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Using In situ simulation when preparing for COVID-19: Health care professional's point of view.

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Title page

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Using In situ simulation when preparing for COVID-19: Health care professional's point of view.

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Abstract

Objectives: The COVID-19 pandemic has forced hospital organization and health care professionals to prepare for large quantities of patients in isolation rooms. In situ simulation may seem promising in order to manage the organizational changes that the pandemic require. This study aims to investigate in situ simulations influence on healthcare professional's preparedness to face the pandemic.

Setting: We conducted full-scale in situ simulations over a 3-week period at a Danish University Hospital

Participants: 277 health care professionals

Interventions: The simulations consisted of a briefing, two scenarios focusing on acute respiratory insufficiency and correct use of personal protective equipment (PPE), and a debriefing. We conducted eight focus group using comparable semi-structured interview guides on the organizational restructuring of the departments and the outcomes of the needs-driven simulation-based program.

Results: The informants perceived that the simulations resulted in positive experiences for the healthcare professionals and perceived the organizational changes as effective. They highlighted that simulation enhanced teamwork, demystified the COVID-19 disease, and improved skills, in correct use of PPE and acute treatment of COVID-19 patients. Data revealed that a pre-defined simulation task force including both experienced simulators and medical experts for facilitation of in situ simulation would be beneficial.

Conclusion: In situ simulation may be useful to enhance learning on organization- and individual level during a pandemic. This educational activity could serve an important role in facilitating hospital preparation and education of large numbers of healthcare professionals during a health care crisis. The establishment of a simulation task force is, suggested to handle coordination and rapid enrolment across the hospital.

Strengths and limitations of this study

Strenghts:

- Study focusing on health care professional's perception of in-situ simulation
- Large population of participants in the early stage of the COVID-19 pandemic

Limitations:

- No pre-intervention interviews were performed
- Most of the COVID-19 Clusters were never activated, thus what was leaned never came into play

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been spreading worldwide since its occurrence by the end of 2019, causing the COVID-19 pandemic. The World Health Organization (WHO) estimated a global mortality at 3.4% in the initial phase of the pandemic [1]. These numbers pressured the existing workforce, and called for an increase in numbers of healthcare professionals, who could act as frontline staff during the pandemic [2]. Vagni and colleagues (2020) found that healthcare professionals involved in the treatment of COVID-19 were exposed to a large degree of stress, especially if they lack adequate knowledge about the disease [3].

Training and correct use of personal protection equipment (PPE) in the care of all patients with respiratory symptoms was essential due to contamination risks [4,5]. Hence, the immense pressure on the healthcare system called for immediate development of just-in-time preparedness strategies in order to meet the challenges of new healthcare professionals not familiar with the disease, risk of contamination, and risk of mental health issues among the professionals [6].

Simulation has a potential to help managing the global COVID-19 crisis and in potentially similar future pandemics [2,7–9]. It is however, not known how the use of in situ simulations affected the healthcare professionals, due to the rare occurrence of pandemics. Thus, the present study aims to investigate how healthcare professionals, educational experts, and leaders at department levels at a University Hospital perceived their involvement in an in situ simulation program.

Reorganization of the hospital and design of COVID-19 clusters

Aarhus University Hospital, which contains above 1200 bedsides, established a COVID-19 clinic focused on COVID-19 testing, identification, and triaging.

In addition, the capacity at the Department of Intensive Care were increased and four COVID-19 clusters were established, with a total capacity of 134 isolation rooms. See figure 1 for details.

Please insert figure 1; COVID-19 Clusters, Aarhus University Hospital. March 2020 – isolationrooms

A stepwise approach was used in order to convert four in-patient departments to COVID-19 patient treatment clusters. The clusters should admit COVID-19 patients sequentially when 50% of the capacity of the previous cluster were in use,

however only COVID-19 cluster 1 and 2 were activated during the study period. The allocated healthcare professionals had their daily work in a variety of clinical departments and faced unfamiliar working routines, with in respect to colleagues, teams, and working locations within the COVID-19 clusters.

Educational activities in the COVID-19 clusters

In order to prepare personnel, a steering committee in each cluster was established. Co-author LE was part of the educational team in cluster 1 and co-author BL was part of the educational team in cluster 2. As part of the educational activities an in situ simulation programme was developed. The programme had an agile structure making it adjustable in regards to the continuous development of new guidelines about triaging, resuscitation, and treatment of COVID-19 patients.

Experiences and insights from the simulation was shared with the hospital administration on a daily basis, in order to ensure that gained knowledge and points of attention could benefit the entire hospital. In this way, there was a close relation between the different levels of management at the hospital.

Materials and Methods

The simulations at Aarhus University Hospital included a total of 277 healthcare professionals (doctors, nurses, and physiotherapists) and were conducted during a three-week period in April 2020. The simulations lasted between 60-90 minutes and consisted of two scenarios focusing on acute respiratory insufficiency and correct use of personal protective equipment (PPE).

Please insert Figure 2; Description of simulated cases

The simulations did not include formal assessments of the learning due to the time-sensitive nature of the training. Instead, the simulations included all healthcare professions that treated covid-19 patients and all participants were asked to actively participate in the simulation and in giving and receiving feedback. The scenarios in the simulation sessions required

collaborative and active learning. The simulations were conducted as rapid cycle deliberate practice, consisting of average 20-minutes briefing, 20-minutes scenario, and 20-minutes debriefings[10].

We conducted eight focus group interviews lasting between 35 minutes and 63 minutes per interview using comparable semi-structured interview guides [11]. The interview guides comprised thematically structured open-ended questions with respect to themes as uncertainty, fear of contamination, and lack of preparedness among healthcare professionals during the pandemic, which is known from the educational literature [2,7,12]. Furthermore, informants were asked to reflect on how the COVID-19 pandemic affected their daily work routines. The semi-structured interview guide allowed the interviewer to probe for additional insight and to dig deeper into the pros and cons of the simulations. The interviewers were trained qualitative researchers who also facilitated the simulations, however the interviewers did not interview participants they had trained. This was done in order to decrease the power relation between interviewer and interviewee. All interviews were transcribed verbatim and narrative coded [11]. The informants in the present study were included based on their experience with being either participants in simulations, facilitators of the simulations, members of the educational committee, or consultants responsible for the included departments. We included doctors, nurses, and other healthcare professionals in order to embrace the voice of all professions. Each focus group had a strategic composition of informants in order to decrease the power differential among the informants according to the methodological recommendations from Stalmeijer and colleagues [13].

We applied a qualitative methodology that relates to the social constructionist understanding of storytelling as being integral to the analysis of healthcare professionals' perspectives and personal experiences when dealing with the pandemic [14].

Patient and public involvement statement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research

Ethics

Participation in the interviews was voluntary and participants' quotes were made anonymous. No ethical approval or trial registration was required for this study according to Danish legislation. All participants provided informed consent and gave permission to recording of the interviews.

Results

In total 24 informants were included in the present study (12 healthcare professionals, 7 medical experts, and 5 consultants responsible for the clusters). The informants perceived that the simulations resulted in positive experiences for the healthcare professionals and experienced the organizational changes as positive (i.e. increase in interdisciplinary actions, decrease of bureaucracy, and a stronger sense of community). The following sections elaborate on these findings.

Anxious concerns and demystification of the COVID-19

The healthcare professionals in the interviews reported a feeling of uncertainty, partly due to being put in a stand-by position for emergency preparedness, and partly due to the severity of the disease combined with an overwhelming amount of information. This is exemplified by a physiotherapist who participated in the simulation:

"I feel like we have been caught in some kind of limbo or 'silence before the storm'…" (Physiotherapist).

Here, in situ simulation was perceived as crucial in preparing for the COVID-19 disease by demystifying the disease and providing hands-on experiences with the patient category, effectively improving a sense of self-efficacy [15]. Especially stress management was experienced as helpful in reducing potential stressors and increasing a sense of comfort in handling the COVID-19 patients, as also noted by the physiotherapist and a registered nurse:

"…we were on such uncertain ground in the beginning. I also think [the simulation training] gave me some sense of security." (Physiotherapist)

"Yes, in that sense it [COVID-19] was demystified." (Registered nurse)

The medical experts that facilitated the simulations highlighted the use of in situ simulations in order to enhance organizational learning and individual learning. Organizational changes, such as an increase in multidisciplinary cooperation and a stronger sense of community, prepared the clusters to the COVID-19 pandemic. The medical experts

highlighted the need for individual learning of the healthcare professionals and perceived the simulation training as key in preparing oneself and the department for the COVID-19 pandemic:

"In our cluster the simulations had a really good effect in order to demystify the disease and decrease fear among the healthcare professionals. The professionals had a lot of uncertainty in regards to what the pandemic would bring. Furthermore, the simulations raised a lot of questions that we, as heads of the cluster could answer in the daily meetings" (Medical expert).

Importance of multidisciplinary team training

Another theme was the importance of interdisciplinary simulation sessions. The sessions highlighted each healthcare professional's value and role when handling COVID-19 patients. This was especially noted by the physiotherapist in the quote below, who experienced a stronger sense of professional identity, as well as an increased sense of comfort in teamwork:

"[…] there has been a great experience of interdisciplinarity and an awesome feeling that we will handle it [COVID-19] together…" (Physiotherapist).

In continuation, teamwork was enhanced during the simulations, according to a managing consultant:

"The fact that experienced and un-experienced healthcare professionals were teamed up in the simulations really help in order to create insight into the value of each team-member. It also helped the new professionals to be integrated in departments, where they never had worked before." (Managing consultant)

In continuation, consultants responsible for departments highlighted how the simulations helped ensuring a professional and calm working environment at the clusters. This is exemplified in the following quote by a head of a department who stressed how the simulations improved the working environment:

"When we started the in situ simulation the atmosphere in the department became calmer. The treatment of COVID-19 patients is actually fairly simple, and the simulations helped the healthcare professionals to realize that. The simulations help them practice the COVID-19 treatment and do some mistakes without jeopardizing patient-safety. It surely helps in order to calm the healthcare professionals and establish a very well-functioning department" (Managing consultant)

The positive gains of in situ simulation were also emphasized in the following quote by another head of department that didn't received any COVID-19 patients, but still valued the simulations.

"This is surely something that we are going to use in the future (...) It has provided us with so much knowledge and teamwork. The content can be anything. It helped all of us because it is interdisciplinary and include experienced and unexperienced healthcare professionals." (Managing consultant)

Design and facilitation of the simulations

The healthcare professionals highlighted the simulation facilitator as a key factor by being engaged in the scenario, ensuring fidelity, and securing a safety net by debriefing the simulations. The medical experts that facilitated the simulations also highlighted the collaboration with in situ simulation experts in order to establish psychological safety [16] and an optimal learning environment.

"It makes it a lot easier for me as a facilitator, when there is an experienced in situ simulation instructor conducting the scenarios together with me. In this way, I know that the educational elements are being taken care of in a professional manner" (Medical expert).

The presence of a medical expert and an educated simulation facilitator in each simulation secured the consistency among the facilitators. This is exemplified by one of the medical experts in the following quote:

"*The fact that we were two medical experts and one simulation expert to conduct all the in situ simulations in our department helped ensure consistency in the scenarios. A lot of the questions from the participants were the same and because we had daily meetings with the heads of the department, we knew what to answer. During the two weeks we spend all our working time conducting these simulations, which made us confident in reaching the learning goals and establishing a smooth facilitation of the simulations."* (Medical expert)

The informants in the present study called for the establishment of a simulation task force across the hospital in order to share knowledge between departments and develop expertise in designing, implementing, and facilitating the simulations.

"I would have benefited by ending each day with an afternoon meeting with all the simulation facilitators from the COVID-clusters across the hospital. The pandemic caused a lot of questions in addition to facilitating the simulations. For example, what happens if a COVID-patient with comorbidity needs to be transferred to another department? If all simulation facilitators made a small daily report and shared this with the other facilitators, we could ensure knowledge sharing across the hospital." (Medical expert)

Due to a lack of PPE, some simulations were conducted without the correct equipment in the initial phase of the simulation program. During the simulation programme the heads of departments realized the value of using the correct PPE, as explained in the quote below.

"The outcome of simulation went from good to better, when we started to use the correct PPE, as this required that the healthcare team worked fully together." (Consultant responsible of department)

Discussion

The interviews in the present study suggest that in situ simulation enhanced teamwork, helped demystify the COVID-19 disease, and provided the healthcare professionals with competences within correct use of PPE and acute treatment of COVID-19 patients.

Healthcare professionals previously exhibit concern about family transmission of infectious diseases, thus it seems reasonable if the COVID-19 pandemic had a negative impact on the healthcare professionals' perceived quality of work [17]. Based on the findings in the present study, it seems that in situ simulation can be a useful tool, when facing such a decrease in the perceived quality of work.

In medical education, Weller and colleagues (2014) investigated effective healthcare teams and found an unacceptable rate of errors due to lack of teamwork between healthcare professionals [18]. Consequently, they put forward seven interventions to overcome barriers to teamwork and team communication, including the use of simulation. Our study indicates that the informants experienced anxiety regarding the rapid spread of the COVID-19 virus. Furthermore,

informants stated that in situ simulation made them feel more comfortable facing the task at hand i.e. by demystifying the treatment of the COVID-19 disease and enhancing teamwork, all in a safe educational environment.

The uncertainty due to COVID-19 is likely to add complexity to the clinical work. Thus, training of healthcare professionals seems key in order to reduce stress and form coping strategies. Our findings align well with the stress model by Palmer and colleagues from 2003, as their model highlight professionals' training in order to face an increased complexity of work and decrease stress [19].

The hospital infrastructure seems influential when supporting the fundamental aim of wellbeing for all patients and delivering high standards of care [20]. This is supported by our findings, suggesting that learning occurred on an organization level as well as the individual level, as stated above. Similar findings are emphasized by Brydges and colleagues (2020), who advocate for the use of simulation when preparing for and responding to the early stages of the COVID-19 pandemic [12].

Simulation seems to have a potential in managing the global COVID-19 pandemic by rapidly facilitating hospital preparation and education of large numbers of healthcare professionals [7,21,22]. Wong and colleagues (2020) advocated for the use of in situ simulation in the beginning of the pandemic in order to test the preparedness of isolation rooms, however, they do not specifically highlight using a coordinated and centralized simulation team to ensure the development of a robust curriculum development, as Dubé et al. (2020) explicitly emphasize [6,23]. While the present study supports the use of simulation in a pandemic, the findings also reveal the need of coordinated planning across the hospital in order to secure that the learning goals of the simulation is reached. The coordination of simulation is highlighted by Brazil and colleagues (2020), who conducted an intervention similar to the one in the present study, orchestrated by a Simulation Service formally established across the hospital [24]. The setting in the present study would have benefitted from the establishment of a simulation task force including educated simulators and medical expert, in order to ensure that the pedagogical, didactical, and medical elements in the simulations where at the highest possible level.

Limitation

Due to the rapid development of the COVID-19 pandemic it was not possible to conduct a study with objective assessment of skills learned e.g. an examination or practical test of what was learned. Nonetheless, the in situ simulations are suggested to decrease stress and improve teamwork among the healthcare professionals. Similar, the simulations may have improved the clinical skills of the participating staff. It has not been possible to conduct a follow-up data collection

in order to establish if demystification of the disease and decrease in stress still is present or new educational activities is needed.

Conclusion

In situ simulation may be useful to enhance learning on an organization level as well as the individual level during a pandemic. This educational activity could serve an important role in facilitating hospital preparation and education of large numbers of healthcare professionals during a pandemic. The establishment of a simulation task force is, however, suggested as in situ simulation across a hospital requires coordination and rapid enrolment in health care crises.

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JJ and RDJ contributed with the idea of the study, collecting of data and the writing of the manuscript. BL, NT and LE contributed with collecting of data. GVE contributed with the idea of the study.

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Figures:

Figure 1: COVID-19 Clusters, Aarhus University Hospital. March 2020 – isolationrooms

Figure 2: Description of simulated cases

Figure 1

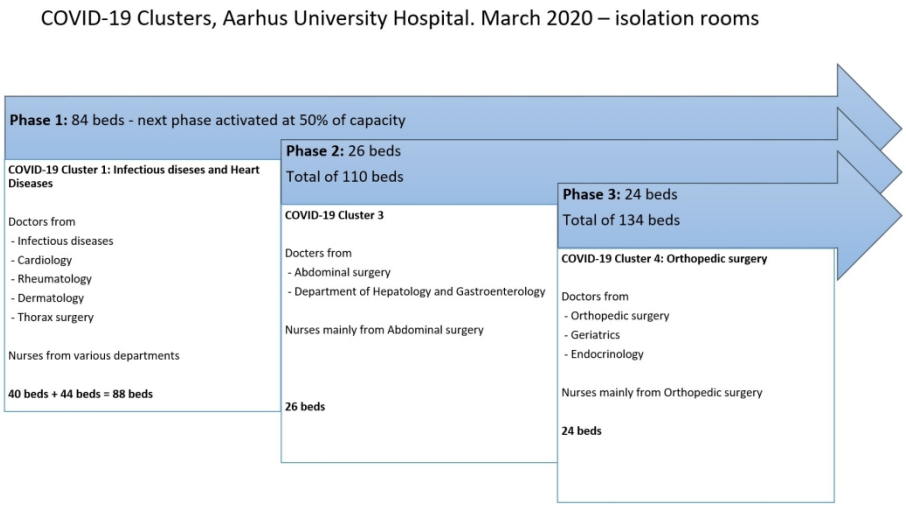

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Figure 2: *Description of simulated cases*

Cases	Background information	Case description	Clinical outcome	Learning objectives
Patient 1	75 years. Known well regulated arterial hypertension High level of function.	Respiratory insufficient Covid-19 infected patient. Dependence on oxygen supplement and elevated bed rail. Mono-organ failure	Patient stabilization on COVID-19 medical ward (non-ICU)	1. Terms of ABCDE approach 2. appropriate use of PPE and medical equipment 3. transportation of equipment to/from isolated patients
Patient 2	64 years. Known dysregulated diabetes II and adipositas. High level of function.	Severe respiratory insufficient Covid-19 patient. ABCD-unstable. Septic shock/central pulmonary embolism and multi organ failure (occasionally extended with adjacent cardiac arrest)	Medical emergency call/acute transfer to ICU and mechanic ventilation (Advanced CPR if cardiac arrest)	4. Advanced ABCDE-approach to critically ill patient. 5. Acute communication strategy and early call for assistance 6. Use of PPE when performing aerosol generating interventions 7. Reflection on indication for intensive care and resurrection

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Abstract

Objectives: The COVID-19 pandemic forced hospital organization and healthcare professionals to prepare for large quantities of patients in isolation rooms. In situ simulation may seem promising in order to manage the organizational changes that the pandemic require. This study aims to investigate in situ simulations influence on healthcare professional's self-perceived preparedness to face the pandemic.

Design: A qualitative focus group study

Setting: We conducted full-scale in situ simulations over a 3-week period in April 2020, including 277 healthcare professionals, at a Danish University Hospital. Subsequently, six semi-structured focus group interviews, including 22 participants from the simulations, were conducted in May 2020.

Participants: 22 healthcare professionals participated in the focus group interviews

Methods: The simulations consisted of a briefing, two scenarios focusing on acute respiratory insufficiency and correct use of personal protective equipment (PPE), and a debriefing. We conducted six focus group interviews using comparable semi-structured interview guides focusing on the organizational restructuring of the departments and outcomes of the needs-driven simulation-based program. We used thematic analysis to identify main themes.

Results: The informants perceived that the simulations resulted in positive experiences for the healthcare professionals and perceived the organizational changes as effective. They highlighted that simulation enhanced teamwork, demystified the COVID-19 disease, and improved skills, in correct use of PPE and acute treatment of COVID-19 patients. Data revealed that a pre-defined simulation task force including both experienced simulators and medical experts for facilitation of in situ simulation would be beneficial.

Conclusion: In situ simulation may be useful to enhance learning on organization- and individual level during a pandemic. This educational activity could serve an important role in facilitating hospital preparation and education of large numbers of healthcare professionals during a health care crisis. Introduction of a simulation task force is, suggested to handle coordination and rapid enrolment across the hospital.

- The study presents insights based on healthcare professionals' experiences with participating in COVID-19 in situ simulations in a university hospital
- A focus group interview intervention of involved health care professionals was performed in close timely relation to the simulations.
- In situ simulation facilitated learning both at the individual and organization levels
- Due to the pandemic a limited number of informants are included in the present study

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been spreading worldwide since its occurrence by the end of 2019, causing the COVID-19 pandemic. The World Health Organization (WHO) estimated a global mortality at 3.4% in the initial phase of the pandemic [1]. These numbers pressured the existing workforce, and called for an increase in numbers of healthcare professionals, who could act as frontline staff during the pandemic [2]. Vagni and colleagues

(2020) found that healthcare professionals involved in the treatment of COVID-19 were exposed to a large degree of stress, especially if they lack adequate knowledge about the disease [3].

Training and correct use of personal protection equipment (PPE) in the care of all patients with respiratory symptoms was essential due to contamination risks [4,5]. Hence, the immense pressure on the healthcare system called for immediate development of just-in-time preparedness strategies in order to meet the challenges of new healthcare professionals not familiar with the disease, risk of contamination, and risk of mental health issues among the professionals [6].

In situ simulation has a potential to help managing the global COVID-19 crisis and in potentially similar future pandemics [2,7–9]. It is however, not known how the use of in situ simulations affected the healthcare professionals, due to the rare occurrence of pandemics. Thus, the present study aims to investigate how healthcare professionals, educational experts, and leaders at department levels at a University Hospital perceived their involvement in an in situ simulation programme.

Reorganization of the hospital and design of COVID-19 clusters

Aarhus University Hospital, which contains above 1200 bedsides, established a COVID-19 clinic focused on COVID-19 testing, identification, and triaging.

In addition, the capacity at the Department of Intensive Care were increased and four COVID-19 clusters were established, with a total capacity of 134 isolation rooms. The term COVID-19 clusters refers to the fact that several medical specialties worked together at one isolation ward. See figure 1 for details.

Please insert figure 1; COVID-19 Clusters, Aarhus University Hospital. March 2020 – isolation rooms

A stepwise approach was used in order to convert four in-patient departments to COVID-19 patient treatment clusters. The clusters should admit COVID-19 patients sequentially when 50% of the capacity of the previous cluster were in use, however only COVID-19 cluster 1 and 2 were activated during the study period. The allocated healthcare professionals had their daily work in a variety of clinical departments and faced unfamiliar working routines, with respect to colleagues, teams, and working locations within the COVID-19 clusters.

Educational activities in the COVID-19 clusters

In order to prepare personnel, a steering committee in each cluster was established. As a part of the steering committee, educational teams were established in order to prepare the healthcare professionals to face the pandemic. Co-author LE was part of the educational team in cluster 1 and co-author BL was part of the educational team in cluster 2. As part of the educational activities an in situ simulation programme was developed. In situ simulation was used as a method due to an educational focus on individual and organizational learning[2]. The programme had an agile structure making it adjustable in regards to the continuous development of new guidelines about triaging, resuscitation, and treatment of COVID-19 patients.

Experiences and insights from the simulation was shared with the hospital administration on a daily basis, in order to ensure that gained knowledge and points of attention could benefit the entire hospital. Hence, the understanding of COVID-19 disease and how to improve the organization of isolation rooms and clinical teams were shared based on insights from the simulations. In this way, there was a close relation between the different levels of management at the hospital.

Methods

We conducted 6 qualitative focus group interviews including a total of 22 healthcare professionals. The focus group method and a narrative research approach can be used to investigate meanings and beliefs that influence the informants' attitudes toward in situ simulation as an educational tool[10]. The informants were participants from a simulation based educational initiative focusing handling and treatment of COVID-19 patients. These simulations took place at Aarhus University Hospital and included a total of 277 healthcare professionals (doctors, nurses, and physiotherapists) and were conducted during a three-week period in April 2020. The team based in situ simulations lasted between 60-90 minutes and consisted of two scenarios focusing on acute respiratory insufficiency, correct use of personal protective equipment (PPE), team communication and transportation of unstable patients, please see figure 2. The participants all simulated both scenarios. All simulations were facilitated by a medical expert and an educated simulation instructor, both present during briefing, conduction, and debriefing of the scenarios. The participants were organized in groups of 4-6 individuals in a team composition that corresponded to the clinical teams in the newly established COVID-19 clusters (1-2 doctors,

2-4 nurses and 1-2 other healthcare professionals). A manikin deputised as patient and all equipment from a basic medical ward was available. Measured vitals was presented on a monitor and operated by the facilitators during the scenarios.

Please insert Figure 2; Description of simulated cases

The simulations did not include formal assessments of the learning due to the time-sensitive nature of the training. Instead, the simulations included all healthcare professions that treated covid-19 patients and all participants were asked to actively participate in the simulation and in giving and receiving feedback. The scenarios in the simulation sessions required collaborative and active learning. The simulations were conducted as rapid cycle deliberate practice, consisting of average 20-minutes briefing, 20-minutes scenario, and 20-minutes debriefings[11]. Rapid cycle deliberate practice was selected as Hunt and colleagues showed that this approach is associated with improvement in performance of key measures and progressive acquisition of trained skills during simulation [11]. Sessions were debriefed using teamGAINS [12] as technical and non-technical leaning objectives were essential for the outcome.

Data collection

The qualitative focus group interviews lasted between 35 minutes and 63 minutes per interview using comparable semi-structured interview guides [13]. The interview (*see full interview topic guide in supplementary material)* guides comprised thematically structured open-ended questions with respect to themes as uncertainty, fear of contamination, and lack of preparedness among healthcare professionals during the pandemic, which is known from the educational literature [2,7,10]. Furthermore, informants were asked to reflect on how the COVID-19 pandemic affected their daily work routines. The themes of the interviews can be seen in the Interview topic guide. The semi-structured interview guide allowed the interviewer to probe for additional insight and to dig deeper into the pros and cons of the simulations. The interviewers were trained qualitative researchers who also facilitated the simulations. However each cluster had it's own facilitators thus, the interviewers did not interview participants they had trained. This was done in order to decrease the power relation between interviewer and interviewee. The informants in the present study were included based on their experience with being either participants in simulations, facilitators of the simulations, members of the educational

committee, or consultants responsible for the included departments. We included doctors, nurses, and other healthcare professionals in order to embrace the voice of all professions. More nurses than doctors were included in order to reflect the composition of the clinical teams from the simulations. We planned for 4-7 informants in each group. However, in the focus group consisting of the consultants responsible for the clusters only 3 informants participated. Each focus group had a strategic composition of informants in order to decrease the power differential among the informants according to the methodological recommendations from Stalmeijer and colleagues [14]. All informants were recruited as volunteers.

We applied a qualitative methodology that relates to the social constructionist and narrative understanding of storytelling as being integral to the analysis of health care professionals' perspectives and personal experiences when dealing with the pandemic [15]. All interviews were transcribed verbatim and reviewed by the investigators (both medical experts and educated simulators). Subsequently, the interviews were analysed thematically by 3 qualitative researcher who created common themes across the transcripts [13]. The generated main themes were reviewed and discussed among investigators in order enhance trustworthiness. The themes are presented in the result section.

Patient and public involvement statement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research

Ethics approval statement

Participation in the focus group interviews was voluntary and participants' quotes were made anonymous. No ethical approval or trial registration was required for this study according to Danish legislation. All participants provided informed consent and gave permission to recording of the interviews.

Results

In total 22 informants were included in the present study (12 healthcare professionals, 7 medical experts, and 3 consultants responsible for the clusters). The informants perceived that the simulations resulted in positive experiences for the healthcare professionals and experienced the organizational changes as positive (i.e. increase in interdisciplinary actions, decrease of bureaucracy, and a stronger sense of community). The following sections elaborate on these findings.

Anxious concerns and demystification of the COVID-19

The healthcare professionals in the interviews reported a feeling of uncertainty, partly due to being put in a stand-by position for emergency preparedness, and partly due to the severity of the disease combined with an overwhelming amount of information. This is exemplified by a physiotherapist who participated in the simulation:

"I feel like we have been caught in some kind of limbo or 'silence before the storm'..." (Physiotherapist).

Here, in situ simulation was perceived as crucial in preparing for the COVID-19 disease by demystifying the disease and providing hands-on experiences with the patient category, effectively improving a sense of self-efficacy [16]. Especially stress management was experienced as helpful in reducing potential stressors and increasing a sense of comfort in handling the COVID-19 patients, as also noted by the physiotherapist and a registered nurse:

"...we were on such uncertain ground in the beginning. I also think [the simulation training] gave me some sense of security." (Physiotherapist)

"Yes, in that sense it [COVID-19] was demystified." (Registered nurse)

The medical experts that facilitated the simulations highlighted the use of in situ simulations in order to enhance organizational learning and individual learning. Organizational changes, such as an increase in multidisciplinary cooperation and a stronger sense of community, prepared the clusters to the COVID-19 pandemic. Based on the simulations several changes were made, e.g. how medical equipment was pre-packed in the COVID-19 clusters, how we organized the isolation rooms, the design of clinical teams as well as how to communicate in and out of quarantine areas. A medical expert pointed out such a specific change in organization that was based directly on experience from the simulation:

"During the simulations, we learned that it is a good idea to start each shift with a 1min meeting in order to clarify roles if an acute situation in an isolation room should occur" (Medical expert)

The medical experts also highlighted the need for individual learning of the healthcare professionals and perceived the simulation training as key in preparing oneself and the department for the COVID-19 pandemic:

"In our cluster the simulations had a really good effect in order to demystify the disease and decrease fear among the healthcare professionals. The professionals had a lot of uncertainty in regards to what the pandemic would bring. Furthermore, the simulations raised a lot of questions that we, as heads of the cluster could answer in the daily meetings" (Medical expert).

Importance of multidisciplinary team training

Another theme was the importance of interdisciplinary simulation sessions. The sessions highlighted each healthcare professional's value and role when handling COVID-19 patients. This was especially noted by the physiotherapist in the quote below, who experienced a stronger sense of professional identity, as well as an increased sense of comfort in teamwork:

"[…] there has been a great experience of interdisciplinarity and an awesome feeling that we will handle it [COVID-19] together…" (Physiotherapist).

In continuation, teamwork was enhanced during the simulations, according to a managing consultant:

"The fact that experienced and un-experienced healthcare professionals were teamed up in the simulations really help in order to create insight into the value of each team-member. It also helped the new professionals to be integrated in departments, where they never had worked before." (Consultant responsible for department)

In continuation, consultants responsible for departments highlighted how the simulations helped ensuring a professional and calm working environment at the clusters. This is exemplified in the following quote by a consultant responsible of department who stressed how the simulations improved the working environment:

"When we started the in situ simulation the atmosphere in the department became calmer. The treatment of COVID-19 patients is actually fairly simple, and the simulations helped the healthcare professionals to realize that. The simulations help them practice the COVID-19 treatment and do some mistakes without jeopardizing patient-safety. It surely helps in order to calm the healthcare professionals and establish a very well-functioning department" (Consultant responsible for department)

The positive gains of in situ simulation were also emphasized in the following quote by another head of department that didn't received any COVID-19 patients, but still valued the simulations.

"This is surely something that we are going to use in the future (...) It has provided us with so much knowledge and teamwork. The content can be anything. It helped all of us because it is interdisciplinary and include experienced and unexperienced healthcare professionals." (Consultant responsible for department)

Design and facilitation of the simulations

The healthcare professionals highlighted the simulation facilitator as a key factor by being engaged in the scenario, ensuring fidelity, and securing a safety net by debriefing the simulations. The medical experts that facilitated the simulations also highlighted the collaboration with in situ simulation experts in order to establish psychological safety [17] and an optimal learning environment.

"It makes it a lot easier for me as a facilitator, when there is an experienced in situ simulation instructor conducting the scenarios together with me. In this way, I know that the educational elements are being taken care of in a professional manner" (Medical expert).

The presence of a medical expert and an educated simulation facilitator in each simulation secured the consistency among the facilitators. This is exemplified by one of the medical experts in the following quote:

"*The fact that we were two medical experts and one simulation expert to conduct all the in situ simulations in our department helped ensure consistency in the scenarios. A lot of the questions from the participants were the same and because we had daily meetings with the heads of the department, we knew what to answer. During the two weeks we spend all our working time conducting these simulations, which made us confident in reaching the learning goals and establishing a smooth facilitation of the simulations."* (Medical expert)

The informants in the present study called for the establishment of a simulation task force across the hospital in order to share knowledge between departments and develop expertise in designing, implementing, and facilitating the simulations.

"I would have benefited by ending each day with an afternoon meeting with all the simulation facilitators from the COVID-clusters across the hospital. The pandemic caused a lot of questions in addition to facilitating the simulations. For example, what happens if a COVID-patient with comorbidity needs to be transferred to another department? If all simulation facilitators made a small daily report and shared this with the other facilitators, we could ensure knowledge sharing across the hospital." (Medical expert)

Due to a lack of PPE, some simulations were conducted without the correct equipment in the initial phase of the simulation program. During the simulation programme the heads of departments realized the value of using the correct PPE, as explained in the quote below.

"The outcome of simulation went from good to better, when we started to use the correct PPE, as this required that the healthcare team worked fully together." (Consultant responsible for department)

Discussion

The interviews in the present study suggest that in situ simulation enhanced teamwork, helped demystify the COVID-19 disease, and provided the healthcare professionals with competences within correct use of PPE and acute treatment of COVID-19 patients.

Healthcare professionals previously exhibit concern about family transmission of infectious diseases, thus it seems reasonable if the COVID-19 pandemic had a negative impact on the healthcare professionals' perceived quality of work [18]. Based on the findings in the present study, it seems that in situ simulation can be a useful tool, when facing such a decrease in the perceived quality of work.

In medical education, Weller and colleagues (2014) investigated effective healthcare teams and found an unacceptable rate of errors due to lack of teamwork between healthcare professionals [19]. Consequently, they put forward seven interventions to overcome barriers to teamwork and team communication, including the use of simulation. Our study indicates that the informants experienced anxiety regarding the rapid spread of the COVID-19 virus. Furthermore, informants stated that in situ simulation made them feel more comfortable facing the task at hand i.e. by demystifying the treatment of the COVID-19 disease and enhancing teamwork, all in a safe educational environment.

The uncertainty due to COVID-19 is likely to add complexity to the clinical work. Thus, training of healthcare professionals seems key in order to reduce stress and form coping strategies. Our findings align well with the stress model

by Palmer and colleagues from 2003, as their model highlight professionals' training in order to face an increased complexity of work and decrease stress [20].

The hospital infrastructure seems influential when supporting the fundamental aim of wellbeing for all patients and delivering high standards of care [21]. This is supported by our findings, suggesting that learning occurred on an organization level as well as the individual level, as stated above. Systematic sharing of the insights, gained from the simulation, lead to changes in approaching COVID-19 patients in the isolation rooms, which reflects the organizational impact of the simulations. Similar findings are emphasized by Brydges and colleagues (2020), who advocate for the use of simulation when preparing for and responding to the early stages of the COVID-19 pandemic [10].

Simulation seems to have a potential in managing the global COVID-19 pandemic by rapidly facilitating hospital preparation and education of large numbers of healthcare professionals [7,22,23]. Wong and colleagues (2020) advocated for the use of in situ simulation in the beginning of the pandemic in order to test the preparedness of isolation rooms, however, they do not specifically highlight using a coordinated and centralized simulation team to ensure the development of a robust curriculum development, as Dubé et al. (2020) explicitly emphasize [6,24]. While the present study supports the use of simulation in a pandemic, the findings also reveal the need of coordinated planning across the hospital in order to secure that the learning goals of the simulation is reached. The coordination of simulation is highlighted by Brazil and colleagues (2020), who conducted an intervention similar to the one in the present study, orchestrated by a Simulation Service formally established across the hospital [25]. The setting in the present study would have benefitted from the establishment of a simulation task force including educated simulating and medical experts, in order to ensure that the pedagogical, didactical, and medical elements in the simulations where at the highest possible level. The main themes derived from the focus group interviews describe perception of in situ simulations from a variety of health care workers in an early stage of the pandemic. This timing seems important in understanding the need for simulation based educational activities prior to a health care crisis. However, due to the rapid development of the COVID-19 pandemic it was not possible to plan and organize the interviews in detail. Relatively few informants (n=3 in one group and n=4 in another) reduce the generalizability of the results in the present study. Furthermore, the circumstances did not allow us to conduct a study with objective assessment of skills learned e.g. an examination or practical test of what was learned. Nonetheless, the in situ simulations are suggested to decrease stress and improve teamwork among the healthcare professionals. Similar, the simulations may have improved the clinical skills of the participating staff. It has not been possible to conduct

a follow-up data collection in order to establish if demystification of the disease and decrease in stress still is present or new educational activities is needed.

Conclusion

In situ simulation may be useful to enhance learning on an organization level as well as the individual level during a pandemic. This educational activity could serve an important role in facilitating hospital preparation and education of large numbers of healthcare professionals during a pandemic. The establishment of a simulation task force is, however, suggested as in situ simulation across a hospital requires coordination and rapid enrolment in health care crises.

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Contributorship statement:

JJ and RDJ contributed with the idea of the study, collecting of data and the writing of the manuscript. BL, NT and LE contributed with collecting of data. GVE contributed with the idea of the study.

All authors read and approved the manuscript before submission.

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Competing interests:

There are no competing interests for any author

Data availability statement

No additional data are available.

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Figures:

Figure 1: COVID-19 Clusters, Aarhus University Hospital. March 2020 – isolationrooms

Figure 2: Description of simulated cases

Figure 1

COVID-19 Clusters, Aarhus University Hospital. March 2020 - Isolation rooms

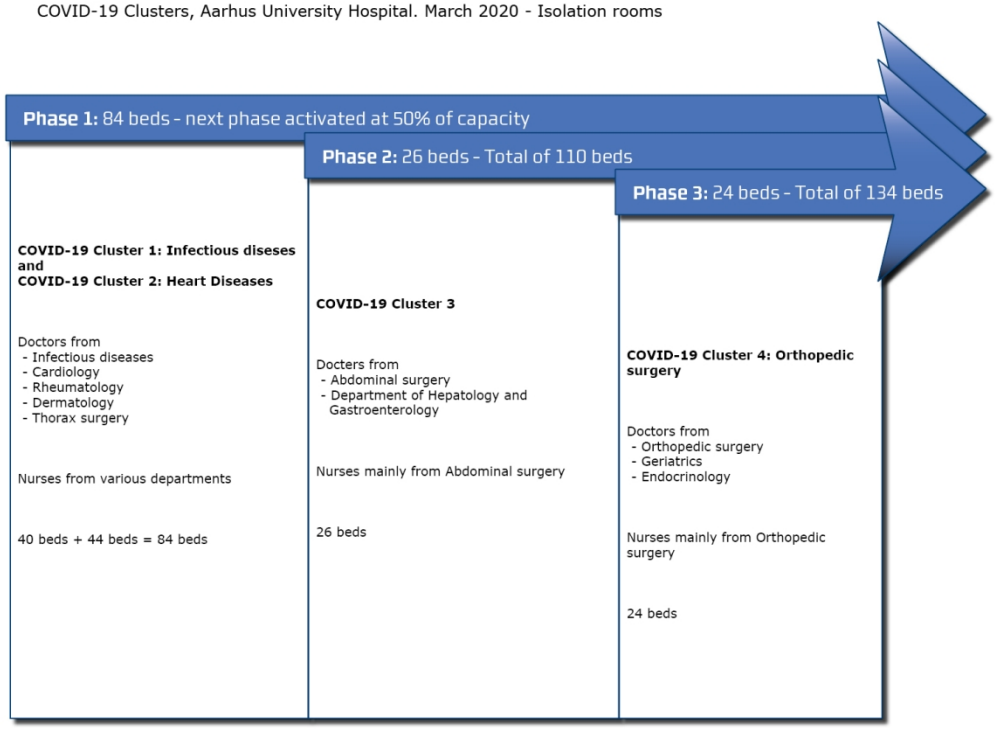

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Figure 2

Description of simulated cases

Cases	Background information	Case description	Clinical outcome	Learning objectives
Patient 1	75 years Known well-regulated arterial hypertension High level of function	Respiratory insufficient Covid-19 infected patient. Dependence on oxygen supplement and upright positioning of bed rail. Single-organ failure	Patient stabilization on COVID-19 medical ward (non-ICU)	1. Terms of ABCDE approach 2. appropriate use of PPE and medical equipment 3. transportation of equipment to/ from isolated patients
Patient 2	64 years Known dysregulated diabetes II and adipositas. High level of function	Severe respiratory insufficient Covid-19 patient. ABCD-unstabile. Septic shock/ central pulmonary embolism and multi-organ failure (occasionally extended with adjacent cardiac arrest)	Medical emergency call/acute transfer to ICU and mechanic ventilation (Advanced CPR if cardiac arrest)	1. Advanced ABCDE-approach to critically ill patient 2. Acute communication strategy and early call for assistance 3. Use of PPE when performing aerosol generating interventions 4. Reflection on indication for intensive care and resuscitation

529x529mm (72 x 72 DPI)

Interview topic guide

Timeframe	Topic	Examples of questions
0-15min	Being a health care professional during a pandemic	Please describe how it is to be a healthcare professional during COVID-19 How has COVID-19 affected your work life?
15-30min	In situ simulation as an educational tool when facing a pandemic	Please describe your experience of participating in the simulation? How has the simulations influenced your daily work?
30min-45min	Content of the specific simulated scenarios	What do you think of the contents of the simulation scenarios? If you were to adjust something in the simulations, please describe such adjustments. Also, would you like to add something to the simulations, if you were in charge? To what extent has the content in the simulation been relevant to your daily work in the department and the treatment of COVID-19 patients?
45min-60min	Outcome of the simulation	What is the outcome of the simulations? What did you learn from the simulations?
60min-75min		

	The educational impact of simulation during a pandemic	If you were in charge of the educational initiatives during a pandemic, what activities would you include? How would you prioritize these activities? Would you recommend your colleagues to engage in simulation activities during a pandemic?

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

	Page/line no(s).
Title and abstract	
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	L3
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	L55
Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	L86-99
Purpose or research question - Purpose of the study and specific objectives or questions	L98
Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	L168
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	L154/170
Context - Setting/site and salient contextual factors; rationale**	L151
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	L154
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	L178
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	L165

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	L151
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	L161
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	L170
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	L168-173
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	L173

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	L182-185
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	L191-267

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	L270-302
Limitations - Trustworthiness and limitations of findings	L302-314

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	L334
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	L332

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
DOI: 10.1097/ACM.0000000000000388