


INSTRUCTIVE CASE

Management of a suspected case of 2019 novel coronavirus infection in a 4-year old child: A simulation scenario

Alice Monzani,¹ Giulia Genoni ,² Marco Binotti,² Francesco Tagliaferri,¹ Ivana Rabbone¹ and Pier Luigi Ingrassia³

¹Division of Pediatrics, Department of Health Sciences, ³Centro Interdipartimentale di Didattica Innovativa e di Simulazione in Medicina e Professioni Sanitarie, SIMNOVA, University of Piemonte Orientale and ²Neonatal and Pediatric Intensive Care, Maggiore della Carità University Hospital, Novara, Italy

Case Report

In December 2019, a cluster of pneumonia cases, which were later proven to be caused by a novel coronavirus, named COVID-19, emerged in Wuhan City, Hubei Province, China.¹ By 5 May 2020, 3 606 038 confirmed cases have been reported globally, with 252 151 deaths. The infection is now spread in 189 countries, with Italy as the third country with most confirmed cases (211 938).² People of all ages are susceptible to COVID-19, even if the elderly and those with underlying chronic illnesses are more likely to develop a more severe disease.¹ Thus far, all paediatric cases with laboratory-confirmed COVID-19 infection tended to be milder, with only a few deaths reported.³ Despite the apparent milder clinical course of COVID-19 infection in the paediatric population, children should be addressed of urgent and careful management.⁴

Herein we present a case scenario that requires the correct approach to three main targets: the paediatric patient, the parents and the health-care workers, being the strict implementation of standard prevention an essential part of the working process. This simulation scenario was used at the SIMNOVA simulation centre, University of Piemonte Orientale, Novara, Italy, during a dedicated programme in the early phase of COVID-19 outbreak, aimed at training paediatric residents to handle suspected cases of COVID-19. The correct management of children with COVID-19 is crucial to limit the spreading of the infection to more

vulnerable family members, therefore playing a key role in a wider health policy perspective.

Materials and Methods

Preparation of the scenario

Monitors required: Thermometer, pulse oximeter.

Other equipment required: Paediatric patient simulator (SimBaby, Laerdal, Wappingers Falls, NY, USA), oxygen tank, nasal prongs, intravenous (IV) normal saline and giving sets, IV cannulas, drugs: paracetamol.

Supporting materials

- Chest X-ray: interstitial changes, mainly at the lung basis
- Labs: complete blood count (CBC), C-reactive protein (CRP), procalcitonin (PCT), blood gas analysis
- Throat swab

Time duration

Set-up: 15 min.

Preparation: 10 min.

Simulation: 15 min.

Debriefing: 45 min.

Case Stem

You are a paediatrician working at a university-based paediatric emergency department. You are visiting outpatients. A mother brings her 4-year-old child for fever, cough and breathing difficulty. A paediatric nurse is undergoing the triage in another room (Table 1).

Background and briefing information for facilitator/coordinator's eyes only

Participants are handed over the case of a 4-year-old girl brought by her mother for fever, cough and breathing difficulty. The first part of the scenario is the pre-triage where the paediatric nurse/learner should take a full medical history of the child, showing that the child went with her family to visit some relatives in Codogno, Lombardy area, 10 days before, and her aunt is now hospitalised for a COVID-19 infection. The paediatric nurse should promptly inform the paediatrician and the pre-triage should be completed in the 'red room', dedicated to patients with

Key Points

- 1 A disease-specific scenario for COVID-19 allows testing of local guidelines.
- 2 Learning personal protective equipment donning/doffing in a simulation scenario would be effective in the perspective of a just-in-time training.
- 3 A disease-specific scenario for COVID-19 could implement and test the management of a multi-disciplinary cooperation.

Correspondence: Dr Giulia Genoni, Pediatric and Neonatal Intensive Care Unit, Maggiore della Carità University Hospital, 28100 Novara, Italy. Fax: +39 03213733598; email: genonigiulia@gmail.com

Alice Monzani and Giulia Genoni equally contributed to the work.

Conflict of interest: None declared.

Accepted for publication 27 May 2020.

Table 1 Case scenario

State	Patient status	Student learning outcomes or actions desired and trigger to move to next state	
1. Baseline Location: Emergency department pre-triage	Patient is unmonitored Eyes open, alert Cough and tachypnoea	Learner actions: Asks the mother (embedded participant stay in room for the duration of the scenario) about child's full medical history (present and past) Invites the child and her mother to wear a surgical face mask	Operator: Fix the respiratory rate (RR) at 30, set the simulator on cough and bilateral crackles If learner does not communicate with the mother, the information about a close contact with a subject with COVID-19 proven infection is not given Teaching points: Early identification Application of current guidelines on recognition, diagnosis and management of COVID-19 infection Use available human resources Perform an accurate full medical history Signs and symptoms of paediatric acute respiratory disease Trigger: Medical history of 'close contact' + acute respiratory disease
2. Moving to the 'red room' Location: Isolation room, emergency department	Patient is unmonitored Eyes open, alert Cough and tachypnoea	Learner actions: Recognises patient is a suspected case of COVID-19 infection Wears personal protection equipment (PPE)	Operator: fix the RR at 30, set the simulator on cough and bilateral crackles If not previously required, the mother gives medical history information Teaching points: Early isolation Application of current guidelines on recognition, diagnosis and management of COVID-19 infection Learn how to wear PPE in strict accordance with the on-off procedure Triggers: Isolation completed
3. Monitoring established Location: Isolation room, emergency department	Blood pressure (BP) 90/65 mmHg Heart rate (HR) 125 bpm RR 30 SpO ₂ 95% Temperature (T) 38.5°C Cough, bilateral crackles Regular heart rhythm	Learner actions: Recognises patient has a mild respiratory distress, perform physical examination and establish a monitoring Asks for infectious medicine consultant's advice (embedded participant) Asks for CBC, CRP, PCT, blood gas analysis and chest X-ray	Operator: shows BP, HR, RR and SpO ₂ If learner does not ask for infectious medicine consultant's advice, the throat swab for COVID-19 real time (RT-PCR) is not made available Teaching points: Early diagnosis Application of current guidelines on recognition, diagnosis and management of COVID-19 infection Diagnosis of paediatric mild respiratory distress Crisis resource management Triggers: Physical findings The infectious medicine consultant arrives in the isolation room
4. Management of suspected COVID-19 infection Location: Isolation room, emergency department	BP 90/65 mmHg HR 130 bpm RR 35 SpO ₂ 94%	Learner actions: Reassesses the patient Starts treatment (O ₂ , IV glucoelectrolytic solution, paracetamol) Discusses with the infectious medicine consultant if performing the throat swab for COVID-19 RT-PCR and possible differential diagnosis Performs the throat swab for COVID-19 RT-PCR	Operator: If labs are requested, give laboratory values If not previously required, the infectious medicine consultant arrives in the isolation room Teaching points: Early treatment Application of current guidelines on recognition, diagnosis and management of COVID-19 infection Recognition of laboratory findings of COVID-19 infection Differential diagnosis of paediatric acute respiratory distress + interstitial pneumonia Correct execution of the throat swab for COVID-19 RT-PCR

(Continues)

Table 1 (Continued)

State	Patient status	Student learning outcomes or actions desired and trigger to move to next state	
			Crisis resource management Triggers: The throat swab for COVID-19 RT-PCR is positive
5. Management of confirmed COVID-19 infection Location: Isolation room, emergency department	BP 105/85 mmHg HR 100 bpm RR 28 SpO ₂ 97% T 37.8°C	Learner actions: Reassesses the patient Discusses and decides with the help of the infectious medicine consultant where to hospitalise the patient Discusses with the infectious medicine consultant what to do with the mother (asymptomatic + medical history of close contact with a positive case) Decides who the child should stay with	Operator: BP, HR, RR and SO ₂ increase Teaching points: Application of local (hospital) guidelines on hospitalisation of paediatric patients with COVID-19 infection Communication with parents Crisis resource management Trigger: The infectious medicine consultant performs the throat swab for COVID-19 RT-PCR to the mother, which is negative
6. End of the scenario	BP 115/90 mmHg HR 98 bpm RR 25 SpO ₂ 98% T 37.5°C	Learner actions: End of the scenario Stop simulation	Operator: BP, HR, RR and SO ₂ continue to improve Stop simulation and start debriefing

suspected infection. The first objective of the scenario is the prompt recognition of a suspected case of COVID-19 infection from the epidemiological history of a 'close contact' plus medical history of acute respiratory disease. Learners should promptly adopt all isolation measures: the child and her mother should be invited to wear a surgical face mask and the team should wear, in strict accordance with the on-off procedure, the personal protective equipment (PPE). The second objective of this simulated case is the correct application of the current guidelines on the management of suspected cases of COVID-19 infection.

After the correct identification of the suspected paediatric case, learners should evaluate the patient and call for the help of the infectious disease medicine consultant (embedded participant).

The patient shows dry cough, mild tachycardia, mild tachypnoea, oxygen saturation of 95% and a core temperature of 38.5°C. The learners should decide to deliver oxygen with nasal prongs and to administer paracetamol; adequate fluid support can be started. Following primary evaluation a basic blood count, CRP, PCT, blood gas analysis, and a chest X-ray can be requested. Nucleic acid testing by RT-PCR of throat swabs should be performed after discussing the case with the infectious disease medicine consultant. The RT-PCR will confirm the COVID-19 infection. The participants should then decide the Department of hospitalisation for the patient.

Patient Data, Background and Baseline State

Patient history

You are visiting outpatients at the emergency department. A mother brings her 4-year-old child for fever, cough, and breathing difficulty from 2 days.

Review of systems

Central nervous system: Alert.
Cardiovascular: Mild tachycardia.
Pulmonary: Mild tachypnoea.
Renal/Hepatic: Negative.
Endocrine: Negative.

Current medications and allergies

Medications: None.
Allergies: Not known.

Physical examination

General: Mild respiratory distress.
Weight: 18 kg.
VS: BP 90/65 mmHg, Pulse 125 bpm, RR 30 rpm, SpO₂ 95%, T 38.5°C.
Airway: Patent, no signs of airway obstruction. Mallampati 1, neck full range of motion.
Lungs: Tachypnoea, bilateral crackles.
Heart: Tachycardia, regular rhythm.

Laboratory, radiology, and other relevant studies

CBC: WBC $6.4 \times 10^9/L$, neutrophils 84%, lymphocytes 12%, PCR 0.82 mg/dL (reference value <1 mg/dL), PCT 0.3 ng/mL.
Chest X-ray: Interstitial changes, mainly at the lung basis.
Throat swab: Tested positive for COVID-19 nucleic acid using RT-PCR.

Discussion

This simulation case provides a way to test and implement procedures for prompt identification, isolation, and management of a suspected COVID-19 infection in a paediatric patient.

In the case of COVID-19, the proper adherence to guidelines often represents a challenge for frontline staff because they are different from usual procedures and rapidly evolving. Simulated cases offer the opportunity to practice using the most updated guidelines and identify issues that are preventing staff from adhering to them. Differently from medical simulation about well-established algorithms, we strongly recommend reviewing the most recent guidelines with learners before running the simulation.

The scenario offered the opportunity to discuss some essential aspects of a suspected COVID-19 case during the debriefing. The following technical skills were reviewed:

- Early identification, early isolation, early diagnosis, and early treatment are all essential and sequential steps to be fulfilled for the proper management.
- Proper donning/doffing of PPE. The team should be able to wear the PPE, in strict accordance with the recommended on-off procedure.
- In the contingency of COVID-19 outbreak, differential diagnoses in a paediatric patient with mild respiratory distress and fever should not be lost sight of and should be discussed with the learners.

The case also offered insights to test important non-technical skills.

- Clear role definition and communication between team members, with the peculiarity of a multi-disciplinary staff.
- Call for the help of the consultant. This resource should be promptly used, in order to discuss with the consultant the timely isolation of the patient and the best options for the hospitalisation, according to local guidelines.
- Effective communication with the child's parent, aimed at collecting essential information about possible sources of infection and at providing clear notions about isolation procedures, in a reassuring but firm way.

When we ran this simulation scenario at the SIMNOVA simulation centre, we showed, from a technical point of view, an improvement in the rapidity and appropriateness of PPE wearing procedures as the learners repeated the scenario. The implementation of the skills in PPE use is of paramount importance to prepare health-care workers to proficiently and safely work departments dealing with suspected COVID-19 cases. Actually, an extremely high rate of secondary infections among health-care workers has been reported in Italy, suggesting inadequate infection control protections in clinical practice. Simulated scenarios could fulfil the need for a just-in-time training, preferably if precociously implemented. In this regard, it would be particularly useful in Countries not already critically involved in the pandemic, and to address not only residents but also paediatric

emergency practitioners, in the front line of the management of suspected COVID-19 cases. Moreover, this simulation scenario offers the opportunity to test how the most updated guidelines fit with the local resources and personnel. Regarding crisis resource management and teamwork, it matches the opportunity to stress some organisational clues that are typical of uncommon and stressful situations and to identify latent safety threats, including fixable problems with teamwork, systems issues and adherence to guidelines.

The design of this scenario was mainly based on the principles of Kolb's Theory of Experiential Learning⁵ and andragogy.⁶ Actually, we aimed to apply experiential learning along with critical reflection, in order to increase residents' engagement in simulation, assist them in discovering strengths and weaknesses and in gaining self-confidence. We used a true-to-life simulated clinical setting, trying to replicating the reality of the workplace, even if it was not possible to provide an *in-situ* simulation, due to the critical involvement of the emergency departments during COVID outbreak. Finally, we aimed to provide a good-judgmental and non-threatening learning environment, in order to reduce residents' anxieties and stress and to encourage sharing of thought and ideas. Indeed, it is known that residents' engagement and interest in simulation education is high, particularly because simulation could represent the way to move from a culture of blame around an error to a new culture of safety, where errors are disclosed in the debriefing.^{7,8}

In conclusion, this scenario aims at providing a holistic training exercise to prepare paediatric residents and physicians for practice in the challenging settings of COVID-19 outbreak but can be easily used for any highly contagious respiratory disease training.

References

- 1 Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet* 2020; **395**: 470–3.
- 2 World Health Organization. *Coronavirus Disease 2019 (COVID-19) Situation Reports*. Geneva, Switzerland: World Health Organization. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/> [accessed 5 May 2020].
- 3 Cai J, Xu J, Lin D *et al.* A case series of children with 2019 novel coronavirus infection: Clinical and epidemiological features. *Clin. Infect. Dis.* 2020; pii: ciae198.
- 4 Shen KL, Yang YH. Diagnosis and treatment of 2019 novel coronavirus infection in children: A pressing issue. *World J. Pediatr.* 2020: 1–3. <https://doi.org/10.1007/s12519-020-00344-6>.
- 5 Kolb DA. *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice Hall; 1984.
- 6 Kearsley G. *Andragogy (M. Knowles). The Theory into Practice Database*; 2010. Available from <http://tip.psychology.org>
- 7 Savoldelli GL, Naik VN, Hamstra SJ, Morgan PJ. Barriers to use of simulation based education. *Can. J. Anaesth.* 2005; **52**: 944–50.
- 8 Binotti M, Genoni G, Rizzollo S *et al.* Simulation-based medical training for paediatric residents in Italy: A nationwide survey. *BMC Med. Educ.* 2019; **19**: 161.