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Guy A. Richards
Charles L. Sprung

Chapter 9. Educational process

On behalf of the European Society of Intensive Care Medicine's Task Force for Intensive Care Unit Triage during an Influenza Epidemic or Mass Disaster.

G. A. Richards
Charlotte Maxeke Johannesburg Hospital, University of the Witwatersrand, Johannesburg, South Africa

C. L. Sprung (✉)
Department of Anesthesiology and Critical Care Medicine, Hadassah Hebrew University Medical Center, Jerusalem, Israel
e-mail: charles.sprung@ekmd.huji.ac.il

Abstract *Purpose:* To provide recommendations and standard operating procedures (SOPs) for intensive care unit (ICU) and hospital preparations for an influenza pandemic or mass disaster with focus on education of all stakeholders, specifically the emergency executive control groups, ICU staff and staff co-opted to assist with patient management. *Methods:* Based on a literature review and expert opinion, a Delphi process was used to define the essential topics, including staff education. *Results:* Key recommendations include: (1) define functional roles and responsibilities of the internal personnel and interface agencies or sectors; (2) determine logistic support and requirements necessary for the effective implementation of the SOPs; (3) determine what is required to maintain the SOPs; (4) recommended training and activities include: (a) personal protection techniques; (b) environmental contamination; (c) medical management; (d) laboratory specimens; (e) alert lists; (f) training of recruited staff; (g) ethical issues; (h) psychosocial issues; (i) dealing with the deceased; (j) policies for restricting visitors; (k) mechanisms for enforcing policies; (5) Training should begin as soon as possible with daily demonstrations followed by supervised practice; (6) identify the staff to participate in training programs, verify that they have participated and evaluate their knowledge subsequently. *Conclusions:* Judicious planning and adoption of protocols for staff education are necessary to optimize outcomes during a pandemic.

Keywords Education · Recommendations · Standard operating procedures · Intensive care unit · Hospital · H1N1 · Influenza epidemic · Pandemic · Disaster

Introduction

The mortality of a pandemic due to a highly pathogenic influenza such as H1NI or H5N1 will ultimately be determined by the interaction of viral factors such as pathogenicity, infectivity and resistance to antivirals, patient factors such as age, immune status and genetic profile, and therapeutic factors such as the quality of health care services, the availability of intensive care units (ICUs), antivirals and, most importantly, vaccines. The quality of health services will depend upon appropriate preparation as well as the availability of a national protocol [1, 2] and an informed and committed staff complement both at an administrative and clinical level. Current ICU staff and critical care infrastructure will be inadequate for the expected influx of patients even in the best equipped hospitals. Calculations in the UK estimate that there will potentially be ten times as many patients requiring mechanical ventilation as the number of beds available, and the mortality and the need for specialized care will be that much greater in developing countries where resources are most constrained [3].

Staff availability must be maximized. With proper prior education, more staff will be available. More will avoid falling ill, will feel more confident that everything possible had been done to ensure their safety and more will perceive that it is their ethical duty to remain at work. In addition, each hospital will have to formulate a triage plan prior to the onset of a disaster or pandemic that should take into account local resources in terms of staff, space and equipment, and this plan will have to be taught and communicated to the appropriate hospital staff (See Chap. 7, Critical care triage). Mass care facilities in close proximity to the triage area must be planned and staff trained as to where these will be and how these areas should be managed (see Chap. 2, Surge capacity and infrastructure considerations). Changing areas have to be provided external to the treatment area where appropriate protective gear can be donned and removed (see Chap. 6, Protection of patients and staff). All staff must be aware of the designated areas allocated for management of ICU patients and must be trained in procedures best designed to contain the infection by the use of a standard management guide. Relevant ethical issues must also be discussed and explored prior to a pandemic. These include issues such as triage, admission and discharge criteria and absenteeism, all of which should be addressed, written down and agreed to, so that each staff member understands in advance the choices that will have to be made. Decision makers and the public should engage in these discussions in order that ethical decisions reflect what most people will accept as fair and good for public health.

Purpose, scope, goals and objectives

Whereas mortality will be inevitable, this can be reduced by adequate preparation not only with regard to the availability of an appropriate physical environment and sufficient equipment and staff, but also by education and training of the most valuable resource of an ICU, the human component.

The purpose of this standard operating procedure (SOP) is to define the education and training necessary within the hospital environment that should help ensure efficient functioning of the ICU. This does not necessarily apply only to ICU staff, as ward and emergency room staff will also be required to be involved in triage and will in many cases be treating patients that in normal circumstances would be admitted to the ICU.

Specific goals

1. To identify specific areas requiring training and education in each hospital. These include:
   a. Procedures that are high risk for disease transmission
   b. The use of personal protective equipment
   c. The use of equipment by staff not usually involved in ICU practice
   d. The handling and management of specimens
   e. Transport of patients in and out of ICU
2. To identify the staff that require training in the performance of these procedures
3. To ensure that a command structure is established that is aware of and trained in crisis management procedures
4. To train all staff as to the nature of the command structure

The key elements of training and education preceding an influenza pandemic are the following:

1. The disease and its implications for hospitals and staff
2. Occupational health of staff
3. Pre-ICU triage
4. Professional responsibilities of currently available staff and of those delegated to assist ICU staff when redeployed
5. Training with regard to medical management of patients
6. Ethical responsibilities
7. Case reporting (for influenza pandemic surveillance and response purposes)
8. Psychological support for patients and relatives
9. Visiting restriction policies

Basic assumptions

1. Current hospital capacity will be exceeded in terms of currently trained staff, equipment and space.
2. There is a need to increase capacity appropriate to anticipated demand.
3. Routine procedures and transport of patients out of the ICU can result in disease transmission.
4. High-risk procedures will be limited to those that are absolutely necessary.
5. Transport and movement of patients should be restricted according to developed protocols.
6. Education and training will reduce disease transmission.

Lines of authority (see Chap. 3, Coordination and collaboration with interface units, and Chap. 7, Critical care triage)

1. Hospital Emergency Executive Control Group (HEECG): A central hospital operations center with

executive responsibility for the overall management of the crisis within the hospital.
2. ICU Emergency Executive Control Group (ICU-EECG): An ICU operations center with executive responsibility for the overall management of the crisis within the ICU. This group or its representatives should have direct access to the HEECG.
3. Triage Officer: Senior intensivist chosen from the ICU staff who has demonstrated leadership and communication skills.
4. Doctors: overall responsibility for ICU services should fall to the ICU director, other intensivists, intensive care trainees and doctors recruited to help care for the critically ill.
5. Nurses: Overall responsibility should fall to the ICU charge nurse, and training in ICU procedures should fall to the nurse educator. Observation of ICU nurses by recruits prior to the event would be invaluable as an introduction to the basic duties of the ICU nurse.
6. Training and education is the overall responsibility of the HEECG who should delegate this to those most knowledgeable in each specific sphere: infection control, medical management, triage, occupational health, etc.

Concepts of operations

Training should begin as soon as possible followed by supervised simulations to ensure optimal use of available facilities and to minimize infection [4]. PP techniques and reduction of environmental contamination should preferably be taught by infection control staff with assistance from ICU directors [5]. Interventions aimed at changing clinical practice show that outreach visits, posted reminders, interactive educational meetings and other multifaceted interventions are effective, but in the event of a pandemic, time constraints and potential lethality of the disease may be limiting factors [6]. Seminars, on-site demonstrations, problem-based learning and simulations are valuable when time is of the essence. In the SARS epidemic, use of a simulator allowed effective training of 275 workers in 2 weeks [7–9].

Teleconferencing involving clinicians and representatives from public health, infection control, infectious diseases, hospital administration and government together with website dissemination of instructional materials is useful to update knowledge during a pandemic [10–12]. A curriculum is available from the European Network of Infectious Disease to use as a guide for staff training [13].

Knowledge and compliance with PP protocols are poor, and consequently knowledge should be re-evaluated frequently [14]. Although an element of coercion is frequently necessary [15, 16], reasons for poor compliance should be addressed. These include availability of appropriate equipment, quality of leadership and an organizational culture that promotes safety [17]. These factors also reduce psychological stress by inspiring confidence [18].

Education must involve all current ICU staff: those selected to be recruited to the ICU or who will be performing critical care tasks outside of the ICU and those who are responsible for triage. Education should be planned to take place on an ongoing basis and involve all staff for certain activities and specific training sessions for specialized operations. Staff that are to be co-opted must be identified early and taught practices specific to their new roles. The administration should identify the staff to participate in training programs, verify that they have participated and evaluate their knowledge frequently.

Functional roles and responsibilities of the internal personnel and interface agencies or sectors

1. Administrative Staff (ICU and Hospital Emergency Executive Control Groups): should be trained with regard to:
   a. The disease and its implications for the hospital and staff
   b. The development and dissemination of protocols for pre-ICU triage
   c. Sourcing of guidelines for the management of a pandemic
   d. Occupational health issues
   e. Sourcing of and ensuring uninterrupted access to vaccines (seasonal and pandemic), antivirals, personal protective equipment (PPE), antibiotics, ventilators, etc.
   f. Identifying where additional staff may be sourced from and where and how they should be trained to fulfill their new duties
   g. Provision of areas in which patients will be managed and the training of staff to prepare these areas
2. All staff must be trained with regard to:
   a. The disease and its implications for hospitals and staff
   b. Infection prevention and control
   c. Pre-ICU triage
   d. Professional responsibilities of currently available staff and those delegated to assist ICU staff
   e. Ethical responsibilities including responses to unjustified absenteeism
3. Emergency department staff must be trained and educated in:
   a. Triage protocols

   b. Treatment strategies for those deemed to be well enough for outpatient therapy and initial therapy for those that are admitted
4. ICU doctors and nurses:
   a. Must be aware of triage and treatment protocols (see Appendix)
   b. Admission and discharge policies
   c. Medical management
   d. Visiting policies
   e. Infection control practices specific to the ICU

Logistics support and requirements necessary for the effective implementation of the SOPs

1. Staff structure capable of expansion
2. Pharmaceutical services
3. Laboratory services
4. Linen and washing services
5. Infection Control services
6. Infrastructural support
7. Equipment supplies
8. Training materials (trainers' guidelines and tools)

Maintenance of standard operating procedures

1. Training programs must be initiated as soon as possible and knowledge evaluated regularly.
2. Education and training should be an ongoing process and ICUs should participate in unit-specific exercises to maintain competence in specific areas.
3. SOP should be reviewed annually for revision and update by the ICU and Hospital Emergency Executive Control Groups.

Recommended training and activities

Establish a schedule for training and education of clinical staff and a mechanism for documenting participation. Utilize weekly infection control updates and meetings, medical grand rounds and educational posters (Fig. 1, CDC poster) as opportunities for training on pandemic influenza. ICU staff should be trained by the most appropriate person available for the task. This will not necessarily be the same person in each hospital or for each activity. Personal protection and environmental control should usually be taught by the infection control officer, medical management by the ICU consultants, laboratory specimens by the laboratory staff and the ethics and psychological activities by psychologists or ethicists if available. Visiting policies and dealing with the deceased should be the responsibility of the HEECG and the ICUEECG.

Training for recruited staff should be less stringent than that for ICU staff. ICU staff and specifically the clinical tutor should be responsible for the training.

Personal protection

1. Staff must be taught: [19, 20].
   a. Correct personal hygiene (hand washing, avoid touching the face, eyes or masks, unprotected coughing and kissing on greeting)
   b. The use of N95 masks such that there is a proper facial seal [it is advisable that facial hair is removed. If staff cannot comply because of religious reasons they should be restricted from direct contact with infected patients unless appropriate full face high efficiency particulate air (HEPA) filtered masks are available]. These should be changed whenever exiting the treatment area.
   c. How to don and remove gowns, disposable gloves and protective glasses so that there is maximal protection and minimal exposure
   d. Proper disposal of clothing and any other contaminated items
   e. Monitoring of staff health: temperature monitoring twice daily and what to do if a staff member becomes ill

Medical management [21] (see Appendix)

Staff must be trained in and protocols developed for:

1. Drug treatment [22]: The use of anti-viral medications must be taught with reference to:
   a. The medications available
   b. Dose and timing of treatment (unit-specific policies should be developed)
   c. Prophylaxis (whether prophylactic therapy will be provided and the type of therapy that will be available must be pre-determined by virologists and medical staff according to availability and practicality prior to the pandemic and these decisions must be communicated to all staff)
   d. The priorities for use of anti-viral medications
2. Ventilation [23]
   a. Basic respiratory support
      i. Non-invasive ventilation,
      ii. Mechanical ventilation (see Appendix)
   b. Rescue strategies
3. Vaccination [5, 24, 25]

There is frequently a reluctance to utilize both seasonal and pandemic vaccines. All staff must be educated

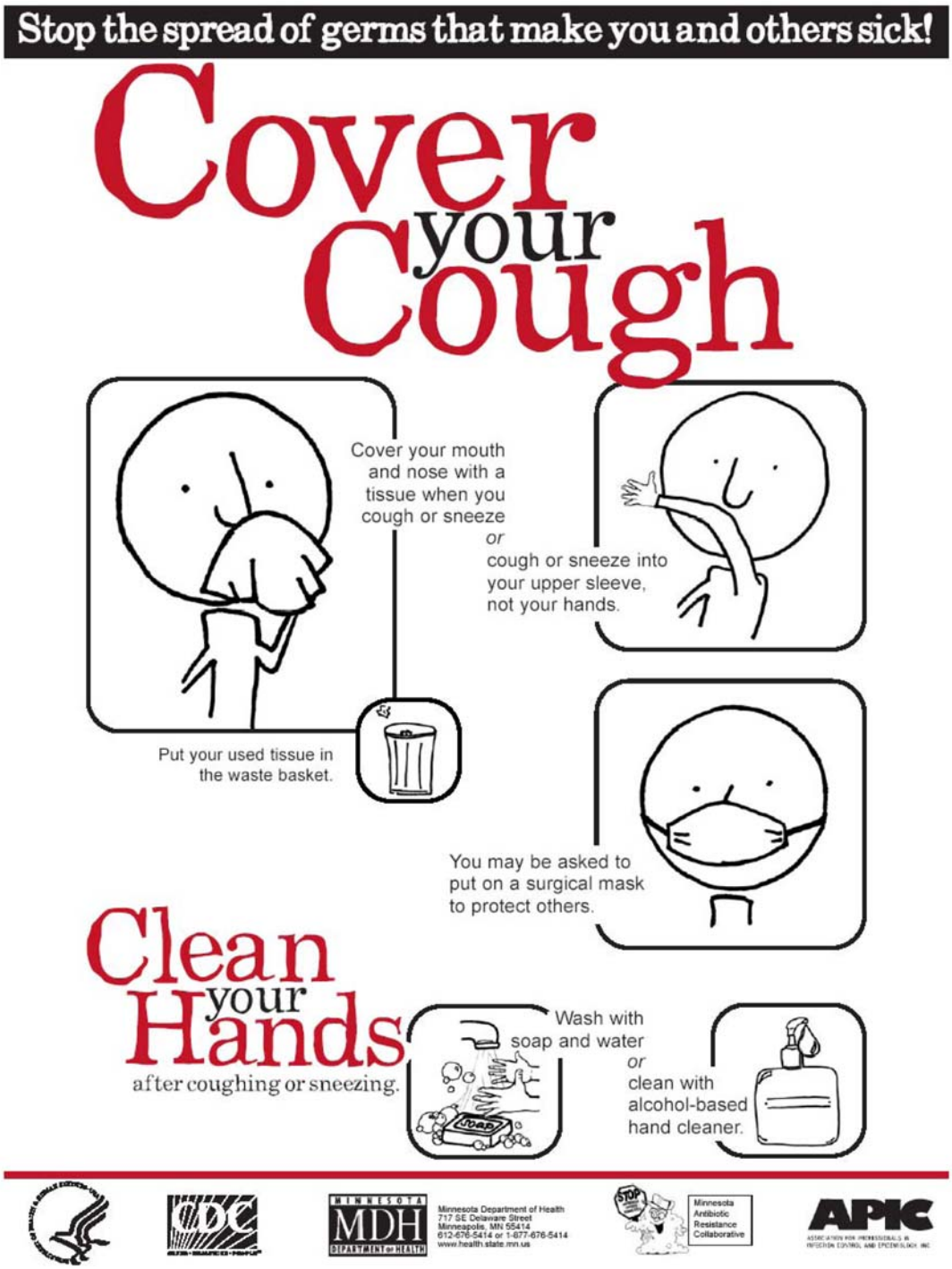

Fig. 1 Stop the spread of germs that make you and others sick! (Courtesy of CDC)

regarding the necessity for vaccines to protect both themselves and those that they are in contact with. As many people as possible must be vaccinated as quickly as possible as soon as a vaccine is available. There are five initial target groups for vaccination efforts (pregnant women, persons who live with or provide care for infants aged <6 months, health care and emergency medical services personnel, children and young adults aged 6 months to 24 years and persons aged 25–64 years who have medical conditions that put them at higher risk for

influenza-related complications). Subsets within the initial target groups in the event that initial vaccine availability is unable to meet demand must be identified along with guidance on the use of vaccine in other adult population groups as vaccine availability increases. (http://www.cdc.gov/flu).

4. Fluids and nutrition
5. Antipyretics/analgesics
6. Use of unproven therapies: statins, corticosteroids, vitamins, activated protein C
7. Palliative care

Environmental control

1. Staff must be taught to decrease environmental contamination
   a. Ventilators should have correct specification mechanical, pleated filters/heat moisture exchange (HME) at catheter mount and exhalation port [26]
   b. Appropriate disposal of organic and inorganic waste
   c. Appropriate decontamination of floors, beds and respiratory equipment

Laboratory specimens

Staff must be taught appropriate management and transport of laboratory specimens. Management of laboratory specimens must be pre-planned in cooperation with the laboratory. Constant and ongoing communication with laboratory staff is vital, and channels of communication must be established early.

Alert lists

It is recommended that a list of specific signs indicating clinical deterioration be established and clearly displayed, indicating specific warning signs that necessitate transfer to a high-care area.

Training of non-ICU staff

1. Non-ICU staff must be allocated specific tasks that are within their capacity. Complete syllabi are available [10]. Tasks should be assigned and taught according to need. Ability to record blood pressure, pulse, respiratory rate, oxygenation, fluid intake and output, suctioning and attention to pressure sites are a minimum requirement. Palliative care and monitoring of noninvasive and mechanical ventilation should be considered.
2. Recruits should also be trained to institute a nutritional program.
3. Some staff should be able to care for patients receiving non-invasive and mechanical ventilation with particular attention to the FAST HUG (Feeding; Analgesia and Sedation; Head up; Ulcer prophylaxis; Glycemic control) [27] protocols plus suctioning and attention to pressure sites.

Ethical issues [28]

1. Individual liberty and autonomy: In a public health crisis, restrictions to individual liberties and autonomy may be necessary to protect the public from serious harm. This includes quarantines, duty hours, restricted access of staff to their families, visiting restrictions, etc.
2. Duty to provide: Providers will have to weigh demands of their professional roles against other competing obligations to their own health and to family and friends. Moreover, health care workers will face significant challenges related to resource allocation, scope of practice, professional liability and workplace conditions. These codes or statements should cover such issues as:
   a. How much risk should health care workers be required to take;
   b. Their duty to care for the sick and to care for themselves so they can continue to provide care; and
   c. Their duty not to harm others by transmitting disease.
3. Instruction in triage procedures for allocating scarce resources (including treatment protocols, nonbeneficial treatment, allocation of vaccines and antiviral medicines, ventilators and intensive care) [29–31].

Psychosocial issues

1. Staff should understand and be taught to deal with stressors related to pandemic influenza:
   a. Signs of distress;
   b. Traumatic grief;
   c. Psychosocial aspects related to the management of mass fatalities;
   d. Stress management and coping strategies;
   e. Strategies for building and sustaining personal resilience;
   f. Behavioral and psychological support resources;
   g. Strategies for helping children and families in times of crisis; and
   h. Critical incident stress debriefings.

Dealing with the deceased

Protocols to remove corpses rapidly must be developed and specific staff allocated to this task. This will require

liaisoning with mortuary staff, and sufficient space must be provided for this purpose; otherwise this could represent an important bottleneck.

Policies for restricting visitors and mechanisms for enforcing these policies

Policies must be in place such that staff is aware of how to manage visitors and what restrictions will be in place. This overlaps with ethical issues as in a high mortality pandemic it will be necessary to separate families and to restrict access to loved ones in the interests of staff safety and society as a whole.

Community education

Educational materials to reduce community spread should be available for distribution to all that enter the hospital. Plentiful material is available on the CDC (http://www.cdc.gov/H1N1FLU/) and WHO (http://www.who.int/csr/disease/swineflu/en/) websites. The public should also be informed that usual treatments may be impossible to deliver and treatments may have to be triaged, but this should be communicated without creating unnecessary panic.

Conflict of interest statement Dr. Richards lectured and consulted for Roche.

Appendix: Treatment protocol examples for patients with influenza and severe acute respiratory infection

A (H1N1) severe disease: SARI (severe acute respiratory infection) in adults [32]

Some cases of A (H1N1) have had an initial typical influenza-like illness (ILI) with high fever followed 4–5 days later by rapid deterioration and severe respiratory disease. The virus is potentially more virulent than thought in that it can infect the lungs, similar to the 1918 virus [33]. (H1N1 replicated efficiently in the lower respiratory tracts of mice, ferrets and non-human primates, whereas seasonal virus seasonal virus did not.)

Complications in those seriously ill with A (H1N1) pandemic influenza include [32, 34]:

1. Primary viral pneumonitis progressing to ALI (PaO_2/FiO_2) ratio <300 or ARDS (PaO_2/FiO_2 ratio <200).
2. Secondary bacterial infection with *Staphylococcus aureus* and *Streptococcus pneumoniae*. Both infections may be severe, rapidly progressive and necrotizing.
3. Pulmonary emboli and a hypercoaguable state have been noted, particularly in the obese.
4. Rhabdomyolysis with renal failure.
5. Myocarditis.
6. Worsening of underlying conditions such as asthma, renal and cardiovascular disease.
7. Some patients may progress to MODS.

Those at risk for severe disease are those with:

a. Comorbid disease: diabetes, chronic renal failure, COPD, asthma, left ventricular dysfunction
b. Obesity appears also to be a risk factor
c. Pregnancy
d. Immunosuppression (anecdotally the acquired immunodeficiency syndrome does not seem to confer increased risk).

SARI: Clinical [35]

Any patient with the following features must be treated as having severe disease:

Sudden onset of fever (>38°C), cough/sore throat AND respiratory rate >30; chest crackles; saturation <90, lethargy, decreased level of consciousness, convulsions, dehydration or X-ray features of pneumonia.

Any patient, particularly young and otherwise healthy presenting with a lower respiratory tract infection, particularly pneumonia, must be initiated on antiviral therapy immediately without awaiting the results of the polymerase chain reaction test.

SARI: Management

- Health care workers (HCWs) should:
  - Take the seasonal vaccine if pandemic vaccine is not available [36] [there appears to be partial protection from H1N1, and if a HCW should become ill with an ILI it is more likely to be A (H1N1)].
  - Monitor temperatures twice daily. Fevers should be reported, and if present, those staff members should confine themselves at home.
  - If a staff member becomes unwell, treat with oseltamivir.
  - Droplet and contact precautions. N95 respirators on contact with patients [37].
- Pharmacotherapy:
  - Antivirals: Neuraminidase inhibitors—oseltamivir (Tamiflu) or zanamavir (Relenza)—should be used for treatment.
  - Dose of oseltamivir should be at least 150 mg BID for 10 days [22].

- Dose of zanamivir is 10 mg BID via diskhaler for 10 days. Two doses should be taken on day 1 provided there is at least 2 h between doses.
- There is no evidence that both agents together make a difference, but where there is potential resistance it may be of value.
- Administer antibiotics as per local community-acquired pneumonia guidelines: amoxicillin/clavulanate OR second or third generation cephalosporin PLUS macrolide, such as azithromycin of clarithromycin.
- Anecdotal reports indicate that atorvastatin 80 mg daily may reduce inflammation [38, 39].
- Corticosteroids: Not effective in H5N1. It is not known if there is efficacy in H1N1, but anecdotally there is no benefit.

- Mechanical ventilation [23, 40–44]: most patients are ventilated for hypoxia due to primary ARDS

  - Intubation and infection control: The most experienced operator should do the intubating [45, 46].
  - Intubate with fitted N95 respirators and goggles or visor.
  - Ensure that there is a heat moisture exchanger capable of filtering viruses at the catheter mount and a pleated hydrophobic filter at the exhalation port of the ventilator.
  - Suctioning must only be performed with N95 respirators, gowns and gloves.
  - Avoid contact of the hands with mouth, eyes and mucous membranes.

- Ventilation may be extremely difficult and represents a balance between management of hypoxia and ventilator-induced lung injury:

  - Initiate with pressure control with a PEEP of 8–10. On occasion higher levels may worsen hypoxia, particularly if the patient is already fully recruited. High PEEP is also associated with the potential for VILI (macro and micro) particularly if TV >6ml/kg ideal body weight and peak pressure >30 cm H_2O;
  - Maintain driving pressure at 14–18 cm H_2O;
  - Tidal volume: 6 ml/kg ideal body weight;
  - Peak pressure: ≤30 cm H_2O.

If hypoxia worsens increase FiO_2 initially then if still low:

- Paralyze
- Avoid fluid overload. (There should be no peripheral edema.)
- Recruitment maneuvers (sustained administration of pressure, proning, APRV) may be of benefit:
- Prone positioning should be considered early, within 8–12 h of admission if hypoxia persists despite the measures above. If hypoxia improves with prone positioning, there are two options:

  1. The patient could be maintained prone for 16 h prior to turning supine again with repeated changes to prone position for at least 16 h on each occasion. This is optimally performed between 1500 and 1600 with return to supine between 0800 and 0900, leaving the period from 0800–1600 supine for necessary procedures.
  2. Alternatively, proning may be maintained for prolonged periods of time, up to 3–5 days, provided that pressure points are cared for with turning to supine only for procedures.

- HFOV has been beneficial in certain circumstances.
- If facilities exist, there is the option of ECMO [47] or administration of NO.
- Persistent hypoxia for weeks is frequent even after inflammatory markers decline to normal and the infiltrates start to clear. It is not known what causes this hypoxia. (PaO_2 of >40 mmHg sat >70% is acceptable, and it is not beneficial to use ventilatory parameters likely to cause lung injury in an attempt to increase oxygenation above these values.)
- Corticosteroids are not of benefit.
- It may be worthwhile to administer omega 3 fatty acids via nasogastric tube and atorvastatin 80 mg daily [39].

Abbreviations

SARI	Severe acute respiratory infection
ALI	Acute lung injury
APRV	Airway pressure release ventilation
ARDS	Acute respiratory distress syndrome
COPD	Chronic obstructive airways disease
ECMO	Extra-corporeal membrane oxygenation
FiO_2	Inspired fraction of oxygen
HFOV	High-frequency oscillatory ventilation
ILI	Influenza-like illness
MODS	Multiple organ dysfunction syndrome
NO	Nitric oxide
PaO_2/FiO_2	The ratio of the partial pressure of arterial oxygen to the inspired fraction of oxygen
PEEP	Positive end expiratory pressure
VILI	Ventilator-induced lung injury

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