance in preventing the transmission of the virus between caregivers, to patients or to their own families, explaining the enthusiasm of all the participants. The feasibility of the procedure and the educative methods used helped reinforce the learners' feeling of self-efficacy.[17] Learners tend to focus on gestures, but making them explicit before they are carried out is fundamental to refine the mental model supporting the psychomotor skill through feedback. Bandura[18] described vicarious learning as an individual learning by looking at his peers if he can relate to them. In this way, video clips, procedural simulation workshops, and peer teaching can support skill transferred between healthcare professionals. This solution seems particularly suitable for rapid, self-administered mass training. In situ simulation was used because using the staff's workplace to train people allows them to project themselves in their future practice and add more value to their training. As staff members wanted to improve their technical skills, they also looked for answers to their local organization's issues. This effect is very well documented in in situ programs.[19] As skills development takes place in a situation,[20] it was helpful to end the training with an airway management immersive clinical simulation for learners to connect the skills seen at each stage of the training. As such, this training included all the stages of a complete Kolb's cycle of experiential learning.[21]

The short time frame and the large number to train were major challenges. A rapid iteration method was used, designing each session like building a new prototype that we then updated using the failures and successes of our colleagues a few hours before. To allow an open communication, it was needed to mitigate the vertical, hierarchical command-and-control type of leadership. If trainers were asked to reach the defined learning goals, they were relatively free to adopt the methods that they saw fit. In the same manner, people could modify the training material shared but were not asked to use it. The most senior trainer acted as a group moderator, ensuring that the core content of the course was aligned with authorities' guidelines to avoid confusion and inaccurate knowledge in trainees. Nevertheless, as official information changed rapidly, conflicting messages may have been presented in some sessions. Each session brought new questions, allowing us to collectively reflect on how to handle organizational issues in a realistic way. By doing so, the problem-solving dynamics was inverted by using the principle of *pushing authority to information* theorized by Marquet.[16] The authority who made the decisions for updating the training course was pushed to the trainer's level, where information for problems, failures, and successes was available. Asking employees to set goals and implementation intentions act as drivers to employee's responsibility and engagement.[22,23] Besides, self-assignment of high goals also promotes self-efficacy, which is a driver of performance.[17,18] Those principles allow for maximal adaptability and could ensure a better skill transfer between employees across an organization. Those moments of exchange led us to go beyond simple procedural training as they drove us to tap into design thinking to create human-centered solutions to a number of arising issues.

In times of crisis, the trainer resource may be lacking because many people need to be trained and/or the trainers themselves are impacted by the crisis. One of the solutions for trainings that do not require technicality or extensive competence is to quickly train referents so they can carry out training under supervision and then independently, allowing for a multiplication of HRs. This collaborative learning by snowballing is effective on small groups.[24] This seems to be also acceptable when a large number of people need to be trained quickly.[25]

Our study has some limitations. Regarding the efficacy of the training, we focused on the rate of sick leaves, without being able to calculate the actual COVID-19 rate of cross-contamination or sick leave for psychological reasons. Moreover, potential confounding factors were not accounted for, as the effect of lockdown policies that were instituted on March 16 in France. Finally, we only studied the short-term effects of this training, but no strong conclusion can be drawn on potential long-lasting effects. The effects of repeating this type of training, not only in anticipation of new COVID-19 waves but also over a long period to perpetuate a high level of compliance with standard precautions, should be evaluated through practice audits.

CONCLUSIONS

A massive training program focusing on basic skills for healthcare workers in the frontline of COVID-19 patient management was feasible. Using an agile approach and in situ simulation, more than 1600 healthcare workers were trained in 11 days. During the first wave of COVID-19 in our hospital, no increase in sick leaves has been observed in our departments, suggesting an efficacy of this training to minimize cross-contamination and psychological impact of COVID-19 in our staff. This experience could be used in the anticipation of new COVID-19 waves or for rapidly preparing hospital staff for an unexpected major health crisis.

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