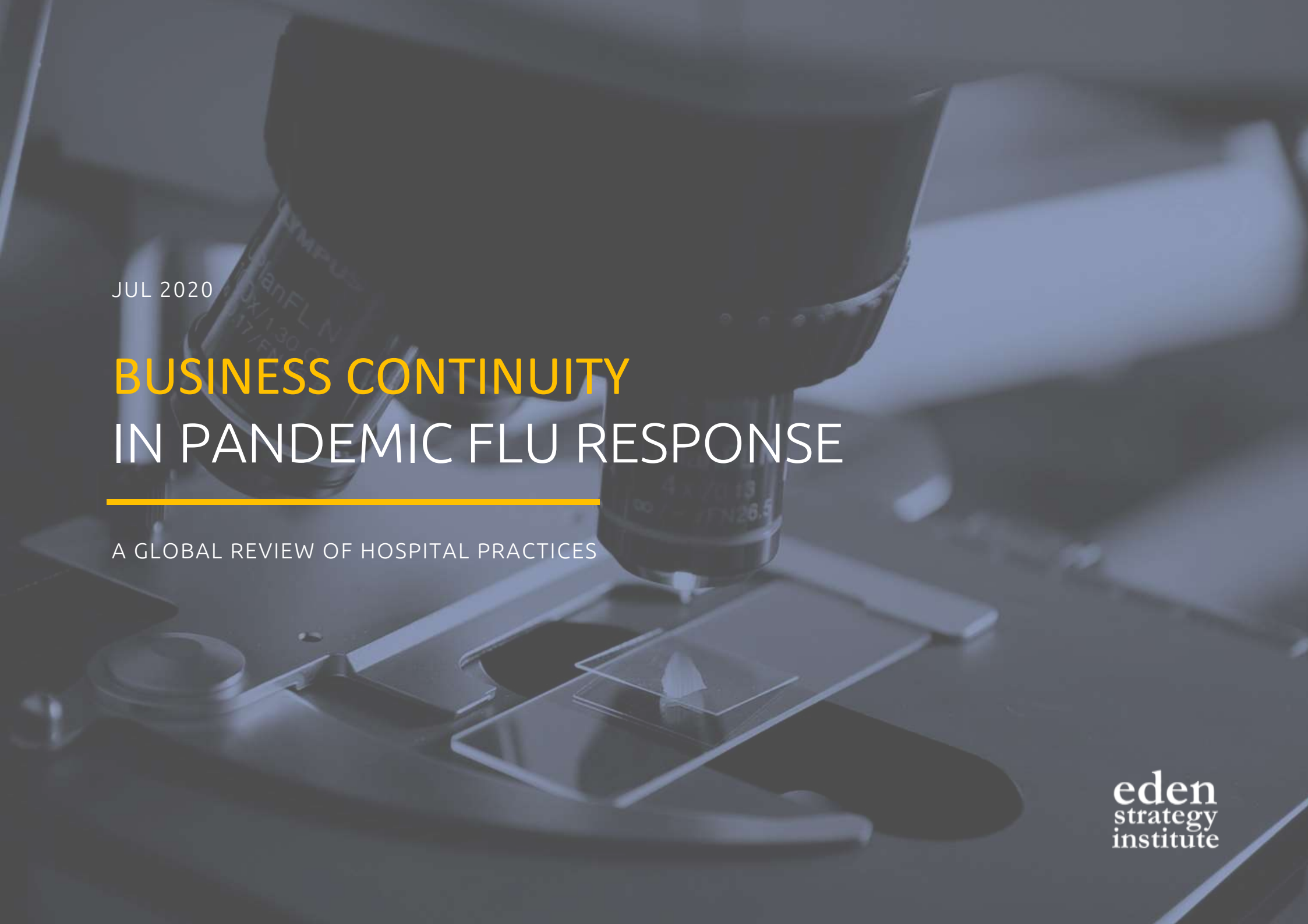


JUL 2020

BUSINESS CONTINUITY IN PANDEMIC FLU RESPONSE

A GLOBAL REVIEW OF HOSPITAL PRACTICES

eden strategy institute

ABOUT EDEN STRATEGY INSTITUTE

Eden Strategy Institute is a strategy consulting firm specializing in Business System Innovation. Eden's Healthcare Capabilities Practice helps healthcare providers, policymakers, and medical technologies firms such as GE Healthcare, InterSystems, and Medtronic in their business resilience with better planning, capability development, and impact analysis. Our other Practice Areas include Smart Cities, Education Innovation, the Emerging Middle Class, Public Service Transformation, and The Fourth Sector.

To learn more about our work, please visit edenstrategyinstitute.com or contact us at query@edenstrategyinstitute.com.

Singapore
1 Fusionopolis Way
#05-15 Connexis North Tower
Singapore 138632
+65 8188 8275

United States
447 Broadway
2F #243
New York 10013
+1 212 203 2688

Malaysia
2a Jalan Stesen Sentral 2
37-02 East Wing Level 37 Q Sentral
50470 Kuala Lumpur
+ 60 3 2935 9201

Australia
Perth PO Box 77
Scarborough WA 6019
+61 86102 3555

eden strategy institute

TABLE OF CONTENTS

TABLE OF CONTENTS 3
EXECUTIVE SUMMARY 4
INTRODUCTION 6
I. BACKGROUND 6
II. OBJECTIVE 7
III. METHODOLOGY 8
IV. GUIDE TO USING THIS DOCUMENT 11
INSIGHTS FROM INTERNATIONAL PRACTICES 15
I. THREAT OF PANDEMICS ON BUSINESS CONTINUITY 15
II. SECTORAL RESPONSE 16
III. REVIEW OF HOSPITAL FUNCTIONAL BUSINESS AREAS 22
1. Logistics 23
2. Human Resources 38
3. Operations 52
4. Communications 76
5. Legal 87
6. Finance 102
IV. REVIEW OF DEPARTMENT-SPECIFIC PRACTICE AREAS 107
1. Hospital Clinics 108
2. Emergency Department 121
3. Isolation Ward 138
4. Intensive Care Unit 150
5. Hospital Lab 173
6. Epidemiology 181
SINGAPORE'S RESPONSE TO THE COVID-19 PANDEMIC 191
APPENDICES 203
TOOLKITS 203
BIBLIOGRAPHY 213

EXECUTIVE SUMMARY

This report discusses existing and emergent risks across operating functions of a hospital in preparing for and responding to a pandemic flu crisis, and deep-dive into key functional business area as well as clinical frontline departments. While the practices are diverse and apply to different business areas and departments of healthcare providers, common patterns have appeared as emergent themes that may inspire insights when preparing a robust response to a flu pandemic. Six emergent principles may inspire readers to reflect on their own contexts:

a. **Invest in redundancy to ensure sufficient resources.** While redundancy connotates obsoletion and dispensability, the COVID-19 pandemic has shown that most healthcare institutions are severely under-prepared. Many hospitals operate with very short cash cycles and limited spike scenarios, and do not invest heavily in stockpiling protective gear, hospitals beds, or medical devices. Public hospitals have a particular role to invest ahead of need in a national stockpile of essential resources; cross-train and drill healthcare professionals on emergency preparedness scenarios regularly; nurture a cultural well of teamwork, trust, and mutual support; prepare an auxiliary multidisciplinary workforce (especially in respiratory therapy); develop capabilities to rapidly build or re-deploy adaptive infrastructure for crises; and provide for adequate fever rooms in Emergency departments and critical care units. Given the interconnectedness of our world, the ability to operate at half capacity during normal times saves lives in pandemics.

b. **Reduce spread with rapid operational and clinical decisions.** With COVID-19 cases doubling every few days globally, delayed responses and actions can have fatal consequences. For this reason, healthcare institutions and government agencies are collaborating closely to streamline extensive processes and improve bureaucratic agility. Special budgets and healthcare bills such as on telemedicine were passed in a matter of days in the United States to enable safer treatment. Emergency departments were restructured to allow pre-screening and temperature taking before patients enter the hospital. South Korea issued licenses to private companies to produce COVID-19 testing kits almost immediately after Daegu reported an outbreak, and within weeks, the country had enough testing capacity for hundreds of thousands of people. The swiftness of action, especially at the onset of outbreaks, is a key determinant of controlling infection rates. This not only required urgent-use approval, but also capabilities to develop rapid lateral flow immunoassay and rapid point-of-care molecular assay tests. Behavioural tactics such as human-centric signage and scent cues, retraining, and emotive storytelling are found to help implement decisions effectively.

c. **Optimise trade-offs by structuring frontline decision-making.** Few healthcare institutions in modern history have seen a medical crisis as severe as the one brought about by COVID-19. Many business continuity plans have not prepared sufficiently for extreme and prolonged stresses on operations. In this time of extreme resource limitations – of healthcare workers, of medical supplies, of hospital bed space – facing immensely high demand, many hospitals have resorted to a rule of thumb to act according to the greatest good for the community. Even with rolling

forecasts for more accurate planning, some hospitals are establishing structured decision parameters and ethical measures to decide who receives treatment, who can be intubated, who should be put on a ventilator, based on a range of factors such as health levels, survivability, age, or societal implications. Data-driven choice architecture and tools for different hospital capacity scenarios help reduce any guilt that frontline healthcare workers may experience when making difficult decisions, and facilitate efficient decision-making.

d. **Automate higher quality care and communications with technology.** Hospitals are using technology to control infections, improve communications, and offer higher standards of care. Sensors help monitor hospital hygiene levels in hospital, mobile applications help in contact tracing, and tablets help to limit contact between patients and healthcare workers. Incidence management systems help coordinate staff expertise even when departments are overloaded, chatbots offer rapid response to patient questions, and social media helps disseminate information at scale. Automatic prompts are built into electronic medical records for accurate case definitions, data is crowdsourced to help with early epidemiological analysis, and computerized ventilator weaning systems help to reduce lung damage.

e. **Adjust risk tolerance when allocating physical and human resources.** While healthcare institutions may traditionally have lower risk tolerance due to the sensitive and precarious nature of medical work, crises demand that hospitals adapt their risk appetites. To boost the emergency clinical workforce, governments are adjusting credentialing criteria for foreign doctors or retired healthcare workers, and allowing medical students to graduate earlier. Surgeons or psychiatrists assume the role of primary healthcare providers, with refresher training and Job Action Sheets for key procedures. Hospitals have expanded their list of qualifiable suppliers by adopting standards from hospitals in other countries, to source more widely for protective equipment. While questions on safety may arise, hospitals are prepared to exercise management discretion on existing protocols or when diverting resources from non-critical functions, against weighing the greater risk of mass infection and high fatality rates.

f. **Ignite fresh solutions by unleashing ground-up innovation.** In times of crisis, the most effective solutions often come from the frontline, such as establishing remote testing sites; adapting smoking areas as isolation wards; applying UV-light or hydrogen peroxide to decontaminate used face masks; using household materials as makeshift PPE in times of emergency; or converting a single ventilator into ten. Similarly, actionable strategies in staff deployment, coordination, and vendor relationships come not from peer-reviewed journals or government directives, but from actual practices that shown immediate effectiveness, such as doctors destressing with five-minute yoga stretch breaks or administrators securing nearby accommodation for healthcare workers. Organic, spontaneous innovation augments well-established standard operating procedures and practice manuals. Openly communicating with, trusting, empowering, and supporting various actors on the ground – including community influencers – with a culture of psychological, legal, and physical safety is crucial for innovation to sustain.

It is our aspiration that this library of knowledge will encourage healthcare sector practitioners to re-contextualize and invent their own methods to reduce risks, build professional, socioemotional, and clinical strength, and develop resilience for an uncertain future.

INTRODUCTION

I. BACKGROUND

In late December 2019, the novel coronavirus disease (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) broke out in Wuhan, China[1]. The disease quickly caught the world's attention due to its rapid spread, and by 30th January 2020, the World Health Organization (WHO) declared a COVID-19 a Public Health Emergency of International Concern[2]. On 11th March 2020, WHO declared COVID-19 a pandemic.[3]

According to Singapore's Ministry of Health (MOH), a pandemic is an epidemic of an infectious disease that has spread through human populations across geographical regions globally[4]. This is caused mainly due to limited immunity against emerging pathogens. The transmissibility and virulence of SARS-CoV-2 have caused great threat to public health, healthcare operations, as well as to society and the economy at large. As of 3 April 2020, the virus continues to spread globally, and a cure or vaccine has yet to be found.

After the outbreak of the severe acute respiratory syndrome coronavirus (SARS-CoV) in 2004, Singapore has put in place nationwide measures to handle future epidemics and pandemics. Amongst these efforts include the development of the Disease Outbreak Response System Condition (DORSCON), the redevelopment of the National Centre for Infectious Disease (NCID), as well as the nationwide readiness and response plan for acute respiratory diseases, spearheaded by MOH. The plan includes a range of key principles to ensure international resilience, including surveillance, management of suspect cases, visitor controls and temperature screening, isolation and discharge of cases, handling of deceased persons, border control measures, contact tracing and quarantine, social distancing, medical treatment, pandemic vaccine, communications, and infection control in non-healthcare settings.

[1] Naming the coronavirus disease (COVID-19) and the virus that causes it. World Health Organization (WHO). Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it
[2] Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). World Health Organization (WHO). Retrieved from https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)
[3] WHO Director-General's opening remarks at the media briefing on COVID-19. World Health Organization (WHO). (Press release). 11 March 2020. Retrieved from https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020
[4] MOH pandemic readiness and response plan for influenza and other acute respiratory diseases (Revised April 2014). Ministry of Health. Retrieved from https://www.moh.gov.sg/docs/librariesprovider5/diseases-updates/interim-pandemic-plan-public-ver-_april-2014.pdf

II. OBJECTIVE

This study scouts for noteworthy international practices in business and operational continuity among healthcare providers, in response to novel acute respiratory infections with pandemic potential (e.g. influenza or SARS).

The objective of this report is to outline divergent and interesting practices among different healthcare institutions globally, in efforts to inspire practitioners to widen their perspectives on different possible approaches to pandemic response. The study focuses on business and operational readiness and response planning, although the practices outlined may have clinical implications.

The authors have made every effort to ensure that the information in this report was correct at press time, but it should be noted that we are not in a position to assess if the approaches described are a best practice nor are we advocating for any particular approach. The information provided in this report is designed to provide helpful information on the subjects discussed. The benefits brought about by business continuity planning are only as robust as the creativity used in the scenarios and planning assumptions. The current situation around COVID-19 continues to evolve rapidly each day, and new developments may occur that invalidate a particular practice.

We therefore do not assume and hereby disclaim any and all liability to any party for any loss, damage, or disruption caused by errors or omissions, whether such errors or omissions result from negligence, accident, or any other cause. The information in this report is meant to supplement, not replace the expertise of clinicians. Hospitals administrators reading this should first consult their faculty and the healthcare community before making their own decisions on practices suitable to their own context. Recognizing the urgent need for scientific research and data on COVID-19, this publication is openly released under a Creative Commons license to facilitate dissemination of reliable, practical information for the public good.

III. METHODOLOGY

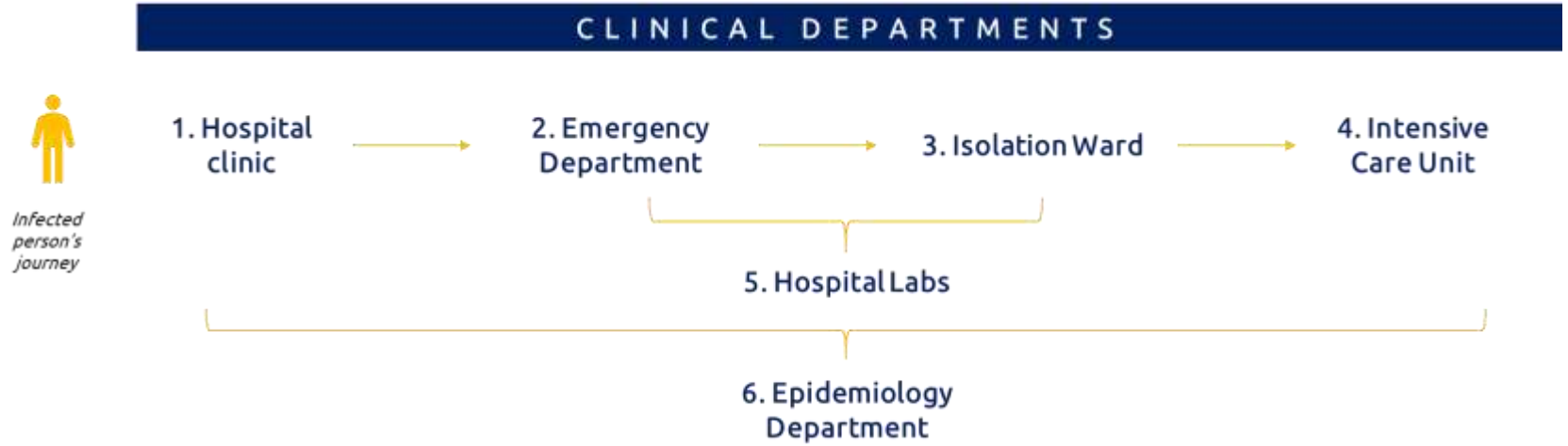


Figure 1. Potential user journey of an infected patient and related departments

To ensure a thorough understanding of the processes involved in fighting the pandemic, we follow the patient journey (Fig. 1) and delve into the risks and interesting practices of six clinical departments in a hospital setting: Hospital Clinics, Emergency Department, Isolation Ward, Intensive Care Unit, Hospital Labs, and Epidemiology Department. Sections under clinical departments are highlighted in blue.

We start by detailing the department workflow, to ensure that the risk identification process is comprehensive, followed by a summary of key risks, and a library of practices and resources in response to each risk identified.

We developed a framework to systematically examine the nature of risks that might be of particular importance to public healthcare providers during a pandemic. This risk framework (Fig. 2) categorises the types of risk experienced by a healthcare provider into three areas: Service Excellence, Operational Resilience, and External Impact. Within each of these areas, specific risks were identified based on how significant they were in affecting the continuity and resilience of a hospital.

Figure 2. Hospital Continuity Risk Framework

For every functional business area and clinical department of a hospital, we used the risk framework to identify all risks associated with that particular department during a pandemic. As each functional business area or clinical department has its own workflow and key functions, we were able to sieve out a risk – or sometimes more than one – associated with various parts of the workflow and key functions of these departments. These identified risks then informed us of where we could dive deeper into searching for interesting and divergent practices around the world that have been able to mitigate that risk.

The research conducted for this study spanned approximately four weeks, and was conducted in the months of March and April 2020. During this time, we conducted an extensive literature review of journal articles, media sources, hospital protocols, international guidelines, social media updates, and books in efforts to understand the wide range of different, interesting strategies that have been employed globally in handling influenza pandemics.

Additionally, we also had the privilege of speaking to several international medical experts in epidemiology, infectious disease, and frontline hospital operations to obtain key insights on pandemic response around the world. We would like to express our heartfelt appreciation to these individuals for spending time with us to verify on-the-ground practices and to share live insights on hospital pandemic response not recorded elsewhere. We are particularly grateful to:

- Professor Arnold S. Monto, MD, Department of Epidemiology, University of Michigan School of Public Health
- Professor Davidson H. Hamer, MD, National Emerging Infectious Disease Lab, Boston University School of Medicine and Center for Global Health & Development, Boston University School of Public Health
- Dr Eric Perakslis, Duke University and Harvard Medical School
- Associate Professor Dr Nahid Bhadelia, MD, MA, National Emerging Infectious Disease Lab, Boston University School of Medicine and Special Pathogens Unit, Boston Medical Center

GUIDE TO USING THIS DOCUMENT

GENERAL REPORT STRUCTURE

This report aggregates a range of key risks and accompanying approaches from official standards recommended by international organizations, existing practices of renowned hospitals, as well as interesting insights and approaches discussed, implemented, and recommended by healthcare thought leaders. As situations differ across institutions and borders in their norms, protocols, availability of resources, and social-economic circumstances, the practices identified in this document are not intended as prescriptive directives, but as a practical playbook of distinct possibilities for organizations and practitioners to choose from and adapt to their own contexts and risks.

This report consists of four main sections.

Section 1 contains general sectoral responses to the pandemic, and how various sectors and industries play crucial role in times of crisis.

Section 2 details interesting practices in handling risks present in six key hospital functional business areas: Logistics, Human Resources, Operations, Legal, Communications, and Finance. These sections are denoted in green.

Section 3 follows the patient journey (Fig. 1) and delves into the risks and interesting practices of six clinical departments in a hospital setting: Hospital Clinics, Emergency Department, Isolation Ward, Intensive Care Unit, Hospital Labs, and Epidemiology Department. Sections addressing operating practices across these hospital clinical departments are denoted in blue.

Section 4 includes a collection of ongoing practices that Singapore has implemented in response to the COVID-19 pandemic.

It is our intent to make this document as comprehensive as possible, so it will be of service to different audiences. For example, hospital operations managers may find Section 2 more relevant, while healthcare practitioners may find Section 3 especially applicable to their respective departments. At the start of every section there is a summary of all the practices detailed. It is recommended that readers start here, either proceeding chronologically or clicking on a hyperlink to see details of a particular practice of interest.

The practices more suited as immediate responses to crisis or emergency situations are labelled as 'Surge Capacity Stage', while those recommended for future planning are labelled as 'Preparedness Stage.'

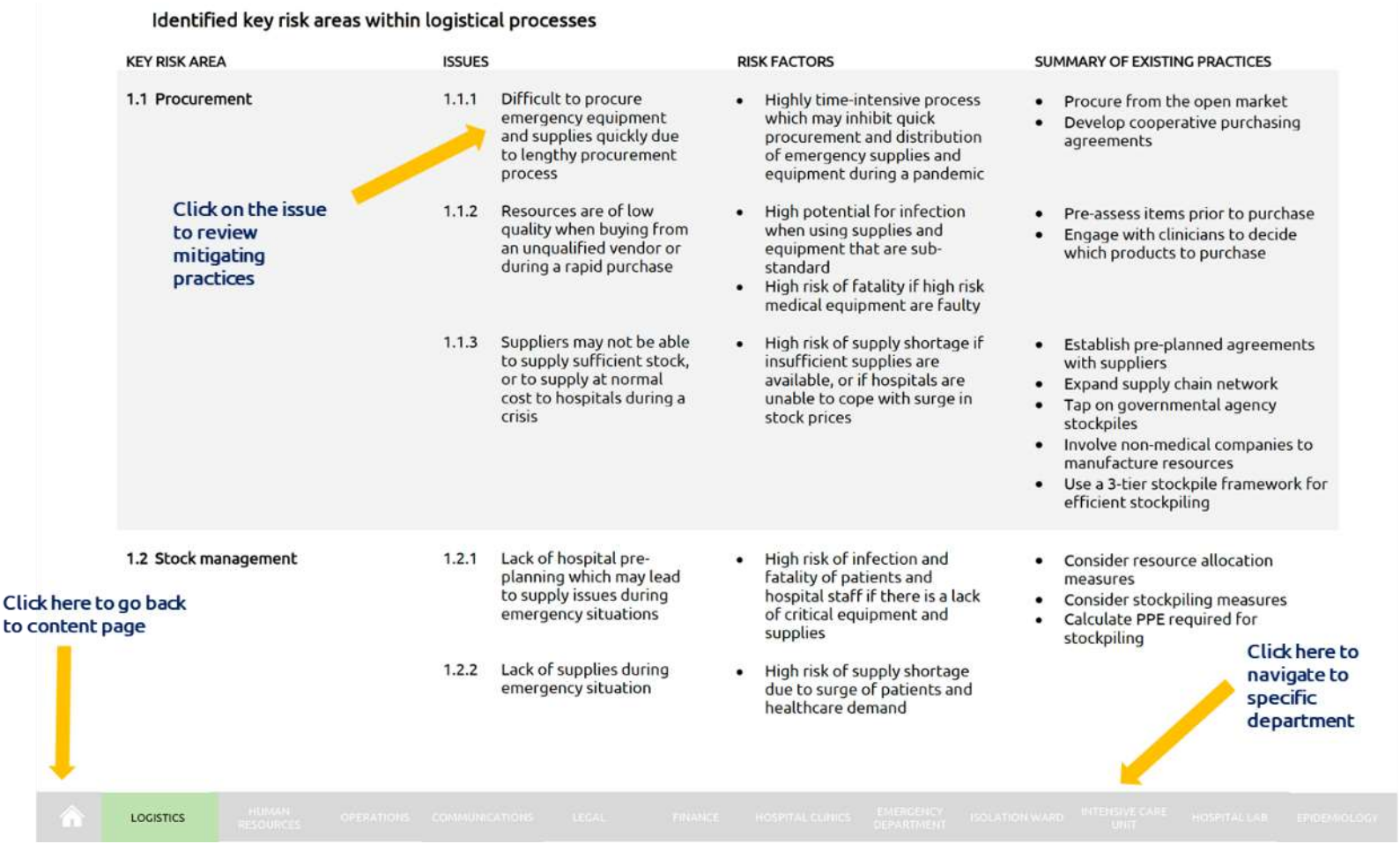
NAVIGATING THE DOCUMENT

Use the table of contents to easily navigate to a relevant section.

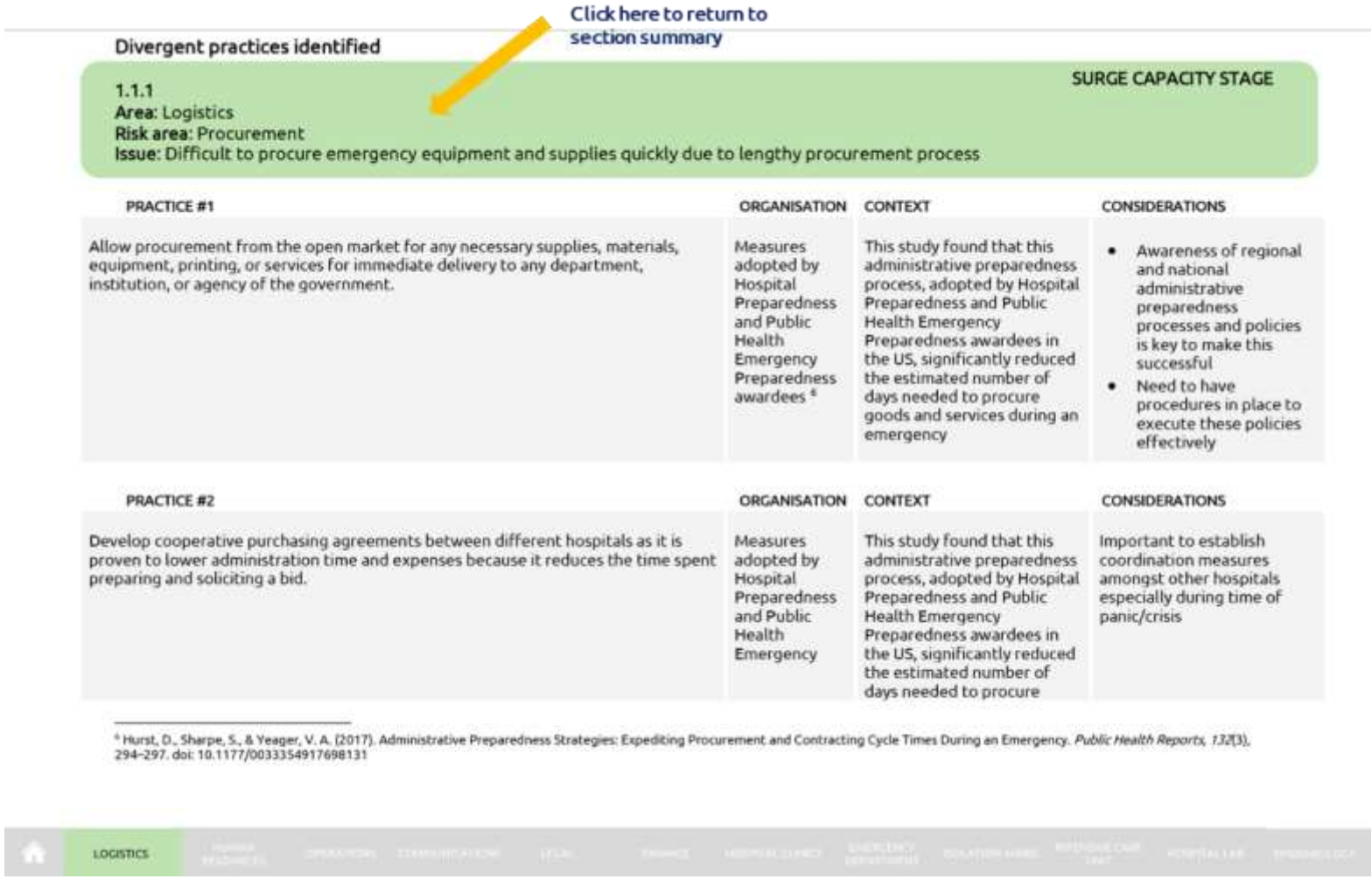
Table of Contents

TABLE OF CONTENTS 2
I. EXECUTIVE SUMMARY 3
II. INTRODUCTION 8
i. Background 8
ii. Objective 9
iii. Methodology 10
iv. About 13
v. How to use this document 14
III. INSIGHTS FROM INTERNATIONAL PRACTICES 18
i. Threat of Pandemics on Business Continuity 18
ii. Sectoral Response 19
iii. Hospital Functional business Areas 25
1. Logistics 26
2. Human Resources 43
3. Operations 59
4. Communications 83
5. Legal 94
6. Finance 110
iv. Department-specific Practice Areas 115
1. Hospital Clinics 116
2. Emergency Department 129
3. Isolation Ward 145
4. Intensive Care Unit 157
5. Hospital Lab 179
6. Epidemiology 188
V. SINGAPORE: OUR RESPONSE TO THE COVID-19 PANDEMIC 198
VI. APPENDICES 208
i. Toolkits 208
ii. Bibliography 219

Every section starts with a department-specific workflow and the summary of key issues, major risk factors, and interesting practices in each workflow. Click on the issue itself to review each practice in detail. To return to the content page, press the home button located on the leftmost side of the bottom navigation tab on each page. To skip to another department, click on the respective department on the navigation tab. We have used green tabs to denote general hospital functions (e.g. human resources, communications, legal) and blue tabs to denote specific hospital departments (e.g. clinics, isolation wards, labs).



To return to the section summary after viewing each detailed practice, click on the green or blue header boxes above.



INSIGHTS FROM INTERNATIONAL PRACTICES

I. THREAT OF PANDEMICS ON BUSINESS CONTINUITY

Influenza ("flu") is an acute, highly-infectious illness resulting from infection by an influenza virus. Typical symptoms include fever, headache, aching muscles, weakness and respiratory symptoms such as a cough, sore throat, and difficulty in breathing. Typically, an adult with symptoms will sufficiently recover to return to work after a week or so. Influenza is transmitted through: Breathing in droplets containing the virus, produced when an infected person talks, coughs or sneezes; or touching an infected person or surface contaminated with the virus and then touching your own or someone else's face. An adult typically becomes infectious about 24 hours before developing symptoms. They are typically no longer infectious once they have recovered from the symptoms. A person usually develops immunity after being infected by a strain of influenza, and will not generally be infected by the same strain again. Influenza is a major cause of death among older people, and more rarely sees fatalities among people of working age. Influenza caused by virus strains already circulating in the human population is known as seasonal influenza, because it is typically most active in winter in temperate countries.

An influenza pandemic is a global epidemic of a newly-emerged strain of influenza. During the early phases of an influenza pandemic, most people have little or no natural immunity to the virus strain, which allows it to spread widely throughout the world. A vaccine to protect people against illness from a pandemic influenza virus may not be widely available until many months after the pandemic begins. Influenza pandemics typically occur in two or three waves, spread over a period that can be more than a year. In each wave, rates of infection start low and reach a peak, before tailing off. Pandemics can vary in severity from something that seems simply like a bad flu season to an especially severe, worldwide influenza epidemic that could lead to high levels of illness, death, social disruption, and economic loss. It is impossible to predict when the next pandemic will occur or whether it will be mild or severe, but it is only a matter of time before another one occurs.

Influenza pandemics affect the business environment depending on their "Clinical Attack Rate" or the percentage of the population who develop the symptoms to be diagnosed as having influenza; and the "Case Fatality Rate", or the percentage of those clinically infected who die as a result. An influenza pandemic is likely to cause a sharp increase in employee absences. Typically, a fairly severe scenario will see employee absences peak at 40 percent over the two worst weeks in each wave of infection. It will disrupt market demand, as well as the flow of supplies and inputs that businesses need to operate, which will also need to make operational changes to reduce the risk of workplace infection. Interruptions to essential services such as food and groceries, banking, drainage/sewerage, electricity, gas, telecommunications, Internet access, and water may occur due to shortage of repair and maintenance staff. Resources will need to be diverted from non-essential services; in extreme cases entire industries and cities face disruption as they are locked down to reduce the spread of infection.

II. SECTORAL RESPONSE

There are typically nine essential sectors necessary to address the critical areas of a national pandemic response. Lead agencies need to be appointed to assume responsibility for each sector, within which agencies with operational roles in a pandemic response will work together (or will establish new work streams where appropriate) to ensure an integrated and coordinated interagency response. Critical infrastructure should be protected during any disaster, including an influenza pandemic. In order to ensure a safe and stable living environment, social functions and economic activities should be maintained during the pandemic period where possible. Therefore, both public and private sectors have to be prepared for the occurrence of an influenza pandemic. The major impact of a pandemic on the governments and enterprises will be manpower shortage for a prolonged period, since many employees will be sick or have to be away from work to care for their families. Furthermore, some might even refuse to work due to the fear of becoming infected at workplace. All sectors should formulate or revise their emergency plans to strengthen their continuity strategies and infection control measures against the effects of the influenza pandemic.[5]

SECTOR	ROLE	CRITICAL DEPENDENCIES
Public Health	• Provide uninterrupted healthcare services • Adequate supply of drugs, reagents and other necessary medical supplies • Adequate supply of health staff • Develop public awareness and risk communication materials • Train other non-health sector staff and provide necessary information to other sectors • Establish appropriate communication channels with other sector institutions • Monitor and minimize the effects of pandemics, including support to pandemic intelligence and surveillance at municipality and community levels • Support health care sector and medical logistics • Support in removal, mortuary and cremation of human remains	• Transport: For movement of supplies, personnel, patients and deceased bodies • Telecommunication: For patient care and emergency • Energy: Power supply, clinical, mortuary and security systems • Water: Healthcare facilities, hygiene • Pharmaceuticals: Consumables and treatment of patients • Finance: Ensure medical supply chain

[5] Royal Government of Bhutan (2011). National Influenza Pandemic Preparedness Plan. Retrieved from https://info.undp.org/docs/pdc/Documents/BTN/00060314_FINAL%20NIPPP.pdf

Food Supply	• Ensure trade facilitation • Ensure adequate trade, storing and supply of food and essential commodities • Liaise with the private trade sectors on supply of food and essential commodities • Issue import licenses for the import of goods from outside countries. • Impose necessary restrictions for import of poultry and livestock products • Establish appropriate communication channels with trade sector institutions • Coordinate and monitor import and supply of fuel • Examine, inspect, and clear imported livestock and livestock products including other risk goods to ensure their safety • Ensure bio and food security • Provision of safe agricultural food and products • Provide transportation and logistical support for transportation of food and fuel supply • Build up adequate stock of food supply in case of emergency • Build up adequate stock of oil supply in case of emergency • Establish operational continuity planning for potential disruption	• Transport: For movement of food and supplies • Energy: Power supply, industrial production • Water: Drinking and agriculture • Finance: Ensure trade transactions
Water and Sanitation	• Ensure adequate legal and regulatory framework is in place to allow for water rationing and distribution during pandemic, giving priority to health facilities • Stockpile essential materials and supplies to ensure safe water provision during the initial and subsequent waves of influenza pandemic • Review equipment maintenance schedule and operational continuity. • Review water treatment protocols to ensure that chlorination practices are appropriate • Maintain appropriate storage and delivery of water in case of pandemics	• Transport: For movement of supplies, personnel, patients and deceased bodies • Telecommunication: For patient care and emergency • Energy: Power supply, clinical, mortuary and security systems • Education: Public awareness • Healthcare and mortuary

	• Maintain appropriate drainage and waste water removal procedures • Create awareness on water and hygiene safety during influenza pandemic	
Power and Electricity	• Develop policies to ensure optimum energy usage, given decreased energy supply and increased energy demand during emergencies, such as influenza pandemic • Coordinate and monitor repatriation of power in shortage of power supply • Establish appropriate communication channels with energy sector institutions • Maintain business/operational continuity among national energy producers and distributors, including timely restoration of electricity production • Ensure continuity and timely restoration of provision and distribution of electricity to critical services, such as hospitals, emergency, infrastructure and communication sectors, and general public. Strengthen internal resilience towards potential disruption of electricity distribution	• Transport: For movement of staff, equipment and supplies • Energy: Power supply and industrial production • Water: Drinking and agriculture • Finance: Ensure transactions • Trade and Supply: Import of supply and equipment
Law and Order	• Overall coordination and support in maintaining law and order • Mobilize law enforcement personnel • Develop, review and revise policies regarding law and enforcement, immigration and movement control for emergency situations • Control and manage immigration and impose necessary movement control in and out of the country • Maintain Law and Order • Respond to requests from medical officers • Assist with the movement of rescue, medical, fire and other essential services • Coordinate movement control over land, including communication and traffic control	• Transport: For movement of personnel and equipment • Telecommunication: For emergency communication • Energy: Power supply and security systems

	• Enforce mechanisms on contract tracing and social distancing • Provide necessary personnel / armed staff support, if necessary • Provide transportation and logistical support • Provide security to essential supplies and supply personnel	
Transport and Telecommunications	• Advise on measures to mitigate impacts on transport measures • Establish appropriate communication and coordination system with transportation sector institutions • Make a decision to limit or halt international and local air and road transportation • Provide advice on safety and security to air and road passengers with support from MOH • Facilitate and make necessary arrangement on air transportation of essential supplies, including drugs, medical supplies, technical assistance and etc. • Ensure border safety and control measures • Maintain business/operational continuity among national transportation companies • Maintain and restore main roads and bridges with national importance (for transportation of critical goods, supplies, personnel and passengers) • Establish operational continuity plan for staff and equipment on maintenance of major routes in case of landslides and absence of staff • Support transportation of necessary supplies of national importance. • Establish necessary safety measures for passengers • Develop business continuity plan for lack of pilots and critical ground staff • Ensure policies for uninterrupted essential communication services across the country • Establish appropriate communication and coordination system with communication sector institutions • Maintain operational continuity among telecommunication companies	• Fuel Supply: Air and road transportation • Telecommunication: For operations • Energy: Power supply • Finance: Ensure supply of equipment and commodities • Transport: For movement of supplies, personnel, patients and deceased bodies • Health: For staff safety • Energy: Power supply for telecommunication • Essential Supply

	• Coordinate with private communication and media providers on facilitation of dissemination of awareness and public information resources. • Develop and establish emergency telecommunication plan for the sector • Ensure continuity and timely restoration of provision telecommunication services to critical services, such as hospitals, emergency, infrastructure and communication sectors, and general public • Strengthen internal resilience towards potential disruption of communication services. Media - Provide support to national authorities on provision and dissemination of accurate, unbiased and timely public messages • Ensure safety and security of media staff	
Finance and Insurance	• Analyse and advice on potential financial implications related to a pandemic • Maintain continuity of uninterrupted collection of revenues and taxes • Timely fund transfer, treasury operation, availability of public funds for emergency • Establish appropriate communication channels with financial sector institutions • Plan for implementation of price control strategies on food, medicine, fuel and other essential goods and establish trigger points for the implementation of these strategies • Advice in implementation of price control • Ensure fund liquidity and operational continuity of financial institutions during influenza pandemics • Provide necessary uninterrupted banking services to the public, including sufficient liquidity management • Ensure the flow of credit and finance in the economy so that the flow of other essential services will not be disrupted	• Transport: For movement of cash and personnel • Telecommunication: For financial and insurance transactions • Energy: Power supply for banking and insurance services

	• Maintain operational continuity of ATMs for potential social distancing measures • Provide timely payment for health-related and other insurance products during emergencies	
Education	• Coordinate the response for education sector among schools and institutions • Organize public awareness campaign in the schools with support from MOH • Advice on closure of schools to local administration and authority • Develop alternative home-based learning methods, in case of school closures • Provide psycho-social counselling and support to children in need • Instruct mobilization of teachers and students for certain activities/programmes Schools • Immediately inform local health authorities on possible symptoms of influenza pandemic • Consult with local authorities on closure of schools • Develop plan of action on measures to be taken at school level • Restrict unnecessary social activities to reduce human to human contact	• Transport: For movement of supplies, teachers and students • Telecommunication: For emergency • and surveillance • Energy: Power supply to schools • Water: Healthcare and hygiene • Food and commodity supply
Private Sector	• Business chambers need to consult with national authorities on workplace safety measures • Consult with national authorities on measures impacting economy and business activities, such as border control, trade restriction due to movement, shortage of supply and discuss on potential facilitation on businesses • Raise awareness among the private sector on business continuity during pandemic outbreaks and what measures to take on workplace • Large companies to develop their business continuity plans to ensure operational continuity with limited staff and resources • Put in place measures to ensure safety and security of employees	• Transport: For movement of supplies, personnel and goods • Telecommunication: For operation and emergency • Energy: Power supply for industrial and service purposes • Health: Healthcare services and facilities • Finance and Insurance: Ensure procurement and trade • Law and Order: Safety of businesses • Water and Sanitation: Health in workplace

III. REVIEW OF HOSPITAL FUNCTIONAL BUSINESS AREAS

In this section, we review the risks and highlight interesting mitigating practices associated with six key hospital functional business areas (Fig. 3): Logistics, Human Resources, Operations, Communications, Legal, and Finance. For each business area, we first map the specific processes and functions supporting the business area. We then highlight key risks (based on the risk framework in Fig. 2) associated with each of these processes, and detail interesting and divergent practices identified that serve to mitigate each of these risks.

Many of the practices we found in this section are novel, and have only surfaced recently due to the unique challenges faced in the COVID-19 pandemic. Some practices, however, are long-established and used by international health agencies and reputable healthcare providers around the world. These have also been included as not every hospital universally adopts these standards.

Figure 3. Hospital Functional Business Areas

1. Logistics

Key logistical functions

Procurement

- Establish budget for procurement
- Selecting supply chain vendors
- Planning quantity and type of item to buy

Purchase

- Establishing payment terms
- Negotiate contracts with service providers and contractors
- Fulfil purchase orders for equipment or supplies

Stock Management

- Acceptance of goods
- Storing of goods in hospital storage area
- Update, track and monitor stock levels on Information System Management

Distribution

- Movement of goods and medicines to various departments within hospital from hospital storage area

Receiving

- Healthcare workers receive supplies
- Sign off on supplies list
- Storage of supplies in department specific storage area

Replenishment

- Healthcare worker monitors supply levels within department specific storage area
- Issue order to procurement unit
- Procurement unit distributes more supply from main storage area or send out purchase order

Identified key risk areas within logistical processes

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
1.1 Procurement	1.1.1	Difficult to procure emergency equipment and supplies quickly due to lengthy procurement process	• Highly time-intensive process which may inhibit quick procurement and distribution of emergency supplies and equipment during a pandemic	• Procure from the open market • Develop cooperative purchasing agreements
	1.1.2	Resources are of low quality when buying from an unqualified vendor or during a rapid purchase	• High potential for infection when using supplies and equipment that are sub-standard • High risk of fatality if high risk medical equipment are faulty	• Pre-assess items prior to purchase • Engage with clinicians to decide which products to purchase
	1.1.3	Suppliers may not be able to supply sufficient stock, or to supply at normal cost to hospitals during a crisis	• High risk of supply shortage if insufficient supplies are available, or if hospitals are unable to cope with surge in stock prices	• Establish pre-planned agreements with suppliers • Expand supply chain network • Tap on governmental agency stockpiles • Involve non-medical companies to manufacture resources • Use a 3-tier stockpile framework for efficient stockpiling
1.2 Stock management	1.2.1	Lack of hospital pre-planning which may lead to supply issues during emergency situations	• High risk of infection and fatality of patients and hospital staff if there is a lack of critical equipment and supplies	• Consider resource allocation measures • Consider stockpiling measures • Calculate PPE required for stockpiling
	1.2.2	Lack of supplies during emergency situation	• High risk of supply shortage due to surge of patients and healthcare demand	• Apply stock taking measures and centralized supply management

				• Follow up on maintenance and repair of equipment • Encourage and accept donations from the public to hospitals
1.3 Distribution	1.3.1	Tendency for confusion to arise when handling large amounts of logistical work during a pandemic	• High potential for error when the team is unprepared on tasks to carry out during emergencies	• Prepare 'Job Action Sheets' • Organize staff training • Create a hospital readiness group
	1.3.2	Insufficient staff to handle higher amounts of logistical work during a pandemic	• High risk of manpower shortage during a pandemic when logistical needs increase significantly	• Establish staffing contingency plans
	1.3.3	Redefine workstreams of secondary hospital services during an emergency	• High risk of manpower shortage when there are great logistic needs such as transferring patients or transporting medicines	• Guide the pharmacy to take on alternative roles • Coordinate a contingency patient transportation strategy

Divergent practices identified

1.1.1 SURGE CAPACITY STAGE
Area: Logistics
Risk area: Procurement
Issue: Difficult to procure emergency equipment and supplies quickly due to lengthy procurement process

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Allow procurement from the open market for any necessary supplies, materials, equipment, printing, or services for immediate delivery to any department, institution, or agency of the government.	Measures adopted by Hospital Preparedness and Public Health Emergency Preparedness awardees [6]	This study found that this administrative preparedness process, adopted by Hospital Preparedness and Public Health Emergency Preparedness awardees in the US, significantly reduced the estimated number of days needed to procure goods and services during an emergency	• Awareness of regional and national administrative preparedness processes and policies is key to make this successful • Need to have procedures in place to execute these policies effectively

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Develop cooperative purchasing agreements between different hospitals as it is proven to lower administration time and expenses because it reduces the time spent preparing and soliciting a bid.	Measures adopted by Hospital Preparedness and Public Health Emergency Preparedness awardees [7]	The administrative preparedness process adopted by Hospital Preparedness and Public Health Emergency Preparedness awardees in the US, significantly reduced the estimated number of days needed to procure goods and services during an emergency	Important to establish coordination measures amongst other hospitals especially during time of panic/crisis

[6] Hurst, D., Sharpe, S., & Yeager, V. A. (2017). Administrative Preparedness Strategies: Expediting Procurement and Contracting Cycle Times During an Emergency. Public Health Reports, 132(3), 294–297. doi: 10.1177/0033354917698131
[7] Ibid

SURGE CAPACITY STAGE

1.1.2
Area: Logistics
Risk area: Procurement
Issue: Resources are of low quality when buying from an unqualified vendor or during a rapid purchase

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Assess the quality of contingency items prior to purchase; request quality certification if available.	WHO[8]	Hospital emergency checklist developed by WHO	Examine legal fine print to assess whether goods can be returned if quality is not up to expectations

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Engage with clinicians before procuring high risk medical supplies and must be able to credibly distinguish between physician preferences and clinical product decisions that are evidence-based such as studies which show the device or equipment has shown clinical success or increased patient safety.	Recommended by McKinsey & Co.[9]	Study on ways the procurement team's sourcing excellence can cut costs in the hospital	Work closely with clinicians to understand their clinical needs and match that with commodities in the market

[8] WHO. (2011). Hospital emergency response checklist . WHO Publication . Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf
[9] McKinsey & Co. (2010). How sourcing excellence can lower hospital costs. Retrieved from https://healthcare.mckinsey.com/sites/default/files/779148_How_Sourcing_Excellence_Can_Lower_Hospital_Costs_Health_International_10.pdf

1.1.3 PREPAREDNESS STAGE

Area: Logistics
Risk area: Procurement
Issue: Suppliers may not be able to supply sufficient stock, or to supply at normal cost to hospitals during a crisis

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish pre-planned agreements with suppliers: • Establish contingency agreements (e.g. memoranda of understanding, mutual aid agreements) with vendors to ensure the procurement and prompt delivery of equipment, supplies and other resources in times of shortage. • Form Mutual Aid Agreements or Memoranda of Understanding with suppliers, especially for medicines and items needed for infection control and prevention.	WHO[10]	Hospital emergency checklist developed by WHO	Involvement with the legal team to draft up contracts with suppliers to supply hospital during emergency crisis

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Expand supply chain network to include more international suppliers	JAMA Network[11]	JAMA sent out a call for ideas from the public on how to source PPE during the COVID-19 pandemic	Need to ensure whether the quality of the resources meet country standards

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Tap on governmental agencies stockpiles to supply hospitals: • Determine what implications the Ministry of Health's logistics-related policies and plans may have with respect to the hospital's logistics activities, particularly the stockpiling and distribution of essential supplies. • Draw up back-up plans that cover, among other points, agreements with the Ministry of Health for resupply mechanisms.	WHO[12]	Hospital Preparedness for Epidemics document published by WHO	Collaborate with intelligence or communications teams to get updates on national supply of essential medications and supplies

[10] WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf
[11] Livingston, E. (2020, March 28). Sourcing Personal Protective Equipment During the COVID-19 Pandemic. Retrieved from https://jamanetwork.com/journals/jama/fullarticle/2764031
[12] WHO. (2014). Hospital Preparedness for Epidemics . Geneva, Switzerland : WHO. Retrieved from https://apps.who.int/iris/rest/bitstreams/674837/

• Consult with authorities to ensure the continuous provision of essential medications and supplies (e.g. those available from institutional and central stockpiles and through emergency agreements with local suppliers and national and international aid agencies).			

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish pre-planned agreements with suppliers: • Establish contingency agreements (e.g. memoranda of understanding, mutual aid agreements) with vendors to ensure the procurement and prompt delivery of equipment, supplies and other resources in times of shortage. • Form Mutual Aid Agreements or Memoranda of Understanding with suppliers, especially for medicines and items needed for infection control and prevention.	WHO[13]	Hospital emergency checklist developed by WHO	Involve the legal team to draft up contracts with suppliers to supply hospital during emergency crisis

PRACTICE #4	ORGANISATION	CONTEXT	CONSIDERATIONS
Involve non-medical related private sector companies in the production of medical supplies. In the US, private companies such as Ford, GM, Tesla are given the go ahead by the government to produce ventilators to try to solve the issue of lack of supply of ventilators.	US Government[14]	Government seeking other sources of procurement, in a situation of low supply of ventilators in US hospitals	Technical medical specialists will have to work closely with automakers to ensure that specifications and quality of ventilators produced meet medical standards

[13] WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf
[14] Korosec, K. (2020, March 22). Ford, GM, Tesla given the 'go ahead' to produce ventilators, Trump says. Retrieved from https://techcrunch.com/2020/03/22/ford-gm-tesla-given-the-go-ahead-to-produce-ventilators-trump-says/

PRACTICE #5	ORGANISATION	CONTEXT	CONSIDERATIONS
Use a 3-tier personal protective equipment (PPE) stockpiling framework that could maintain a minimum stockpile for the surge demand of PPE in the early stage of a pandemic. • This stockpile replacement model employs a first-in-first-out (FIFO) principle in which the oldest stock in the central government stockpile is regularly replaced and replenished with the same amount of new and qualified products, ensuring the availability and maintenance of the minimum stockpiles. • The three components of the framework include warehouse management (by a private contractor), stockpile replacement (by FIFO principle), and joint procurement (where contractors build an online procurement system to take orders). • Government stockpiling may be more cost efficient than individual hospital stockpiles due to purchases in bulk, as well as efficiency in transporting resources where it is needed from a central location instead of hospitals sharing their resources.	Taiwan Centers for Disease Control (Taiwan CDC)[15]	Taiwan CDC's preparation from experience with SARS on PPE shortages	The success of these procurement projects depends on the market acceptability, market circulation, and contractors' sales channels. At present, the replaced surgical masks are distributed to domestic or overseas institutions, while N95 respirators and coveralls are sold for medical protection and mostly industrial safety in Taiwan.[16]

[15] Chen, Yu-Ju, et al. "Stockpile Model of Personal Protective Equipment in Taiwan." Health Security, vol. 15, no. 2, 2017, doi: 10.1089/hs.2016.0103. Retrieved from https://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC5404251&blobtype=pdf

[16] Chen, Yu-Ju, et al. "Stockpile Model of Personal Protective Equipment in Taiwan." Health Security, vol. 15, no. 2, 2017, doi: 10.1089/hs.2016.0103. Retrieved from https://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC5404251&blobtype=pdf

PREPAREDNESS STAGE

1.2.1
Area: Logistics
Risk area: Stock management
Issue: Lack of hospital pre-planning which may lead to supply issues during emergency situations

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider resource allocation measures: • Assess the hospital's current logistics system and likely priority needs for resources and supplies during an emergency, including human resources, types and quantities of consumables, medicines and equipment, and means and mechanisms of transportation. • Develop an Emergency Response Plan (including the Epidemic Sub-plan) and Standard Operating Procedures for the hospital's logistics functions that cover, among other requirements, standard procedures for emergency procurement of supplies and equipment, for transportation of resources to, from, and within the hospital, for storage of supplies and equipment, and for stock monitoring, tracking and reporting.	WHO[17]	Hospital Preparedness for Epidemics document published by WHO	Need to assign a team in the hospital responsible for the facilitation and planning of emergency response during crisis

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider stockpiling measures: • Develop and maintain an updated inventory of all equipment, supplies and pharmaceuticals; establish a shortage-alert mechanism. • Estimate the consumption of essential supplies and pharmaceuticals, (e.g. amount used per week) using the most likely disaster scenarios. • Identify physical space within the hospital for the storage and stockpiling of additional supplies, taking ease of access, security, temperature, ventilation, light exposure, and humidity level into consideration. Ensure an uninterrupted cold chain for essential items requiring refrigeration.	WHO[18]	Hospital emergency checklist developed by WHO	• Need to understand how much supplies hospital needs in a week to monitor preparedness levels • Safekeeping and monitoring of expiry dates of items is important to prevent deterioration of stockpiled items

[17] WHO. (2014). Hospital Preparedness for Epidemics . Geneva, Switzerland : WHO. Retrieved from https://apps.who.int/iris/rest/bitstreams/674837/retrieve
[18] WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf

• Stockpile essential supplies and pharmaceuticals in accordance with national guidelines. Ensure the timely use of stockpiled items to avoid loss due to expiration. • Develop and manage the hospital's emergency stocks of such items as medicines, consumables, hand hygiene products and personal protective equipment.			

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Calculate amount of PPE required for stockpiling: • Use of PPE calculator by CDC to determine amount of PPE to stockpile and purchase. • Alongside factors in the PPE calculator, facilities should also consider various factors including: acuity of patient, configuration of the healthcare team/roles and intended interaction with patient, length of shifts, number of required breaks for staff wearing PPE, isolation unit location and support strategies, waste management strategy, lab location, lab testing demand, hospital protocols for products, and length of patient's hospital stay.	CDC[19]	CDC created Ebola preparedness programs for countries experiencing an Ebola outbreak, the latest being in 2018 in Eastern Democratic Republic of the Congo	• Managed by hospital logistics or emergency preparedness teams • Calculation of PPE required could be based on historical pandemic and forecasted pandemic frequency

[19] CDC. (2016, January 21). PPE Calculator. Retrieved from https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/calculator.html

SURGE CAPACITY STAGE

1.2.2
Area: Logistics
Risk area: Stock management
Issue: Lack of supplies during emergency situation

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Apply stock taking measures and centralized supply management: • Monitor stock levels and keep records of outgoing and incoming flows of medicines and other essential items, and take the action needed to maintain adequate levels of routine and emergency supplies. • Consider centralizing the management of supplies within the hospital so as to facilitate prioritization and distribution of items to critical areas or the stockpiling of items needed for specific purposes, such as antiviral drugs or personal protective equipment required in an epidemic, or to meet the additional demands created by a concurrent emergency.	WHO[20]	Hospital Preparedness for Epidemics document published by WHO	• A comprehensive stock management information system is required to keep track of outgoing and incoming flow of medicine • Might require an ethical framework to decide which parties get supplies when they are in limited stock

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Ensure that a mechanism exists for the prompt maintenance and repair of equipment required for essential services.	WHO[21]	Hospital emergency checklist developed by WHO	During emergency situations it may be essential to have an in-hospital maintenance team to provide speedy maintenance service

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS

[20]WHO. (2014). Hospital Preparedness for Epidemics . Geneva, Switzerland : WHO. Retrieved from https://apps.who.int/iris/rest/bitstreams/674837/retrieve.
[21] WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf

Allow and encourage healthcare systems to accept donations from the public. E.g. UVA Health systems to receive donation of non-expired PPE (isolation gowns, isolation masks, eye shields, N-95 masks, bouffant caps, surgeon caps, hand sanitizer, disinfectant wipes, shoe covers, Dacron nasopharyngeal or oropharyngeal swabs) and Manufactured VTM reagents. Doctors obtain supplies through donations using the website #GetUsPPE. Medical users can request for supplies, specifying quantity and type in hopes of the community donating these supplies to the hospital.	UVA Health System[22] #GetUsPPE[23]	UVA Health System's call for donation of PPE and clinical supplies to combat COVID-19 shortage. #GetUsPPE is a website started by doctors to bridge the supply of PPE in households and other places and demand of PPE in hospitals, and is a grassroots movement founded by physicians and medical researchers on the frontlines of the COVID-19 pandemic.	Manpower required to receive items at collection point and to quality check them before transport to hospital grounds

[22] Newsroom, N. B. C. (2020, March 21). URGENT: UVA Health accepting donations of to combat COVID-19. Retrieved from https://www.nbc12.com/2020/03/21/urgent-uva-health-accepting-donations-combat-covid-/
[23] #GetUsPPE. (n.d.). #GetUsPPE - Getting Protective Equipment to our Healthcare Heroes. Retrieved from https://getusppe.org/

PREPAREDNESS STAGE

1.3.1
Area: Logistics
Risk area: Distribution
Issue: Tendency for confusion to arise when handling large amounts of logistical work during a pandemic

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Prepare 'Job Action Sheets' for logistical staff describing their roles and tasks in an emergency situation.	WHO[24]	Hospital Preparedness for Epidemics document published by WHO	Need to work closely with Human Resource team to come up with contingency plans during emergency crisis

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Ensure that logistics staff receive training and participate in regular exercises in order to enhance their ability to fulfil their roles in implementing the hospital's emergency response. • Emergency preparedness training is important in reducing loss of life and property, and it reduces the panic and stress during the emergency when people are more knowledgeable on actions to take	WHO[25]	Hospital Preparedness for Epidemics document published by WHO	Need to work closely with Human Resource team to plan emergency training and exercises to prepare emergency scenario capabilities

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Appoint a multidisciplinary group of skilled personnel to ensure the readiness of the hospital's logistics system to function effectively in an emergency.	WHO[26]	Hospital Preparedness for Epidemics document published by WHO	Important to coordinate and plan with different hospital departments to create a multidisciplinary logistics emergency team

[24] WHO. (2014). Hospital Preparedness for Epidemics . Geneva, Switzerland : WHO. doi: https://apps.who.int/iris/rest/bitstreams/674837/retrieve
[25] Ibid
[26] Ibid

1.3.2 SURGE CAPACITY STAGE

Area: Logistics
Risk area: Distribution
Issue: Insufficient staff to handle higher amounts of logistical work during a pandemic

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish a staffing contingency plan, with steps including: • Assessing staffing needs for the emergency and work with the human resource department to secure additional logistics staff. • Enlisting additional staff from among personnel who normally perform duties involving equipment, stocks, procurement and administrative functions. • Recruiting volunteer staff for logistics functions if necessary.	WHO[27]	Hospital Preparedness for Epidemics document published by WHO	• Need to work closely with Human Resource team to come up with contingency plans during emergency crisis • Prioritize staff workload to accommodate emergency situation needs

[27] Ibid

1.3.3 SURGE CAPACITY STAGE

Area: Logistics
Risk area: Distribution
Issue: Redefined workstreams of secondary hospital services during an emergency

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Define the hospital pharmacy's role in providing pharmaceuticals to patients being treated at home or at alternative treatment sites.	WHO[28]	Hospital emergency checklist developed by WHO	Important to coordinate between various hospital departments and functions to determine call of action during emergency situation

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Coordinate a contingency transportation strategy with pre-hospital networks (such as those conducting anaesthesia and emergency medicine) and transportation/ ambulance services to ensure continuous patient transferal.	WHO[29]	Hospital emergency checklist developed by WHO	Important to coordinate between various hospital departments and functions to determine call of action in emergency situations

[28] WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf
[29] Ibid

2. Human Resources

Key human resource functions

Recruitment

- Recruit general hospital staff through listing job on hiring portals, attending career events, and interviewing potential recruits
- Recruit doctors and nurses from medical schools or based on collaboration projects
- Recruit temporary workers during surge capacity

Promotion of staff well-being

- Provide counselling for staff who have personal, family, or work issues
- Organize activities and events to improve staff morale and retention
- Identify and mitigate work-related psychological stressors for staff

Management of HR policies

- Manage personnel, including hiring and firing of staff
- Manage benefits and compensation
- Mediate labour disputes between internal staff and mediation of labor unions
- Handle administrative hospital matters

Staff development and training

- Conduct employee orientation
- Conduct staff training and performance assessment
- Run professional development programs
- Educate staff on state and federal regulations education
- Enforce workplace safety and hygiene rules
- Create standards and rubrics for hiring new staff

Identified key risk areas within logistical processes

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
2.1 Recruitment	2.1.1	Hospitals are unable to recruit staff from existing workforce of doctors and nurses	• High risk of manpower shortage when existing workforce is fully occupied on frontlines	• Call up medical students and retired healthcare workers back to work
2.2 Promotion of staff-wellbeing	2.2.1	Healthcare workers experience extreme mental and physical exhaustion during a pandemic	• High potential for error as fatigue leads to operational lapses and oversight	• Establish plans to ensure staff well-being during a pandemic • Implement areas for rest and de-stress, allow workers to establish connection with family, and provide counselling services for hospital staff
	2.2.2	High incidence of PTSD among emergency health workers after a pandemic	• High impact on staff morale due to burnout or post-traumatic stress disorder (PTSD) during pandemic	• Establish crisis intervention team to provide psychological support and therapy for healthcare workers in the wake of a traumatic event • Build strong interpersonal bonds between healthcare staff to establish workplace support system
2.3 Management of HR policies	2.3.1	Weak culture of safety hinders staff from raising errors and emergency alerts due to fear of punishment	• High potential for error when staff are uncomfortable with raising issues to superiors	• Establish a culture of safety through open communication, and greater involvement of staff • Encourage healthcare workers to take sick leave if needed
	2.3.2	Insufficient manpower during emergency situations due to surge in demand	• High risk of manpower shortage when demand is in surge capacity	• Manage manpower during an emergency • Establish contingency planning with HR

	2.3.3	High risk of spread of virus amongst healthcare workers	• High risk of infection due to the high concentration of healthcare workers intermingling in a highly infectious environment	• Implement a flexible work policy for non-medical staff • Split frontline staff into teams • Isolate and separate sick employee
	2.3.4	High risk of spread of virus from healthcare workers to the public	• High risk of infection when healthcare workers interact with the public such as their family members	• Reserve accommodation for healthcare workers
2.4 Staff development and training	2.4.1	Newly-recruited staff may not have experience in specific department and hospital practices	• High potential for error as temporary staff may not be as experienced on procedures and hospital workflow	• Train new staff • Cross train existing staff

Divergent practices identified

2.1.1 **PREPAREDNESS STAGE**
Area: Human Resources
Risk area: Recruitment
Issue: Hospitals are unable to recruit staff from existing workforce of doctors and nurses

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Recruit staff from pool of medical students and retired healthcare workers: • In Vietnam, hospitals re-activating retired medical staff to take care of the elderly, and on medical students to join volunteer activities when needed. • In the UK, in 48 hours, 4,000 retired nurses and 500 doctors answered to the NHS's call to work. The NHS are also extending temporary work to final year medical students and nursing students in the form of joining the "NHS Army".	Vietnamese hospitals[30] NHS[31] Boston University Schools of Public Health and Medicine[32]	Insufficient manpower in hospitals. In Vietnam, retired medical staff are taking on care of the elderly, whereas students are more involved in voluntary supporting activities. In the UK, medical students are offered temporary fully paid roles.	• Might have legal implications if malpractice occurs due to lack of proper medical licensing in volunteer workforce • Training of temporary medical workers is essential to ensure high standards of medical care especially during an emergency • Skill matching is needed when allocating healthcare worker to relevant departments • Supplemental training required for people with irrelevant skills

[30] Reuters. (2020, March 21). Vietnam calls up medical students, retired doctors in coronavirus fight. Retrieved from https://finance.yahoo.com/news/vietnam-calls-medical-students-retired-111531660.html
[31] The London Economic. (2020, March 22). 4,500 retired doctors and nurses sign up to rejoin NHS in just 48 hours. Retrieved from https://www.thelondoneconomic.com/news/4500-retired-doctors-and-nurses-sign-up-to-rejoin-nhs-in-just-48-hours/22/03/?fbclid=IwAR1pD9UCAOB8xg_CYAkgT7JvbvuJ7J3La_oylDNysKJyCvNnmVguf2FEZM8
[32] Hamer, D. (2020, March 27th). Teleconference with Eden Strategy Institute.

2.2.1 PREPAREDNESS STAGE

Area: Human Resources
Risk area: Promotion of staff well-being
Issue: Healthcare workers experience extreme mental and physical exhaustion during a pandemic

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish guidelines to ensure staff well-being during a pandemic: • Establishing a contingency plan for the provision of food, water and living space for hospital personnel. • Identifying domestic support measures (e.g. travel, childcare, care for ill or disabled family members) to enable staff flexibility for shift reassignment and longer working hours. • Ensuring adequate shift rotation and self-care for clinical staff to support morale and reduce medical error. • Ensuring the availability of multidisciplinary psychosocial support teams that include social workers, counsellors, interpreters and clergy for the families of staff and patients.	WHO[33]	Hospital emergency checklist developed by WHO on the chapter of Human Resources	• Collaborate with the logistics team to provide resources such as food, water, and living quarters for hospital personnel • Organize activities to encourage self-care and for counselling purposes

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Initiate measures to help healthcare workers relax and de-stress in the hospital setting, such as: • Provision of a place for rest where staff can temporarily isolate themselves from their family. • Arrangement of leisure activities and training on how to relax properly for staff to reduce stress. • Provision of food and daily living supplies. • Allowing staff to video record their daily routines in the hospital to share with their families.	Second Xiangya Hospital of Central South University[34]	These measures were implemented during the COVID-19 outbreak in China, as hospital staff faced extremely high levels of stress dealing with an enormous influx of patients with a highly infectious disease.	• Need to assess real on-the-ground needs of nurses and doctors such as rest, counselling, interaction with family, public validation and support • Apart from providing resting spaces,

[33] WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf
[34] Chen, Q., Liang, M., Li, Y., Guo, J., Fei, D., Wang, L., ... & Wang, J. (2020). Mental health care for medical staff in China during the COVID-19 outbreak. The Lancet Psychiatry, 7(4), e15-e16.

• Visits by psychological counsellors regularly to staff rest areas to listen to difficulties or stories encountered by staff at work, and provision of appropriate support. • Arrangement of pre-job training to address identification of and responses to psychological problems in patients with COVID-19, with hospital security staff available to help with uncooperative patients. • Development of detailed rules on the use and management of protective equipment to reduce worry.			relaxation activities, and counselling, active decontamination of facilities has also been found to significantly help reduce stress and reassure caregivers, patients, and visitors

2.2.2
Area: Human Resources
Risk area: Promotion of staff well-being
Issue: High incidence of PTSD among emergency health workers after a pandemic

SURGE CAPACITY STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Establishment of a crisis intervention team (known as Code Lavender) for healthcare staff during high-stress events, which is made up of representatives from the spiritual care and healing services departments. The team will respond within 30 minutes to any Cleveland Clinic hospital to provide therapies such as Reiki, meditation, acupressure, prayer, and counselling for staff, with continued check-ins on staff over the next few weeks after the activation of Code Lavender.	Cleveland Clinic[35]	Mostly activated during isolated stressful incidents (e.g. death of a patient involved in a severe car accident) rather than epidemics	Need to ensure that this intervention is built into the culture of a hospital so that there is no stigma around using it

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
• Build relational reserves – strong social bonds among healthcare workers – prior to the pandemic, through supportive, collaborative, and interdisciplinary relationships that can provide the basis for a formal or informal support system during a pandemic. • Organise training sessions to teach healthcare workers how to support others and equip them with psychological first aid skills to help them self-determine whether they need or want psychological assistance	Recommendation published in the Canadian Journal of Public Health by doctors from Mount Sinai Hospital, University of Toronto[36]	Recommendations were developed based on lessons from SARS, using the success of magnet hospitals and hospitals with strong focus on organizational justice as learning points	These practices are usually established prior to a pandemic, and may be difficult to kickstart in the middle of a pandemic

[35] Cleveland Clinic (2018). Code Lavender: A tool for staff support. Retrieved from https://my.clevelandclinic.org/-/scassets/files/org/locations/hillcrest-hospital/spiritual-services/code-lavender.ashx?la=en
[36] Maunder, R. G., Leszcz, M., Savage, D., Adam, M. A, et al (2008). Applying the Lessons of SARS to Pandemic Influenza. Canadian Journal of Public Health, 99(6), 486–488. doi: 10.1007/bf03403782

2.3.1 PREPAREDNESS STAGE

Area: Human Resources
Risk area: Management of HR policies
Issue: Weak culture of safety hinders staff from raising errors and emergency alerts due to fear of punishment

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Cultivate a culture of safety in the hospital setting. A culture of safety encompasses these key features: • Acknowledgment of the high-risk nature of an organization's activities and the determination to achieve consistently safe operations • A blame-free environment where individuals are able to report errors or near misses without fear of reprimand or punishment • Encouragement of collaboration across ranks and disciplines to seek solutions to patient safety problems • Organizational commitment of resources to address safety concerns Achieve a culture of safety in the workforce through these key steps: • Open communication and having talks that are hosted in a safe environment • Review and reinforce key messages on a culture of safety during training sessions • Have superiors lead by example and encourage staff to speak up and voice their concerns freely • Ensure greater involvement of staff in decision making processes.	Patient Safety Network[37] Occupational Safety Group[38]	Guidelines to instil a culture of safety in the workforce to enable open communication	• A culture of safety is important to ensure that healthcare workers will be more confident in raising issues that could potentially create great harm to patients and the public if overlooked

[37] Patient Safety Network . (n.d.). Culture of Safety. Retrieved from https://psnet.ahrq.gov/primer/culture-safety
[38] Occupational Safety Group . (n.d.). Six Tips to Help you Build a Positive Safety Culture. Retrieved from https://osg.ca/six-tips-to-help-you-build-a-positive-safety-culture-in-your-workplace/

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
For healthcare workers, take a sick day off when not feeling well to prevent transmitting infections to patients. Developing a culture of safety in being able to take sick leave should start not just from the management or human resource level, but from the ground up where doctors and nurses take a sick leave to be an example to their peers.	The Guardian[39]	Opinion piece on doctor's work ethic when they are ill. In many hospitals, it is the unspoken rule that if doctors are ill, they do not take a sick day off as repercussions and effect on manpower and patient care can be great. However, during this period with coronavirus, the importance on preventing transmission trumps other considerations.	Implement rewards and incentives to encourage doctors to take a sick day off

[39] Srivastava, R. (2020, March 9). The message to doctors has always been clear: if you get sick, do it on your own time | Ranjana Srivastava. Retrieved from https://www.theguardian.com/commentisfree/2020/mar/09/the-message-to-doctors-has-always-been-clear-if-you-get-sick-do-it-on-your-own-time?CMP=share_btn_fb&fbclid=IwAR22DN3IMqHSK4c21twewfIQNKpyaWtaoqg2l1Y9zgYnIO6uLnVHbgwcn64

2.3.2 PREPAREDNESS STAGE
Area: Human Resources
Risk area: Management of HR policies
Issue: Insufficient manpower during emergency situations due to surge in demand

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Manage manpower during an emergency: • Update the hospital staff contact list. • Estimate and continuously monitor staff absenteeism. • Establish a clear staff sick-leave policy, including contingencies for ill or injured family members or dependents of staff. • Identify the minimum needs in terms of healthcare workers and other hospital staff to ensure the operational sufficiency of a given hospital department.	WHO[40]	Hospital emergency checklist developed by WHO	Important to address these issues with staff and get their buy-in to ensure compliance

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish a contingency or surge capacity plan for managing staff shortages and for increasing numbers of skilled staff required to meet increased demand for logistics services.	WHO[41]	Hospital Preparedness for Epidemics document published by WHO	Need to work closely with various hospital departments to come up with contingency plans during emergency crisis

[40] Ibid
[41] WHO. (2014). Hospital Preparedness for Epidemics . Geneva, Switzerland : WHO. doi: https://apps.who.int/iris/rest/bitstreams/674837/retrieve

2.3.3
Area: Human Resources
Risk area: Management of HR policies
Issue: High risk of spread of virus amongst healthcare workers

PREPAREDNESS STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement a flexible work policy for non-medical staff: • Following a flexible working policy, employees may work from home 5 days a week during a pandemic to reduce spread of virus • Employee must be contactable during working hours • Urgent issues should be dealt with appropriately before remote working policy starts • Absences for pandemic infections/diseases will be treated as sick leave and paid in line with the company's occupational sick pay policy • When employees are on leave in situations where they are the primary carer for a family member who have contracted the pandemic illness, or breakdown of care arrangements for their loved ones or children during the pandemic, employees will need to seek managers permission to take annual leave, flexi time, or unpaid leaves for special circumstances	Brent and One Council[42]	HR Policy during pandemic situation	HR team needs to communicate policies clearly to non-frontline hospital staff and decide which staff can work from home to ensure buy-in and compliance

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Split frontline staff into teams: • Establish modular teams of healthcare workers that work in different 12-hour shifts, such that they do not interact with other teams.	Singapore Hospitals[43]	During the SARS period, in Singapore hospitals, doctors were split into four teams of 21. Each team took alternate 12-hour shifts and did not interact with other teams.	It is important to have a clear and structure oversight of schedules; this may require the appointment of a team, or the use of tools for effective planning

[42] Brent, and One Council . HR Pandemic Policy. Jan. 2015, democracy.brent.gov.uk/documents/s29645/pandemic policy.pdf.
[43] South China Morning Post . (2020, March 29). Why so few Covid-19 infections in Singapore's health workers? Retrieved from https://www.scmp.com/week-asia/health-environment/article/3077345/coronavirus-why-so-few-infections-singapores-health?fbclid=IwAR2uj7Root94TOOU0ivdOU10PBr4jpLY_f-05SwLTxwd7GqqR41KQO2vtXY

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider practices recommended by the CDC when dealing with a sick employee: • Actively encourage employees with respiratory illness and fever to stay home until they are free of a fever for at least 24 hours • Ensure that your sick leave policies are modified to be flexible enough they are consistent with any public health guidance and employees are aware of these modified policies • Consider whether you really need to require a health care provider's note for employees who are sick with acute respiratory illness to validate their illness, as health care provider offices and medical facilities may be extremely busy and not able to provide such documentation in a timely way. • Be prepared to separate sick employees. The CDC recommends employees who appear to have acute respiratory illness symptoms (i.e., cough, shortness of breath) upon arrival to work, or become sick during the day, should be separated from other employees and sent home immediately. • Sick employees should be told to cover their noses and mouths with a tissue when coughing or sneezing (or an elbow or shoulder if no tissue is available).	CDC[44]	CDC's guidelines for human resource departments on handling staff concerns during a pandemic	• HR department should check and circulate the national health guidelines as to where the sick employee can receive treatment and testing for COVID-19 • HR should also check on national policies on whether it is mandatory to work from home to reduce transmission of virus

[44] Dailey, A. M., Mitchell, J. O., & Bruce , J. M. (2020, March 10). Helping Human Resources Managers Prepare for Coronavirus Pandemic. Retrieved from https://www.natlawreview.com/article/helping-human-resources-managers-prepare-coronavirus-pandemic

2.3.4
Area: Human Resources
Risk area: Management of HR policies
Issue: High risk of spread of virus from healthcare workers to the public

PREPAREDNESS STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
For healthcare workers, consider only returning to families once the pandemic is over. The HR department can arrange housing facilities for healthcare workers to reduce spread of virus to their families and to the public.	University of Michigan[45]	• The SARS epidemic was driven by spread of the infection in healthcare workers • During SARS, healthcare workers only returned home once the epidemic was over, which was not the case with a majority of medical workers during the COVID-19 pandemic	HR department needs to work together with hospital management to arrange housing facilities for healthcare workers during a pandemic situation to limit their contact with public

[45] Monto, A. (2020, March 31st). Teleconference with Eden Strategy Institute.

PREPAREDNESS STAGE

2.4.1
Area: Human Resources
Risk area: Development and training
Issue: Newly recruited staff may not have experience in specific department and hospital practices

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Train new and existing staff, specifically: • Train additional staff (e.g. retired staff, reserve military personnel, university affiliates/students and volunteers) according to the anticipated need. • Cross-train health-care providers in high-demand services (e.g. emergency, surgical, and intensive care units). • Provide training and exercises in areas of potential increased clinical demand, including emergency and intensive care, to ensure adequate staff capacity and competency.	WHO[46]	This guideline is part of the hospital emergency checklist developed by WHO	Need to determine the best method to train additional staff that is not time-intensive but produces quality results; traditional in-person training modules may need to be shortened or carried out remotely

[46] WHO. (2011). Hospital emergency response checklist.. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf

3. Operations

Key operational functions

Facilities management

- Maintenance of equipment
- Maintenance of infrastructure
- Maintenance of landscape and green spaces
- Stock take of equipment and infrastructure

Safety and security

- General hygiene practices
- General protection practices
- Crowd control and internal traffic facilitation
- Management of crisis and mass panic

Human flow and physical layout management

- Placement and arrangement of clinical resources
- Placement of patients
- Hospital points of entry
- Traffic flow within hospitals
- Construction of physical infrastructure

Resource allocation

- Planning and distribution of resources within hospital
- Planning and distribution of personnel within hospital

IT infrastructure management

- Inpatient clinical functions e.g. Clinical documentation, registration, billing, clinical orders and lab results
- Ambulatory clinical functions e.g. Health records, scheduling
- Business functions e.g. Inventory, payroll
- Network, security, infrastructure

Identified key risk areas within operational processes

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
3.1 Resource allocation	3.1.1	Hospitals do not have sufficient internal staffing and healthcare workers to cope with surge in patients	• High risk of fatality due to limited health services to those in need • High impact on healthcare workers morale due to intense workload	• Establish multidisciplinary teams across various hospitals to coordinate and allocate resources • Transfer of patients to other healthcare facilities through public system coordination or collaboration with private hospitals • Convert hospitals into pandemic-specific hospitals
	3.1.2	Certain departments that are central in dealing with the crisis do not have sufficient healthcare workers to cope with surge in patients	• High risk of fatality due to limited health services to those in need • High impact on healthcare workers morale due to intense workload	• Deploy and team up healthcare workers with relevant skills to battle the pandemic • Redeploy healthcare workers with less relevant skills to frontline duties
	3.1.3	Insufficient supply of PPE	• High risk of infection as healthcare workers do not have sufficient protection when handling patients	• Use household materials to create PPE • Disinfect N95 masks using hydrogen peroxide • Stock up PPE based on role of hospital facility
	3.1.4	Insufficient supply of ventilators	• High risk of fatality when there are insufficient ventilators for critically ill patients	• Increase capacity of ventilators by attaching tubes and hoses to create a modified circuit • 3D print a ventilator adaptor to fit a store bought snorkelling mask

3.2 Safety and security	3.2.1	Lapses in compliance of healthcare workers with hand hygiene standards due to insufficient reminders and enforcement	• High risk of infection due to the number of patients healthcare workers interact with daily • High risk of manpower shortage due to the likelihood of healthcare workers falling sick	• Conduct regular trainings for healthcare workers • Use props, such as posters and guidelines, as reminders • Develop behavioural tactics to improve compliance • Implement measures to monitor hygiene level • Make changes to the placement of hygiene facilities
	3.2.2	Insufficient disinfection of potentially highly-infectious, non-critical surfaces in hospitals	• High risk of infection due to the spread of infectious pathogens in hospital environment	• Combine the use of new disinfection methods with monitoring efforts • Ensure stringent disinfection of even non-critical surfaces
	3.2.3	High traffic in the hospital increases the risk of mass infection	• High risk of infection due to the high concentration of people in a highly infectious environment	• Restrict visitors except for exceptional cases • Encourage remote communication with patient
3.3 Human flow and physical layout management	3.3.1	Ineffective hospital planning and layout may lead to large distances travelled by those who are infectious, increasing spread to others	• High risk of infection due to the spread of infectious pathogens in hospital environment	• Maintain discrete clinical pathways into hospitals and wards • Dedicate pathways to patients suspected of an infection • Implement quick changes to hospital layout to manage traffic flow • Create infrastructure that is separate from the main hospital building • Transform rooms of infected patients into more critical-care rooms instead of transferring patients

3.4 IT infrastructure management	3.4.1 In-person contact with patients increases risk of transmission of virus from patient to healthcare worker	• Highly time intensive process when doing manual procedures • High potential for infection when healthcare workers are exposed to patients in person	• Use IT infrastructure to limit patient and healthcare worker contact

Divergent practices identified

3.1.1 **SURGE CAPACITY STAGE**
Area: Operations
Risk area: Resource allocation
Issue: Hospitals do not have sufficient healthcare workers to cope with surge in patients

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS

Establish provincial/regional multidisciplinary teams across hospitals to relocate and centralize resources to fight COVID-19:
• The multidisciplinary teams include personnel from the intensive care unit, emergency department, infectious disease department, respiratory department, psychological department, infection control department, administrative department, and nursing department.
• Medical resources of the whole province were redistributed into 4 groups:
  ○ Group 1: Supporting Wuhan – medical teams dispatched to support hardest hit areas
  ○ Group 2: Establishing fever clinics – medical teams worked to diagnose, isolate, and exclude non-COVID-19 patients
  ○ Group 3: Centralized management – appointment of 4 hospitals to treat COVID-19 patients
  ○ Group 4: Quality control and inspection – includes provincial health authorities, medical experts, and infection control experts
	Hospitals in Heilongjiang Province, China[47]	Taken from Heilongjiang province, one of the hardest hit regions by COVID-19. There was a need to reshuffle resource allocation within hospitals in the province, as well as the distribution of resources to Wuhan to contain further spread.	• Existing coordination and central management of hospitals in the region is important for rapid deployment and redistribution of resources
			• Resources must be balanced to tackle spread in the local province, but also redistributed to other provinces to contain further spread

[47] Wang, H., Wang, S., & Yu, K. (2020). COVID-19 infection epidemic: the medical management strategies in Heilongjiang Province, China. Retrieved from https://ccforum.biomedcentral.com/articles/10.1186/s13054-020-2832-8

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Coordinate with other hospitals to transfer non-critical patients to other facilities, through system coordination at the ministry level. • In Vietnam, 6 hospitals in the city is selected, with some hospitals named as the primary healthcare facility to contain the virus, other than the central hospital for infectious disease. • Collaboration and transfer of non-critical patients between hospitals will reduce stress on limited resources and open up capacity of hospitals for critically ill patients	Hospitals in Vietnam[48]	In preparation for potential surge in cases, to ensure minimal cross-infection between hospitals and zones	Ensure that selected hospitals have enough capacity and resources can be concentrated to a single hospital to fight the outbreak

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Convert hospitals which lie in zones with high number of cases into a pandemic-specific facility, while transferring patients to other hospitals.	Hospitals in Vietnam[49]	In preparation for potential surge in cases, to ensure minimal cross-infection between hospitals and zones	Need to define criteria to select which hospitals to turn into a pandemic-specific facility, as well as the effects of doing that on the current residents of the area

PRACTICE #4	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish partnerships with private hospitals to transfer non-critical patients to public hospitals to free up public hospitals for more urgent cases: • Private hospitals would support the COVID-19 response through activities such as providing care for public patients, carrying out category 1 elective surgery, and providing wards and theatres to expand ICU capacity.	Hospitals in Australia[50]	To account for increasing demand for hospital services, private hospitals in Australia are working with public hospitals to allocate patients, adding another 30,000 beds and 105,000 healthcare workers to the public healthcare force.	• Restrictions in healthcare services (e.g. postponing elective surgery) lead to a fall in income for private hospitals, and potential layoffs. Financial support is crucial for private hospitals to contribute their resources fully.

[48] Phòng chống COVID-19 tại Hà Nội: 6 bệnh viện mũi nhọn chuẩn bị 1.000 giường bệnh. (2020, March 12). Retrieved from https://baotainguyenmoitruong.vn/phong-chong-covid-19-tai-ha-noi-6-benh-vien-mui-nhon-chuan-bi-1-000-giuong-benh-300231.html
[49] Ibid
[50] Davey, M. (2020, March 31st). Australian government will pay half to integrate private hospitals into Covid-19 response. The Guardian. Retrieved from https://www.theguardian.com/australia-news/2020/mar/31/federal-government-pay-half-integrate-private-public-hospitals-covid-19-response

• Private hospitals might also provide accommodation for quarantine and isolation cases where safety procedures are put in place		The federal government will bear half of the cost of integrating the private hospital system with the public healthcare in preparation for COVID-19.	• Need to ensure that private hospitals have access to healthcare supplies and equipment to protect staff members.

3.1.2 SURGE CAPACITY STAGE

Area: Operations
Risk area: Resource allocation
Issue: Some departments in hospitals do not have sufficient healthcare workers to cope with surge in patients

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Reassign medical resourced based on the demand and specialty required from different medical departments. • E.g. In China, physicians from general wards who specialized in respiratory or infectious disease treated mild patients, while critical cases were handled by a team led by intensivists. Medical treatment and nursing were managed in the same way as mentioned above. • At Mt Sinai hospital, specialists who do not typically treat infectious diseases are redeployed to care for infected patients during a pandemic, by grouping cardiologists, cardiac surgeons, intensivists, cardiovascular nurses into a pandemic-fighting team.	Hospitals in Heilongjiang Province, China[51] Mount Sinai Morningside, US[52]	Taken from Heilongjiang province, one of the hardest hit regions by COVID-19. There was a need to allocate medical resources within hospitals to departments that are hardest hit	• Healthcare workers need to have general transferability of skills to begin with to successfully take on new roles when needed • Healthcare workers should pick up duties that are aligned with their existing duties, to reduce the risk of error • Assurance of quality and ethics is important, especially when doctors are being assigned to roles as they may not have prior or recent training in these roles • There is a potential risk of legal complications if specialists are not properly trained for their new roles

[51] Wang, H., Wang, S., & Yu, K. (2020). COVID-19 infection epidemic: the medical management strategies in Heilongjiang Province, China. Retrieved from https://ccforum.biomedcentral.com/articles/10.1186/s13054-020-2832-8
[52] Bannow, T., & Castellucci, M. (2020, March 30). Hospitals redeploy specialists to COVID-19 front lines. Retrieved from https://www.modernhealthcare.com/hospitals/hospitals-redeploy-specialists-covid-19-front-lines

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Reassign healthcare workers with non-urgent roles, such as surgeons and anesthesiologist, to supplement healthcare workers fighting on the frontline. Essential things to note: • Emergency credentialing may be required. • Skill matching is needed to decide on appropriate allocation of staff members. • Supplement trainings required for those with less relevant skills. • Supplement trainings for non-medical personnel to do ancillary aspects such as temperature taking, hygiene enforcement.	Hospitals in Boston, Massachusetts[53]	The quick spike in cases in Massachusetts quickly led to a manpower shortage, requiring the reallocation of staffing.	Assurance of quality and ethics is important, especially when doctors are being assigned to roles that they may not have prior or recent training in; legal complications may arise if something goes amiss

[53] Badhelia, N. (2020, March 27th). Teleconference with Eden Strategy Institute.

3.1.3
Area: Operations
Risk area: Resource allocation
Issue: Insufficient supply of PPE

SURGE CAPACITY STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Create makeshift PPE in desperate stock-out situations using these innovative ways: Use of: • Snorkel and scuba, 3D printed, welder's, civilian military grade gas masks, ski buffs to create prefabricated masks • Use of sports eye protectors, motorcycle helmets with visors, balaclavas to create eye and face shields • Use of plastic ponchos or poly bags, bedbug sheet material to create gowns. • Use of adhesive bandage as nasal PPE • Sewing own fabric masks and gowns, coffee filter masks, home HVAC filter masks • Plastic bags and rice sacks to create own handmade PPE[54]	JAMA Network[55] Mail & Guardian[56]	JAMA sent out a call for ideas from the public on how to source PPE during the COVID-19 pandemic Development of own PPE in Sierra Leone for safe burials due to lack of supplies	• Used as a last resort strategy as these types of homemade equipment are not scientifically proven to prevent transmission of infectious pathogens • Hospitals can collaborate with research institutions and labs to carry out research on the safety of these equipment

[54] Weston, M., Macupe, B., & Kiewit, L. (2020, April 1). How to tackle Covid-19 in informal settlements. Retrieved from https://mg.co.za/article/2020-03-27-how-to-tackle-covid-19-in-informal-settlements/?utm_medium=Social&utm_source=Facebook&fbclid=IwAR3Nmfvk3q1DrwOfW8SkWLtI4fsFcbzhZFpNKkAvq1S1L8Edk_6LCL6a-io#Echobox=1585508598
[55] Livingston, E. (2020, March 28). Sourcing Personal Protective Equipment During the COVID-19 Pandemic. Retrieved from https://jamanetwork.com/journals/jama/fullarticle/2764031
[56] Weston, M., Macupe, B., & Kiewit, L. (2020, April 1). How to tackle Covid-19 in informal settlements. Retrieved from https://mg.co.za/article/2020-03-27-how-to-tackle-covid-19-in-informal-settlements/?utm_medium=Social&utm_source=Facebook&fbclid=IwAR3Nmfvk3q1DrwOfW8SkWLtI4fsFcbzhZFpNKkAvq1S1L8Edk_6LCL6a-io#Echobox=1585508598

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Use hydrogen peroxide vapor to decontaminate and re-use N95 masks. This practice is able to clean 500 masks in one cycle, which takes about 4 hours. The disinfected respirators can be decontaminated and re-used for about 30-50 times.	Duke University and Health System[57]	Short supply of N95 masks in hospitals have led a team at Duke to experiment and succeed in decontamination strategies	After decontamination, need to ensure that mask has no tears and that it still fits snugly around face, or else it would defeat the purpose of preventing transmission of virus

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider various methods to extend life of PPE: • Rotate equipment through 72-h cycles given current understanding of surface viability. • Use of disinfectants such as Heat (eg, autoclave), UV, ozone, ethylene oxide, hydrogen peroxide, bleach, isopropyl alcohol, gamma or e-beam radiation, microwave, copper sulfate, methylene blue with light, sodium chlorine, iodine, zinc oxide impregnation (gowns), hypochlorous acid, commercial laundering (for cloth). • Extend supply of current PPE by using plastic face shields (water bottle cutouts, thermoplastic sheets, A4 acetate sheets, Ziploc bags) to preserve face masks and eyewear.	JAMA Network[58]	JAMA sent out a call for ideas from the public on how to source PPE during the COVID-19 pandemic	Cleaning methods may still pose a risk of contamination of PPE as this method has not been fully evidenced to prevent the spread of virus

[57] Andrew, S. (2020, March 27). Duke researchers are decontaminating N95 masks so doctors can reuse them to treat coronavirus patients. Retrieved from https://edition.cnn.com/2020/03/27/health/n95-respirator-rewear-coronavirus-duke-trnd/index.html?fbclid=IwAR2bgePgnMGcBWjl5izU4AL5udHI7mqquiSTFnBrIubzPSuEFuDrcD9sxdw
[58] Livingston, E. (2020, March 28). Sourcing Personal Protective Equipment During the COVID-19 Pandemic. Retrieved from https://jamanetwork.com/journals/jama/fullarticle/2764031

PRACTICE #4	ORGANISATION	CONTEXT	CONSIDERATIONS
Stock up enough PPE to match the role of that particular hospital facility. In the Ebola context, for example: • Frontline facility – stock up PPE sufficient for 12 to 24 hours of care • Ebola Assessment Hospital – stock up PPE for at least 4 to 5 days of patient care • Ebola Treatment Hospital – stock up PPE for at least 7 days of patient care	CDC[59]	These guidelines were part of considerations recommended by the CDC for US healthcare facilities to ensure adequate supplies of personal protective equipment for Ebola preparedness	• The PPE requirements should be adapted to coronavirus or specific pandemic situations • Amount of PPE each day depends on the number of patients, the acuity of patients, projected number of staff and healthcare team configuration, length of shifts, number of required breaks for staff wearing PPE, isolation unit location and staff support strategies, waste management strategy, lab location, lab testing demand, and hospital protocols for products

[59] CDC. (2016, January 5). PPE Supply Considerations. Retrieved from https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/supplies.html

3.1.4
Area: Operations
Risk area: Resource allocation
Issue: Insufficient supply of ventilators

SURGE CAPACITY STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider practices to increase the capacity of a single ventilator, only used as a last resort: • A study found that during Surge Capacity in disasters, a ventilator can be used to support 4 patients by using a modified circuit. • A doctor from Ontario used one ventilator for 9 people, rigging the ventilator up using medical tubes and hoses. The ventilator will need to function at higher than normal capacity, but this method works for patients with similar lung capacity.	US National Library of Medicine[60] Perth and Smiths Falls District Hospital in Ontario[61]	An experiment was done to test whether a four-limbed ventilator circuit could ventilate four adult-human-sized sheep, which has the potential to improve disaster preparedness by expanding local ventilator capacity	• Only to be used as a last resort option as there is no medical proof of safety or efficacy on this technique • Hospitals can collaborate with research institutions and labs to carry out research on the safety of these equipment

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Use 3D-printed adaptor to turn retail shop-snorkelling masks (e.g. from Decathlon) into ventilators.	Isinnova[62]	Insufficient ventilators	• Correct 3D printing method and non-scented and skin safe materials used as this will be in close contact with the patient • Disclosure to patients that this is not a

[60] Paladino, L., Silverberg, M., Charchaflieh, J. G., Eason, J. K., et al. (2008). Increasing Ventilator Surge Capacity in Disasters: Ventilation of Four Adult-Human-Sized Sheep on a Single Ventilator With a Modified Circuit. Resucitation , 77(1). Retrieved from https://pubmed.ncbi.nlm.nih.gov/18164798/
[61] Perry, T. (2020, April 2). Canadian doctor's brilliant 'evil genius' hack transforms 1 ventilator into 9. Retrieved from https://www.upworthy.com/canadian-doctors-brilliant-evil-genius-hack-turns-one-ventilator-into-nine?fbclid=IwAR0GfNRT6I8b2Wk4ULTfjYmNJYpJuwiZO1JGxXtQfS8yijwpD0ZcE0829TY
[62] Isinnova. (2020, March 26). Easy – Covid19 ENG. Retrieved from https://www.isinnova.it/easy-covid19-eng/

			certified medical device to minimize legal liability

3.2.1
Area: Operations
Risk area: Safety and security
Issue: Lapses in compliance of healthcare workers with hand hygiene standards due to insufficient reminders and enforcement

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider toolkits and guidelines developed by WHO for healthcare facilities to use on-site. In particular, WHO follows the 'My 5 Moments Hand Hygiene in Patients' developed by the Swiss National Hand Hygiene Campaign: • One – Before touching a patient • Two – Before clean/aseptic procedure • Three – After body fluid exposure risk • Four – After touching a patient • Give – After touching patient surrounding Tools for ensuring basic infrastructure and facilities for hand hygiene: • Ward infrastructure survey. • Alcohol-based hand rub planning and costing tool. • Guide to local production: WHO-recommended hand rub formulations d) Soap/hand rub consumption survey. • Protocol for evaluation of tolerability and acceptability of alcohol-based hand rub in use or planned to be introduced. • Protocol for evaluation and comparison of tolerability and acceptability of different alcohol-based hand rubs. Available material for staff reminders at the workplace: • Hand hygiene poster. • How to hand rub poster. • How to hand wash poster. • Hand hygiene: When and how leaflet. • Save lives: Clean your hands screensaver.	WHO[63]	Guidelines developed by WHO for infection prevention and control, with regard to hand hygiene	• Important to ensure that all healthcare facilities follow a minimum standard when it comes to basic handwashing • Regular audit and checks can be put in place to ensure compliance over time, with adequate use of workplace reminders and tools

[63] Infection prevention and control – Hand hygiene tools and resources. World Health Organization. Retrieved at https://www.who.int/infection-prevention/tools/hand-hygiene/en/

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Develop behavioural tactics to help improve compliance, such as: • Present staff with real-life, personal stories regarding the human cost of hospital-acquired infections can make an emotional appeal to providers to improve compliance. • Administrators play the role of vocal advocates to reinforce the importance of hand hygiene. • Consistent retraining of employees with regard to hygiene best practices and system-wide benefits of compliance. • Strategic posting of signage in key locations in the hospital e.g. posting the image of man's eyes over the sanitizer dispensers boosted hand hygiene compliance by 33%, while a clean, citrus smell also significantly improves compliance[64]. • Create a culture where healthcare workers become advocates themselves, instead of complying out of fear of being punished.	Recommended by Ecolab[65]	Developed as a range of techniques to encourage hand hygiene amongst healthcare practitioners	• Ensure regular trainings, reminders, or training sessions during normal capacity period to ensure behaviors continue during surge periods

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Put in place measures to monitor hygiene level, such as through: • Direct observation: involves monitoring the actual hand hygiene actions of staff. It can be done manually — with an actual person doing the monitoring — or it can be done with the assistance of technology such as smartphone apps. • Measuring product use: This is an indirect way of conducting observations by quantifying the amount of soap and sanitizer used. • Electronic monitoring: Several different types of sensors are now available to measure handwashing compliance. While they can be expensive, a major benefit of electronic monitoring is it can provide administrators with real-time feedback on compliance prior to a healthcare worker's interaction with patients.	Recommended by Ecolab[66]	Developed as a range of techniques to encourage hand hygiene amongst healthcare practitioners	• The implementation of surveillance measure should be done only when there is a significant lack of compliance observed, to avoid unnecessary expenditure

[64] King, D., Vlaev, I., Everett-Thomas, R., Fitzpatrick, M., Darzi, A., & Birnbach, D. J. (2016). "Priming" hand hygiene compliance in clinical environments. Health Psychology, 35(1), 96. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/26214075

[65,45] Zimmerman, B. (2016, December 7th). A culture of support: 4 ways to improve hand hygiene compliance. Beckers Hospital Review. Retrieved from https://www.beckershospitalreview.com/quality/a-culture-of-support-4-ways-to-improve-hand-hygiene-compliance.html

Compliance with environmental hygiene can be measured by direct observation, fluorescent markers, ATP or environmental culture.			

PRACTICE #4	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider increasing sinks and placing sinks in more effective areas: • Make changes to the placement of hand washing facilities in the hospital: Handwashing after direct contact with patients or their support equipment was recorded. The ratio of beds to sinks was 1:1 in the medical ICU and 4:1 in the surgical ICU. • The nurses in the unit with one sink per bed had a significantly greater number of handwashes (76%) than those in the unit with fewer sinks (51%). • Existing practices of leaving hand sanitizer at doorways and corridors instead of in hospital rooms also reduce frequency of handwashing[67].	Findings published in the US National Library of Medicine, National Institutes of Health[68]	The frequency of handwashing in two ICUs was compared to see the effectiveness of sink placement in ensuring hand hygiene techniques	• For wards with high level of infection such as ICUs and Isolation, a redundancy mindset should be adopted to ensure maximum compliance to hand hygiene • For normal wards, installation of additional infrastructure may not be necessary as this can be costly to implement

[67] Anthes, E. (2020, March 22nd). Pandemics spread in hospitals. Changes in design and protocol can save lives. The Palm Beach Post. Retrieved from https://www.palmbeachpost.com/opinion/20200322/anthes-pandemics-spread-in-hospitals-changes-in-design-and-protocols-can-save-lives
[68] Kaplan, L. M., & McGuckin, M. (1986). Increasing handwashing compliance with more accessible sinks. Infection Control & Hospital Epidemiology, 7(8), 408-410. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/3638277

3.2.2
Area: Operations
Risk area: Safety and security
Issue: Insufficient disinfection of potentially highly-infectious, non-critical surfaces in hospitals

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Combine the disinfection of surfaces with monitoring efforts. The main monitoring efforts include: • Visual monitor: Fairly unreliable and subjective. • Adenosine triphosphate (ATP) bioluminescence: Fast yet sensitive way to monitor effectiveness of cleaning. Less than 500 relative light units (RLU) suggest that a surface is clean. Some studies advocate that a more stringent cut-off of 250 RLU should be used. This method is reliable but expensive. • Fluorescent markers (UV light): Complete or partial removal of fluorescent markers during terminal cleaning is correlated with less surface contamination. This method is useful for demonstrating appropriate cleaning of surfaces by detecting the remains of the fluorescent dye.	International Society for Infectious Disease, United States[69]	Different methods of monitoring hygiene level on various surfaces	Should be done routinely to ensure that cleaning techniques are up-to-standards, especially upon the outbreak of a pandemic to minimize spread of infection

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Ensure stringent methods to disinfect hospital floors, as items may fall to the floor and become contaminated: • Over 80 percent of the bacterial load on hospital floors can be removed by detergent-based cleaning only. • Water used for mop rinsing usually becomes increasingly contaminated and spread microbes. It should be routinely discarded in favour of fresh detergent solutions between bed spaces or every 15 min, whichever is sooner. • Disinfectants can be used for floors in high-risk clinical areas. • Mop heads may be disposable, with the length of time and/or areas of use specified; if not, they are employed for a particular duty, e.g. Operating	Recommendations from a study published in the US National Library of Medicine[70]	Particular methods for decontaminating non-critical surfaces such as floors	Especially during pandemic surge, it is important to ensure that even non-critical surfaces are cleaned, especially when there is heavy traffic coming in and out of wards

[69] Gonzalo M.L. et al. (2018 June). Disinfection in the Hospital Environment. Guide to Infection control in the Hospital. Retrieved from https://isid.org/wp-content/uploads/2018/06/ISID_Infection_Guide_Chapter10.pdf
[70] Dancer, S. J. (2014). Controlling hospital-acquired infection: focus on the role of the environment and new technologies for decontamination. Clinical microbiology reviews, 27(4), 665-690. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4187643/

	theatre, before being bagged and sent for decontamination, usually on a daily basis.			

3.2.3
Area: Operations
Risk area: Safety and security
Issue: High traffic in the hospital increases the risk of mass infection

SURGE CAPACITY STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Reduce visitors by placing restrictions on visits: • Complete ban of all visitors except for exceptional cases, which is at the discretion of nurse-in-charge. • Limit the visiting of patients to direct family members and parents only, and limit the number of visitors to one, except for patients in end-of-life care • Limit visiting time, together with number of visitors. • All visits must be scheduled and arranged beforehand. • Encourage remote communications with patients, patient check-in through healthcare workers for status of family members[71].	Hospitals across Southern England[72]	In response to high risk of infection and high traffic of people, hospitals impose restrictions on visitors to ensure	• Visitor policies should depend on hospital capacity and rate of infection; ensure that all visitors are signed in, in case contact tracing is required • The restriction of both timing and number of visitors makes it easier to identify individuals who are potentially at risk, knowing their visiting hours

[71] Visitor Restrictions Due to Coronavirus. UCSF Health. Retrieved from https://www.ucsfhealth.org/for-visitors/visitor-restrictions-due-to-coronavirus
[72] BBC News (2020, March 19th).Coronavirus: Hospitals across southern England impose visitor restrictions. BBC News. Retrieved from https://www.bbc.com/news/uk-england-51962793

3.3.1
Area: Operations
Risk area: Planning and layout
Issue: Ineffective hospital planning and layout may lead to large distances travelled by those who are infectious, increasing spread to others

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Maintain discrete clinical pathways into hospital wards and departments in case there is a need to treat highly-infectious patients without exposing them to others in the hospital: • In the emergency department and outpatient clinic, doors lead directly from the outdoors to several private isolation rooms so patients suspected of being contagious can bypass the communal waiting area. • The inpatient rooms are sited on the upper floors. They have doors that open onto balconies that wrap around the circular building. When patients are admitted, they can be taken to their rooms via these outdoor walkways. • Another set of doors connects each patient room to an indoor corridor used by hospital staffers.	Skane University Hospital, Sweden[73]	Minimize movement of potentially infectious patients through public spaces	While redesign of hospitals during times of crisis is not possible, future development of hospitals can take into account traffic flows and hospital areas specifically for highly-infectious diseases

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Dedicate pathways and elevators for patients who are suspected of an infectious disease, following a particular protocol: • Patients will travel through a dedicated elevator and be taken directly to place of testing. • If patient cannot go into the room, porter will bring patient back to his/her room through the same way.	Mount Sinai Hospital, Canada[74]	Minimize exposure of infectious patients with other people in the hospital	• Pre-planning and design of hospitals before the outbreak of a pandemic, with designated equipment and infrastructure, is key • In cases where this is not possible, designated paths should be marked out to minimize exposure

[73] Anthes, E. (2020, March 22nd). Pandemics spread in hospitals. Changes in design and protocol can save lives. The Palm Beach Post. Retrieved from https://www.palmbeachpost.com/opinion/20200322/anthes-pandemics-spread-in-hospitals-changes-in-design-and-protocols-can-save-lives
[74] Mount Sinai Hospital. Procedures for transportation of patients in vre/mrsa precautions. Retrieved from https://eportal.mountsinai.ca/Microbiology/protocols/pdf/k2biv.pdf.

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement changes and additions to hospital layout and facilities to contain infection spread: • Hualien Tzu Chi Hospital re-engineered diagnostic and specimen collection procedures and traffic flow for patients suspected of having flu or coronavirus as a one-stop service. • A one-stop medicine pick-up window is setup for patients with continuous prescription. This pick-up window is another convenient service to protect patients so that they avoid going inside the hospital. • Two external negative pressure rooms are set up to collect specimens in an environment that protects both visitors and medical personnel.	Hualien Tzu Chi Hospital, Taiwan[75]	Rapid development of methods to deal with spike in COVID-19 infection	Hospital workflows has to match the layout of infrastructure and facilities to ensure efficient management of patient and procedures

PRACTICE #4	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement several design parameters in an ambulance bay to limit the risk of infection, such as: • Having an ambulance bay that is closed off from other areas of the hospital so that patients can be safely evaluated there before entering the hospital. • Having several negative pressure zones in the ambulance bay that can be turned on to limit the spread of the virus.	Rush University Hospital, Chicago[76]	Limiting patient movement within hospital to reduce risk of virus transmission	• Requires pre-planning of the hospital layout to ensure limited movement of infected patient within the hospital • Considerations on having several ambulance bays in the event that one bay is closed off and there are multiple patients who need treatment

[75] Tzu Chi Foundation (2020, March 4th). Hualien Tzu Chi Hospital Sets up External Negative Pressure Specimen Collection. Retrieved from http://tw.tzuchi.org/en/index.php?option=com_content&view=article&id=1491%3Ahualien-tzu-chi-hospital-sets-up-external-negative-pressure-specimen-collection-&catid=125%3Aepidemic-prevention-for-covid-19&Itemid=369&lang=en

[76] Peters, A. (2020, March 26). How we can redesign cities to fight future pandemics. Retrieved from https://www.fastcompany.com/90479665/how-we-can-redesign-cities-to-fight-future-pandemics?fbclid=IwAR0Nff_KMc6uHg92zxCadNStA0CUyyIODYtJ98FjDbgzqGYHEDptHI3fsxU

PRACTICE #5	ORGANISATION	CONTEXT	CONSIDERATIONS
Transform hospital rooms from an acute care room to an ICU room if the patient illness worsens to reduce risk of spreading the virus in the hospital when patients have to be transferred or moved	Rush University Hospital, Chicago[77]	Limiting patient movement within hospital to reduce risk of virus transmission	• Cases where acute care rooms turn into ICU rooms could be when patients health worsens and there is too much risk with transferring the patient to the ICU ward. • Acute care rooms can also be converted into ICU wards when current ICU wards are fully booked.

[77] Ibid

3.4.1
Area: Operations
Risk area: IT infrastructure management
Issue: In-person contact with patients increases risk of transmission of virus from patient to healthcare worker

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Leverage on IT infrastructure to tackle hospital issues related to the COVID-19 epidemic: • Artificial intelligence (AI)-assisted infection risk identification, temperature monitoring, online screening, and consultation platforms. • AI-assisted radiological image interpretation and intervention recommendations. • Big data analytics for epidemic prevention and control: a) Predictive modelling and turning point projection. b) Supercomputing for vaccine and drug development. • Contact-free technologies: a) Unprecedented growth of Internet. b) Telemedicine services. c) Care in the Quarantine Area. d) Unprecedented growth in telecommuting and online education. e) Drones deployed for crowd activity monitoring, environment disinfection and fever detection. f) Contact-free supply delivery.	Imaging Technology News[78]	Deployment of health IT in China's fight against the COVID-19 epidemic	• Work with the IT department in hospitals to develop some of these solutions • Necessary for legal team to deal with issues relating to data privacy and consent of using certain technology solutions

[78] Imaging Technology News . (2020, March 23). Deployment of Health IT in China's Fight Against the COVID-19 Epidemic. Retrieved from https://www.itnonline.com/article/deployment-health-it-china's-fight-against-covid-19-epidemic?fbclid=IwAR1ThYia76lN4TBlSmdAT2TrSPraROPsZ9_u7GEsyozKquEa_dzCBZNCSG8

4. Communications

Key operational functions

Develop communications protocols

- Develop mechanisms, including clearance processes, to ensure coordinated and consistent actions, messages and community engagement within hospital and with all partners
- Develop formal structures and agreed procedures to conduct risk communication and community engagement (legal and policy frameworks, risk communication plan, funding)
- Nominate at least one hospital spokesperson with training in media handling (who can communicate uncertainty and convey complex science into understandable language), ensuring that all employees know who it is

Provide accurate and timely information to staff, patients, and public

- Consolidate necessary information
- Draft message with appropriate framing and language
- Vet and approve message
- Broadcast message on appropriate channels, such as through briefings, newsletters, social media, news outlets etc.
- Share sources of information for fact checking or further information if needed
- Provide contact point for further information
- Update staff, patients, and public regularly of actions taken
- Address rumours and misinformation quickly
- Monitor and forecast potential public and media relation issues
- Establish telecommunications channels (teleconferences, calls etc.)
- Establish contact activation system

Communicate risks effectively to staff, patients, and public

- Coordinate with local public health and emergency response agencies on appropriate message and information sharing initiatives
- Use public platforms, i.e. through advertisements, media platforms, interviews, public notices etc. to broadcast important information, if needed
- Develop pre-planned risk communications message options for employees

Coordinate information sharing within the hospital, across the supply chain, with government partners, and with related sectors

- Prioritise normal and emergency communications protocols, processes, and capabilities for rapid information sharing with all relevant stakeholders
- Apply and strengthen health sector coordination and communication mechanisms with pandemic preparedness, response, and recovery partners (e.g. national emergency management agencies and other government agencies, and the health-care sector at subnational and local levels)
- Meet with all internal and external stakeholder groups to identify concerns and support needs
- Inform suppliers and customers of alternative procedures for business operations, e.g. pickups/deliveries/permitted visits to hospital premises

Identified key risk areas within communications processes

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
4.1 Provide accurate and timely information to staff, patients, and public	4.1.1	Rumours and misinformation spread quickly in a rapidly changing healthcare situation	• High risk of mass panic if public is unaware that information is false and act upon it	• Provide guidelines to help public identify rumours • Anticipate and address questions from public • Debunk misinformation regularly
4.2 Communicate risks effectively to staff, patients, and public	4.2.1	Need to ensure that risks communicated are taken seriously	• High potential for infection if risks communicated are not taken seriously	• Humanise threat of disease • Use community influencers to communicate risks
	4.2.2	Staff require an outlet to convey important information and needs to the public during a crisis	• High impact on staff morale if they feel like their fears and concerns are not aired and addressed	• Schedule media interviews for hospital staff
	4.2.3	Staff may bypass stipulated media guidelines to speak publicly about working conditions and on-the-ground situations[79]	• High risk of miscommunication and high risk to public reputation if message is emotional, biased, or false	• Require staff to obtain permission before speaking publicly • Enforce disciplinary action on staff who speak to the media unauthorised

[79] Carville , O., Court, E., & Brown, K. V. (2020, March 31). Hospitals Tell Doctors They'll Be Fired If They Speak Out About Lack of Gear. Retrieved from https://www.bloomberg.com/news/articles/2020-03-31/hospitals-tell-doctors-they-ll-be-fired-if-they-talk-to-press?utm_medium=social&utm_content=politics&utm_campaign=socialflow-organic&cmpid=socialflow-facebook-politics&utm_source=facebook&fbclid=IwAR39KGL3GAmtZ-ESh5qiVIYn4XMVWcuueXPhzAoIvsmKNa0y-juQRJ6y94Y

4.3 Coordinate information sharing within the hospital, across the supply chain, with government partners, and with related sectors	4.3.1	Lack of mass broadcast channels for hospitals to share information rapidly with partners and patients	• High potential for infection if critical information is not broadcast quickly during a pandemic	• Use social media to disseminate information • Create chat platforms and chatbots for people to get their questions answered quickly
	4.3.2	Difficult to obtain authenticated information quickly for immediate action	• High potential for infection if critical information cannot be acted upon as it is not officially authenticated	• Use information from pre-prints to guide decision-making
	4.3.3	Lack of information reporting structure for unified response	• High risk of internal/external miscommunication due to lack of discipline and accountability at all levels in conveying information	• Use incidence management system

4.1.1
Area: Communications
Risk area: Provide accurate and timely information to staff, patients, and public
Issue: Rumours and misinformation spread quickly in a rapidly changing healthcare situation

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Provide clear guidelines on how to identify rumours and spot fake news, and advise public to refer to official healthcare organisation's website for the latest information from the organisation.	Johns Hopkins Medicine[80]	Website is specifically for COVID-19 information and updates	Real examples of fake news can be used to demonstrate the common traits that false information tend to have

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Anticipate questions about the situation that may arise for the layperson, and address these questions in simple language on healthcare organisation's website.	CDC[81]	Website is specifically for COVID-19 information and updates	A good understanding of a layperson's concerns will be helpful in anticipating the questions asked

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Debunk all misinformation and rumours that are circulating by having regular updates on organisation's website to explicitly state that those pieces of information are false.	Ministry of Health, Singapore[82]	Website is specifically for COVID-19 information and updates	Updates need to be regular and constant in order to quickly quell the spread of rumours

[80] Moore, S. (2020, March 28). Coronavirus Myths, Rumors and Misinformation: Johns Hopkins Medicine. Retrieved from https://www.hopkinsmedicine.org/coronavirus/coronavirus-myths-rumors-misinformation.html
[81] Centers for Disease Control and Prevention. (2020, March 12). Stop the Spread of Rumors. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/share-facts.html
[82] Ministry of Health, Singapore. (2020, April 1). Clarifications on Misinformation Regarding COVID-19. Retrieved from https://www.moh.gov.sg/covid-19/clarifications

4.2.1
Area: Communications
Risk area: Communicate risks effectively to staff, patients, and public
Issue: Need to ensure that risks communicated are taken seriously

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Humanize the threat of disease and remove excessive medical jargon to ensure that the message is very clear to its audience, and that the audience is suitably moved to take necessary precautions. Personal stories, for example, can generate emotional associations with the threat and make it more "real".	Recommendation from a study published in BMC Public Health[83]	Recommendation is based a study conducted to explore communication strategies to promote vaccination	Personal anecdotes still need to be supported by clear, straightforward facts and evidence

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Work with influencers in the community such as community leaders, religious leaders, women leaders, and health workers to communicate risks and promote good hygiene practices.	Recommendation by WHO[84]	A recommendation posted on Twitter by WHO during the COVID-19 pandemic	Such influencers also need to have adequate training in risk communication, and understand clearly of the reason behind the message they are conveying so that they can explain it to their audience

[83] Steffens, M. S., Dunn, A. G., Wiley, K. E., & Leask, J. (2019). How organisations promoting vaccination respond to misinformation on social media: a qualitative investigation. BMC public health, 19(1), 1-12.
[84] World Health Organisation. (2020, March 20). "Risk communications should work with influencers in the community such as community leaders, religious leaders, women leaders & local health workers to promote #COVID19 safe practices like hand washing, respiratory hygiene & social distancing". Retrieved from https://twitter.com/WHO/status/1241012632557150211

4.2.2
Area: Communications
Risk area: Communicate risks effectively to staff, patients, and public
Issue: Staff require an outlet to convey important information and needs to the public during a crisis

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Encourage and schedule media interviews for nurses, physicians, and trainees to share important information, concerns and experiences with the public in times of a public health crisis.	Mount Sinai Hospital, University of California San Francisco Medical Center[85]	Established in response to convey rapidly-evolving on-the-ground challenges to the public during COVID-19 pandemic	• Need to ensure that the information shared by different employees is consistent and factual • Might need to train staff on media handling techniques

[85] Carville, O., Court, E., & Brown, K. V. (2020, March 31). Hospitals Tell Doctors They'll Be Fired If They Speak Out About Lack of Gear. Retrieved from https://www.bloomberg.com/news/articles/2020-03-31/hospitals-tell-doctors-they-ll-be-fired-if-they-talk-to-press?utm_medium=social&utm_content=politics&utm_campaign=socialflow-organic&cmpid=socialflow-facebook-politics&utm_source=facebook&fbclid=IwAR39KGL3GAmtZ-ESh5qiVIYn4XMVWcuueXPhzAoIvsmKNa0y-juQRJ6y94Y

4.2.3
Area: Communications
Risk area: Communicate risks effectively to staff, patients, and public
Issue: Staff may bypass stipulated media guidelines to speak publicly about working conditions and on-the-ground situations

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Require staff to obtain permission before speaking publicly, and ensure that all media requests are vetted by the public relations department before engaging in any public disclosure of information.	Montefiore Health System[86]	Especially enforced during COVID-19 pandemic to control staff communication with media outlets	• Need to ensure that the process of obtaining permission to speak publicly is efficient, so that information is released as soon as possible in a rapidly evolving pandemic • Need to be transparent about the media request vetting process, and the rationale behind why some might be accepted while others are not

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Subject staff who speak to the media without authorization to disciplinary action, including the possibility of termination.	NYU Langone Health[87]	Especially enforced during COVID-19 pandemic to control staff communication with media outlets	Staff might feel disempowered by such measures, which may cause a plunge in overall morale and work standards

[86] Ibid
[87] Ibid

4.3.1
Area: Communications
Risk area: Coordinate information sharing within the hospital, across the supply chain, with government partners, and with related sectors
Issue: Lack of mass broadcast channels for hospitals to share information rapidly with partners and patients

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use social media (like Facebook or Twitter) to disseminate quick, free, and easy access to critical information to the masses. Social media allows real-time interaction between healthcare providers and patients or business partners, and provides a tool and space for instant information exchange, participation, and expression.	Recommendation by a paper published in Cogent Social Sciences[88] and a paper published in AJPH Research[89]	The study, which was based in Spain, found that the general public appreciated hospitals' communication potential through social media, though this mode of communication was not yet widespread within the population	Need to make extra effort to establish credibility of information posted on social media as some may be unfamiliar with it as a source of trustworthy information

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Create chat platforms (e.g. via Whatsapp or Telegram) where the public can send their questions to and have them answered immediately by a chatbot, which presents a menu of options and advises the inquirer where to get further help or information.	WHO Health Alert[90]	Set up to handle COVID-19-related questions from anyone in the world	Need to ensure that chatbots are able to provide useful information that answers the question posed, and not just generic answers

[88] De Las Heras-Pedrosa, C., Rando-Cueto, D., Jambrino-Maldonado, C., & Paniagua-Rojano, F. J. (2020). Analysis and study of hospital communication via social media from the patient perspective. Cogent Social Sciences, 6(1), 1718578.
[89] Sinnenberg, L., Buttenheim, A. M., Padrez, K., Mancheno, C., Ungar, L., & Merchant, R. M. (2017). Twitter as a tool for health research: a systematic review. American journal of public health, 107(1), e1-e8.
[90] World Health Organisation. (2020). WHO Health Alert, Whatsapp Chat. Retrieved from https://api.whatsapp.com/send?phone=41225017596&text=hi&source=&data=

4.3.2
Area: Communications
Risk area: Coordinate information sharing within the hospital, across the supply chain, with government partners, and with related sectors
Issue: Difficult to obtain authenticated information quickly for immediate action

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Utilise pre-prints (scientific papers that have not been peer edited yet) to obtain valuable preliminary information quickly to inform and guide assessment of a public health emergency and actions to be taken.	WHO[91]	WHO posted on Twitter that it would use preprints to guide assessments of COVID-19, and a similar measure was also promoted during the 2016 Zika virus outbreak, with research organisations arguing that preprints could be useful in a public health emergency[92]	• Need to triangulate and corroborate information in pre-prints with other reputable sources as an interim means of fact-checking • Some observations have been made about how quickly errors in pre-prints are pointed out by the scientific community, usually through social media

[91] World Health Organisation. (2020, Jan 27). "GREAT NEWS! The editors of major scientific journals have agreed to share any papers about the new #coronavirus (2019-nCoV) with WHO before publication, with authors' consent. This is important to inform our assessment of the situation, our guidance to countries and actions." Retrieved from https://twitter.com/WHO/status/1221475167869833217
[92] Thomasy, H., Schulson, M., & Schulson, M. (2020, April 1). In the Race to Crack Covid-19, Scientists Bypass Peer Review. Retrieved from https://undark.org/2020/04/01/scientific-publishing-covid-19/

4.3.3
Area: Communications
Risk area: Coordinate information sharing within the hospital, across the supply chain, with government partners, and with related sectors
Issue: Lack of information reporting structure for unified response

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use an incidence management system response structure (e.g. in Fig. 7) to facilitate coordination of staff and expertise across various organisational components, and appoint various persons-in-charge at each level of the reporting structure to ensure accountability and discipline in communicating key information.	Recommended by Dr. Tom Frieden, former director of the CDC[93]	The CDC's Emergency Operations Center, which is activated in response to public health emergencies, always operates according to the principles of the Incident Management System regardless of the type of public health emergency that has occurred[94]	Need to be flexible in allowing decision-making to be driven by multiple agencies or departments, to prevent bottlenecks from occurring if one part of the response structure chain is overwhelmed or not functioning

[93] Frieden, T. (2020, April 12). What the C.D.C. Can Do to Slow This Pandemic. Retrieved from https://www.nytimes.com/2020/04/12/opinion/cdc-coronavirus.html?action=click&module=Opinion&pgtype=Homepage
[94] Iskander, J., Rose, D. A., & Ghiya, N. D. (2017). Science in emergency response at CDC: structure and functions. American Journal of Public Health, 107(S2), S122-S125. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5594391/pdf/AJPH.2017.303951.pdf

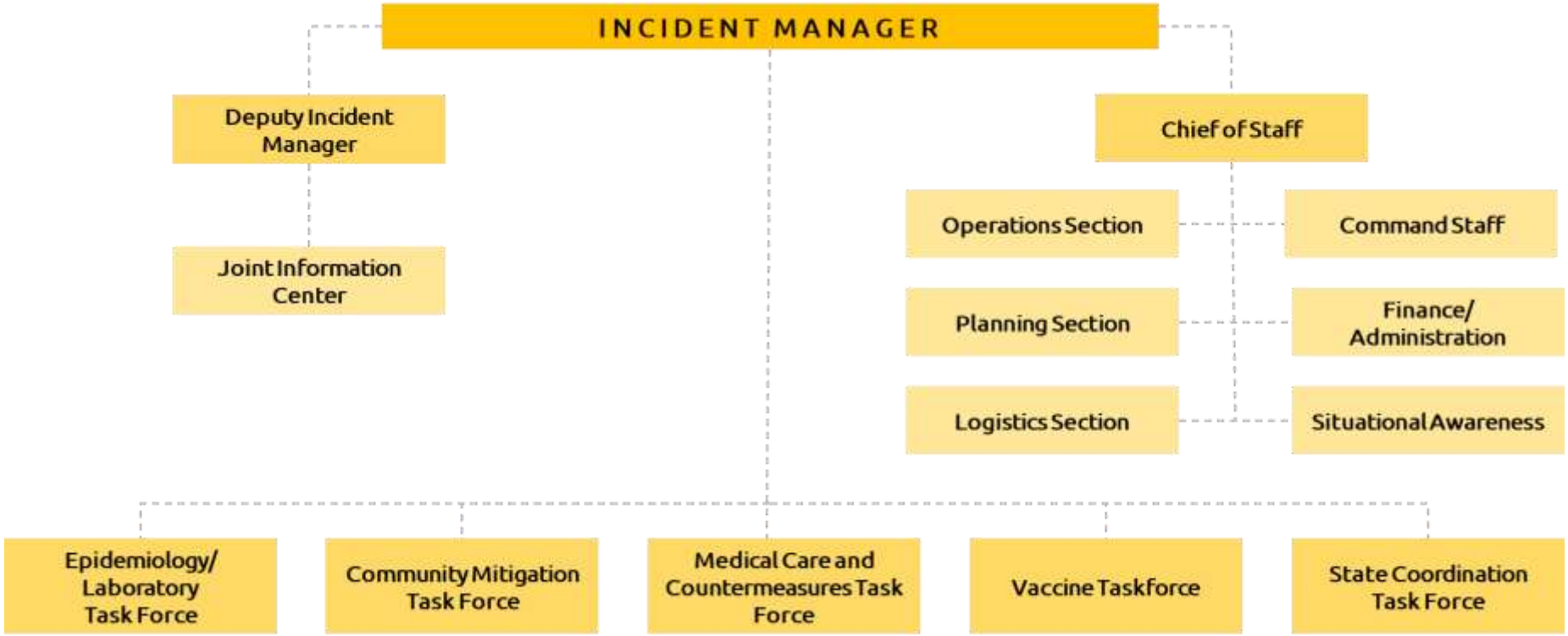


Figure 4. CDC incident management system structure for the response to 2009 H1N1 influenza[95]

[95] Papagiotas, S. S., Frank, M., Bruce, S., & Posid, J. M. (2012). From SARS to 2009 H1N1 influenza: the evolution of a public health incident management system at CDC. Public Health Reports, 127(3), 267-274. Retrieved from https://journals.sagepub.com/doi/abs/10.1177/003335491212700306

5. Legal

Key legal functions

Contract and leases

- Preparation, review, defense of contract
- Applicable to staff members, vendors, partners

Intellectual property

- Governing norms and procedures over patents, designs, trademarks, copyright, now-how, confidential information, trade secrets, release of medical reports

Corporate governance

- Code of governance
- Corporate workflow and bureaucracies

Licensure and accreditation

- Medical accreditation e.g. Telemedicine, doctor, nurses
- Hospital licensure

Medical ethics

- Training for staff: communication, material, trainings, workshops
- Practice-specific trainings e.g. Death certification, autopsy, medicolegal investigation of death
- Health practitioners' code of conduct and ethics

Compliance

- Policies, procedures, and schedules
- Perform internal audits
- Measure compliance program performance
- Discipline for non-compliance
- Investigate and remedial measures

Identified key risk areas within legal processes

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
5.1 Medical ethics	5.1.1	Healthcare practitioners have to decide on who to prioritize treatment due to increase in demand for healthcare services	• High risk of fatality due to the limited medical support provided to patients • High impact on staff morale due to the ethical trauma induced • High risk to public reputation and mass panic due to potentially unfavourable reaction from the public	• Develop patient triage criteria according to the principle of maximizing benefits for the mass • Implement patient triage frameworks and parameters to make the process more scientific and efficient
	5.1.2	Lack of awareness on medical ethics and legal repercussions can lead to malpractice by healthcare workers	• High impact on staff morale due to the ethical trauma induced	• Implement clinical ethics support systems within hospitals • Implement practices to avoid moral distress and dilemmas • Use a checklist to think through moral and ethical issues
5.2 Licensure and accreditation	5.2.1	Accreditation of healthcare workers can be a long process that results in delays in deployment of personnel	• High risk of manpower shortage due to insufficient healthcare workers with qualifications	• Fast-track the conversion of foreign medical qualifications • Quicken the graduation process for medical students
	5.2.2	Temporary staff may not have the proper credentials required	• High risk of legal repercussions when staff are not properly licensed	• Provide necessary credentials for temporary staff

5.3 Contract and leases	5.3.1	Healthcare workers have limited legal protection and provision despite being highly exposed to infections	• High risk of manpower shortage due to healthcare workers quitting/getting infected • High impact on staff morale due to the lack of protection • High risk of infection as healthcare workers become infected	• Institute legal protections and rights for healthcare workers • Institute legal clinical orders to protect healthcare workers • Remove legal barriers to telehealth practices to enhance workers' safety
	5.3.2	Lack of support from vendors in maintaining supplies may result in supply shortage	• High risk of supply shortage due to spoiled equipment	• Democratize the knowledge of ventilator maintenance

5.1.1 **SURGE CAPACITY STAGE**
Area: Legal
Risk area: Medical Ethics
Issue: Healthcare practitioners have to decide on who to prioritize treatment due to increase in demand for healthcare services

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Informed by the principle of maximizing benefits for the largest number, develop resource allocation criteria to guarantee that those patients with the highest chance of therapeutic success will retain access to intensive care: • Every time a bed comes free, two anaesthesiologists consult with a specialist in resuscitation and an internal medicine physician to decide who will occupy it. • Age, pre-existing medical conditions, whether or not patient has a family, are important factors. So is having a family. • Those who are too old to have a high likelihood of recovery, or who have too low a number of "life-years" left even if they should survive are of lower priority. • The presence of comorbidities also needs to be carefully evaluated, because patients have lower chances of survival, but also because patients in a worse state of overall health could require a greater share of scarce resources to survive. • These guidelines apply even to patients who require intensive care for reasons other than the coronavirus.	Hospitals in Italy [96]	Given the rapid rise in cases in Italy, resources had to be allocated efficiently to those who may most benefit from them	• Primarily dependent on survivability, which might not be sensitive to differences in social class and income levels • Applied to all patients who require intensive care, and not just COVID-19 which may lead to the rise in non-COVID-19 deaths. This may be a major indicator of the pandemic that is currently under reported: the rise of non-COVID-19 deaths due to the deprivation of treatment

[96] Mounk, Y. (2020, March 11th). The Extraordinary Decisions Facing Italian Doctors. The Atlantic. Retrieved from https://www.theatlantic.com/ideas/archive/2020/03/who-gets-hospital-bed/607807/

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement patient triage into ICU and use of ventilators based on a range of factors, including health, age, cooperation during treatment, reproductive capacity, ability to live a fulfilling life, as well as quantifiable frameworks: • Priority to otherwise healthy people who are most likely to fully recover. • First layer of triage: Consider declining admission to an intensive care unit to people who have conditions that will likely result in near-immediate death even if they get that treatment e.g. exclude patients who may have a cardiac arrest that is unresponsive to standard interventions such as defibrillation, persons with severe mental retardation, baseline functional status. • Exclusion of patients with severe congestive heart failure, chronic lung disease, severe dementia. • Adapt Sequential Organ Failure Assessment (SOFA) (Fig. 4) , which measures the functioning of major body systems, to further qualify patients, then take into account special considerations such as pregnant women with a healthy fetus (more points for women who are more far into the pregnancy), one point benefit to front-line healthcare workers, and if the scores are tied, the tiebreaker goes to the person in the youngest age group. • Removing people from ventilators: If patients are not showing improvement while on ventilators, they may have their ventilators removed earlier to save resources for others; however, doctors are concerned about this because there is evidence that shows that sometimes patients get worse for a few days before actually getting better. Legal protections are still being put in place to protect providers in implementing these guidelines	Hospitals across the United States[97]	A review of triage policies in various states in the US to determine who gets access to ICUs and ventilators, along with complications and ethical issues that arise	• In general, this is a more complex range of triage methods that take into account matters such as pregnancy, quality of life, remaining lifespan, which may require more effort and deliberation from healthcare workers • Important to note that in contexts with more diversity of races, nationalities, and income levels, triage methods must be sensitive to issues relating to inequality and injustice e.g. People with underlying medical problems may get ranked lower, yet-low income often have more health problems because they cannot afford care and those who are differently-abled

[97] Baker, M., and Fink, S. (2020, March 31st). At the Top of the Covid-19 Curve, How do Hospitals Decide Who Gets Treatment? The New York Times. Retrieved from https://www.nytimes.com/2020/03/31/us/coronavirus-covid-triage-rationing-ventilators.html

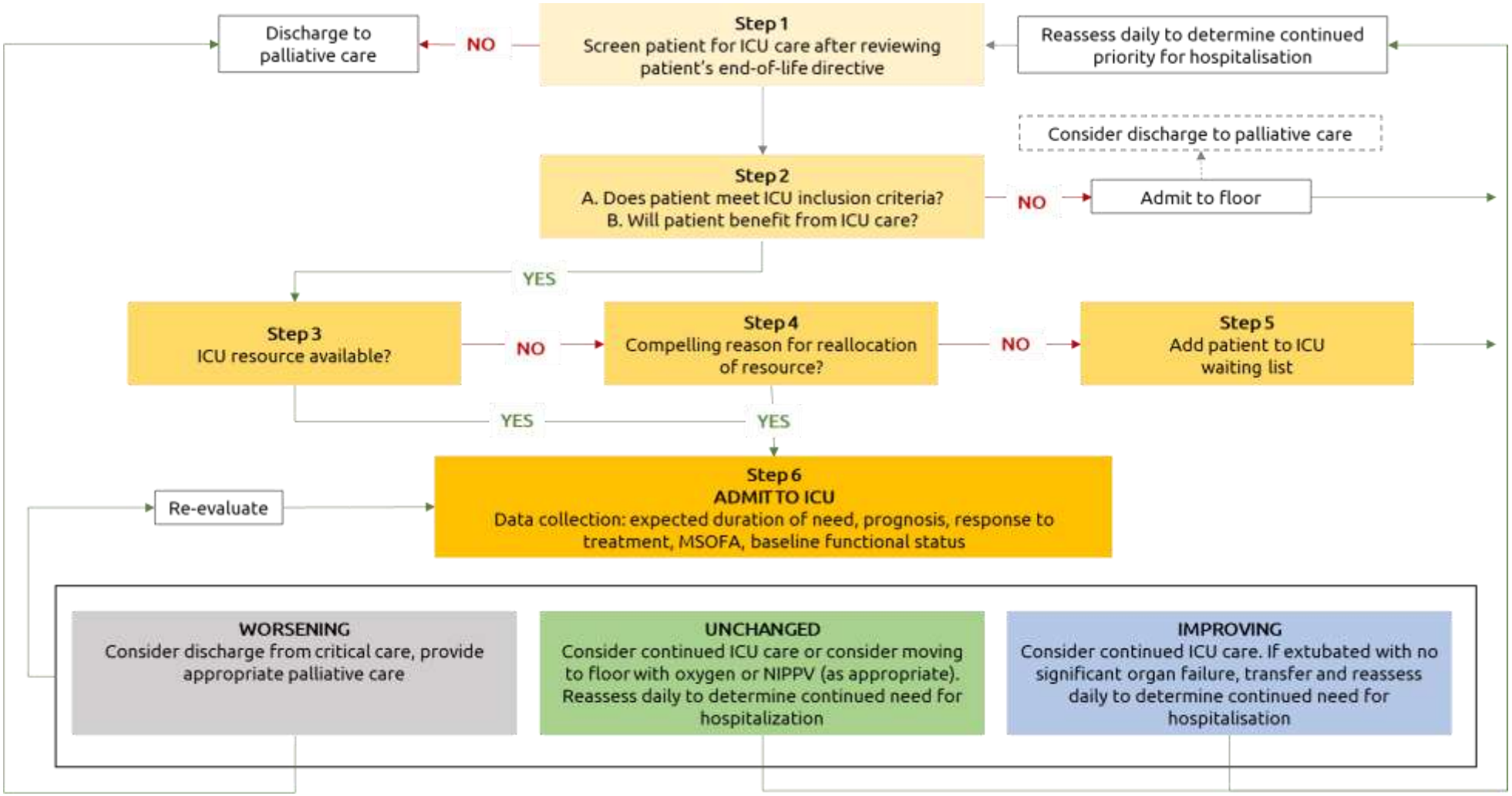


Figure 5. Decision-tree on critical triage, developed in the United States

COLOR CODE AND LEVEL OF ACCESS		ASSESSMENT OF MORTALITY RISK/ ORGAN FAILURE
BLUE	• No ventilator provided • Use Alternative forms of medical intervention and/or palliative care or discharge • Reassess if ventilators become available	Exclusion criterion OR SOFA > 11
RED	• Highest • Use ventilators as available	SOFA < 7 OR Single organ failure
YELLOW	• Intermediate • Use ventilators as available	SOFA 8 - 11
GREEN	• Use alternative forms of medical intervention or defer or discharge • Reassess as needed	No significant organ failure AND/OR No requirement for lifesavings resources

Figure 6. Sequential Organ Failure Assessment framework, used by New York hospitals for ventilator access

[98] Ibid
[99] Ibid

5.1.2
Area: Legal
Risk area: Medical Ethics
Issue: Lack of awareness on medical ethics and legal repercussions can lead to malpractice by healthcare workers

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement clinical ethics support systems for healthcare workers to ensure knowledge of medical ethical issues, such as: • Clinical ethics consultation/committees: provide healthcare personnel with advice and recommendations regarding the best course of action. • Moral case deliberation/ethics rounds/ethics discussion groups/ethics reflection groups: support the idea that group reflection increases insight into ethical issues, giving healthcare personnel opportunities to think and reflect more than a "top-down" perspective. A "bottom-up" approach leaves the healthcare personnel with the moral responsibility for their choice of action in clinical practice, while a "top-down" approach risks removing such moral responsibility.	Recommendation by researchers studying clinical ethics support approaches, various hospitals[100]	Comprehensive review of clinical ethics approaches that are available to support healthcare personnel in handling ethically difficult decisions	• Important to institutionalize norms and practices during normal capacity to further enhance healthcare workers' ability to handle ethical situations in times of high stress • Possible to quickly implement ethics reflection groups to provide peer guidance and support to healthcare workers

[100] Rasoal, D., Skovdahl, K., Gifford, M., & Kihlgren, A. (2017, December). Clinical ethics support for healthcare personnel: an integrative literature review. In Hec Forum (Vol. 29, No. 4, pp. 313-346). Springer Netherlands. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5688194/

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement practices to avoid moral distress to nurses: • Encourage compliance and referral to American Nurses Association nursing code of ethics. • Offer ongoing education through orientation and retraining of experienced healthcare workers. • Create an environment for nurses to share openly about their ethical dilemmas. • Bring together different disciplines who may share moral dilemmas. • Provide advice from ethics experts. • Add unit-based ethics mentors. • Hold a family conference for clinicians thinking through uncertainties. • Sponsor ethics journal or book clubs. • Reach out to professional associations. • Offer employee counselling services.	Recommendations from experts in the healthcare industry[101]	Given increasing ethical dilemmas that nurses face, there needs to be better support system in place to ensure that healthcare workers have effective coping mechanism with moral stresses; this was a collection of best practices by leading healthcare experts	• More than just channels of support, cultivating an environment where healthcare workers can discuss and reflect their ethical and moral stresses is crucial to a healthier and more conducive workplace

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Use an ethical checklist to prompt healthcare workers to think about moral and ethical issues in their daily work. For example, medical ethical issues are considered in the following circumstances: • Patient's wishes are unclear, or patient refuses treatment. • Questionable capacity to consent to or refuse treatment. • Disagreement involving relatives. • End-of-life Issues (e.g. Advance directive, "do not attempt resuscitation" decisions, lasting power of attorney, limitation of treatment). • Issue over goal of care or appropriateness of current treatment. • Confidentiality or disclosure issue. • Resource or fairness issue. • Other issues (please note). • No notable ethical issues.	Recommendation taken from Journal of Medical Ethics[102]	This checklist is adapted from Daniel Sokol, and is an effective and convenient way to remind healthcare workers of ethical issues that may exist in their line of work	• While a checklist is a fast and easy tool to ensure comprehensiveness in thinking about moral and ethical issues, it is important to further put in place support channels for healthcare workers to deal with these issues

[101]Wood, D. (2014, March 3rd). 10 Best Practices for Addressing Ethical Issues and Moral Distress. AMN Healthcare Research and Insights. Retrieved from https://www.amnhealthcare.com/latest-healthcare-news/10-Best-Practices-Addressing-Ethical-Issues-Moral-Distress/
[102]Mills, S., & Bryden, D. (2010). A practical approach to teaching medical ethics. Journal of Medical Ethics, 36(1), 50-54. Retrieved April 2, 2020, from www.jstor.org/stable/20696716

5.2.1 **SURGE CAPACITY STAGE**
Area: Legal
Risk area: Licensure and accreditation
Issue: Accreditation of healthcare workers can be a long process that results in delays in deployment of personnel

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Fast-track registration of doctors who gained qualifications overseas in UK. This was an appeal by refugees who have gained qualifications overseas, but have been working as taxi drivers or in takeaways because the reaccreditation process in the UK takes too long and is an expensive one.	Appeal to the government and the General Medical Council, UK[103] [104]	With recent spike in COVID-19 cases in the UK and a shortage of qualified medical practitioners, considerations are being given to quickly requalify doctors who have got their qualifications overseas.	While expedient registration processes are crucial given the surge, it is important that doctors who have got their qualifications overseas are familiarized to the practices, workflows, and equipment used in the country to minimize erroneous practices

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Quicken the graduation of final-year medical students, allowing them to start practicing 8 or 9 months ahead of schedule to support the healthcare system by waiving the mandatory exams students sit before qualifying.	Practiced in Italy[105]	This act will lead to the increase of 10,000 doctors into healthcare services, a	• Newly-graduating doctors, as Italy has done, should be placed in less crucial roles, so

[103] Taylor, D. (March 25th 2020). Covid-19: call for fast-track registration of refugee doctors in UK. The Guardian. Retrieved from https://www.theguardian.com/world/2020/mar/25/covid-19-call-for-fast-track-registration-of-refugee-doctors-in-uk
[104] CBC. Lift barriers to accredit foreign-educated doctors quickly, report's author urges. Yahoo! News. Retrieved from https://sg.news.yahoo.com/lift-barriers-accredit-foreign-educated-120100722.html

[105] Kottasova, I. (2020, March 20th). Thousands of medical students are being fast-tracked into doctors to help fight the coronavirus. CNN. Retrieved from https://edition.cnn.com/2020/03/19/europe/medical-students-coronavirus-intl/index.html

The graduates will be sent to work in general practitioners' clinics and at old peoples' homes, freeing up more experienced colleagues who will be sent to the rapidly filling hospitals.		much-needed boost in the current healthcare system	as to free up time for more experienced healthcare workers • Long-term training should be put in place for newly-graduating doctors to ensure they complete their training in the future

5.2.2 SURGE CAPACITY STAGE

Area: Legal
Risk area: Licensure and accreditation
Issue: Temporary staff may not have the proper credentials required

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider steps to provide credentials for temporary staff: • Address liability, insurance and temporary licensing issues relating to additional staff and volunteers who may be required to work in areas outside the scope of their training or for which they have no license. • Establish a system of rapidly providing healthcare workers (e.g. voluntary medical personnel) with necessary credentials in an emergency situation, in accordance with hospital and health authority policy.	WHO[106]	Hospital emergency checklist developed by WHO	Coordinate and collaborate with ministries and national government to ensure protection for temporary staff and hospitals in times of crisis

[106] WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf

SURGE CAPACITY STAGE

5.3.1
Area: Legal
Risk area: Contract and leases
Issue: Healthcare workers have limited legal protection and provision despite being highly exposed to infections

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Institute legal protections for healthcare workers of all professions on the frontlines in fighting epidemics, such as: • Ensuring frontline workers are properly equipped. • Financial protection for frontline health care workers. Establish a health care worker fund to protect frontline health care providers including but not limited to physicians, nurses, respiratory therapists, radiology technicians, emergency medical service providers and other first responders, advanced practice providers, certified nursing assistants, and nursing home staff, and their families from financial harm resulting from exposure or infection. • Child and elder care for health care workers working extra or unscheduled shifts. • Facilitate sharing of best practices among healthcare providers. Use a multimedia approach to reach as many health care personnel as possible with a goal of sharing best practices (how to set up COVID-19 wards most efficiently, how to consider an alternate staffing model, facilitating testing during a surge demand, etc.). • Continuity of funding. The Centers for Medicare and Medicaid services should not deny residency funding to hospitals if residents are sent home for safety or quarantine related to COVID-19.	Recommendations for a COVID-19 Stimulus Bill in the US[107]	A list of recommendations for enhanced Bill in the US to ensure protection for healthcare workers as well as the community at large, in response to the current risks that healthcare workers face	• The protection of healthcare workers is of utmost priority to maintain a functioning healthcare system, and legal procedures should be put in place to ensure this • In the US, there are cases of private hospital associations that lobby against bills to disallow hospitals to operate if healthcare workers are not given protective gears, due to the impact on the profitability of hospitals. In this case, support can be given to private hospitals to also ensure their financial stability as they support public health measures.

[107] Forman, H., et al. (2020, March 12th). Health Care Priorities For A COVID-19 Stimulus Bill: Recommendations To The Administration, Congress, And Other Federal, State And Local Leaders From Public Health, Medical, Policy And Legal Experts. Health Affairs. Retrieved from https://www.healthaffairs.org/do/10.1377/hblog20200312.363618/full/

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Legally institute do-not-resuscitate practices for COVID-19 patients to minimize exposure of healthcare workers in risky procedures that may lead to infection of healthcare workers.	Mount Sinai Hospital New York, US[108]	Due to overwhelming number of COVID-19 cases and fatality, coupled with the severe lack of healthcare supplies, measures are put in place to protect the well-being of healthcare workers.	While this may be a necessary measure at certain phases of the epidemic, public communication is crucial to uphold hospital reputation and protect healthcare workers from legal charges

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Remove legal barriers to telehealth practices to ensure that healthcare workers are not in harms' way when attending to patients: • The Centers for Medicare & Medicaid Services (CMS) would temporarily pay clinicians to provide telehealth services for beneficiaries residing across the entire country. Going forward, a range of healthcare providers, such as doctors, nurse practitioners, clinical psychologists, and licensed clinical social workers, will be able to deliver telehealth services in any healthcare facility including a physician's office, hospital, nursing home or rural health clinic, as well as from their homes. • The Office for Civil Rights (OCR) additionally announced that effective immediately, it will waive potential penalties for HIPAA violations against providers who serve patients through everyday communications technologies during the COVID-19 public health emergency.	Hospitals and practitioners across the US[109]	Given the wide spread infection rate of COVID-19 and the burden it places on healthcare workers, government regulatory bodies have loosened restrictions around telemedicine practices to increase provision of primary healthcare services to the public	• There is a need to ensure data privacy and confidentiality in telemedicine, and put in place precautions to reduce the risk of cyber security attacks • Measures need to be put in place to consider post-emergency scenarios, if / how restrictions would be restated

[108] Voytko, L. (2020, April 1st). Overwhelmed NYC hospitals reportedly implementing "Do Not Resuscitate" policies for coronavirus patients. Forbes. Retrieved from https://www.forbes.com/sites/lisettevoytko/2020/04/01/overwhelmed-nyc-hospitals-reportedly-implementing-do-not-resuscitate-policies-for-coronavirus-patients/#7157510b3146
[109] Leventhal, R. (2020, March 19th). HIPAA and COVID-19: Restrictions Loosened, But Experts Preach Caution. Healthcare Innovation. Retrieved from https://www.hcinnovationgroup.com/covid-19/article/21130404/hipaa-and-covid19-restrictions-loosened-but-experts-preach-caution

5.3.2
Area: Legal
Risk area: Contract and leases
Issue: Lack of support from vendors in maintaining supplies may result in supply shortage

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Remove barriers to fixing ventilators and other COVID-19 related equipment put in place by suppliers: • Many manufacturers do not provide access to repair documentation, limiting who can repair the equipment, which discourages third-party medical repair companies or in-house medical engineers from trying to fix things. • Medical device manufacturers should immediately release all repair documentation and software, schematics and manuals for that equipment, especially ventilators.	Advocates in the United States[110]	In the face of ventilator over-use and supply shortage in the US, advocates are calling for the democratization of repair documentation. The Society of Critical Care Medicine estimates that there are as many as 100,000 such older ventilators across the country	• The ability to sustain the lifespan of existing medical equipment is crucial in and epidemic; hospitals should ensure coordination and partnership with suppliers to make sure such information on repairs is made available to hospitals and the public in times of crisis • Hospitals can also consider paying a minimal subscription fee to get access to repair materials

[110] Proctor, N. (2020, March 18th). Advocates say to remove barriers to fixing ventilators, other covid-19-related medical equipment. US PIRG. Retrieved from https://uspirg.org/news/usp/advocates-say-remove-barriers-fixing-ventilators-other-covid-19-related-medical-equipment

6. Finance

Key financial functions

Management of accounts receivable

- Produce all hospital invoices
- Provide pricing information to patients
- Record all cash received by the hospital
- Validate patient eligibility for treatment
- Ensure claims are submitted to health insurers in a timely manner

Management of accounts payable

- Fulfil purchase orders for equipment or supplies
- Negotiate contracts with service providers and contractors
- Record and validate vendor invoices
- Settle payment of vendor invoices
- Maintain receipts from purchases for the hospital
- Reconcile supplier statements and ensure compliance with legal accounting requirements

Management of payroll

- Prepare monthly payrolls
- Ensure accuracy and validity of all payments to employees
- Operate a payroll query desk accessible to all employees with queries regarding salary payment

Management of hospital budget

- Allocate resources to various departments and services
- Track revenues and losses
- Maintain accurate and auditable financial records
- Forecast potential earnings or losses
- Maintain cash reserves for unexpected or planned expenses
- Analyse and inform long-term investment decisions

Identified key risk areas within financial processes

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
6.1 Management of hospital budget	6.1.1	Significant loss of revenue and profits for hospital during a pandemic (due to cancellation of elective procedures, large number of patients being unable to pay for medical expenses, or higher costs due to the large amount of resources needed during a pan	• High risk to financial sustainability of the hospital if revenue loss is prolonged and insufficiently mitigated	• Suspend employment benefits • Reduce staff pay • Furlough non-essential staff • Rely on government financial assistance
	6.1.2	Need to forecast potential earnings and losses	• High risk to financial sustainability of the hospital if forecasting is inaccurate	• Use a rolling forecast

6.1.1 SURGE CAPACITY STAGE

Area: Finance
Risk area: Management of hospital budget
Issue: Significant loss of revenue and profits for hospital during a pandemic (due to cancellation of elective procedures, large number of patients being unable to pay for medical expenses, or higher costs due to the large amount of resources needed during a pandemic)

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Suspend employment benefits such as paid time off, discretionary bonuses, or contributions to employees' retirement accounts.	Alteon Health, US[111]	Taking place due to the COVID-19 pandemic	The most redundant benefits should be the first to be removed, keeping core salary as intact for as long as possible

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Reduce staff pay, including that of nurses, doctors, or top hospital executives.	Numerous hospitals across the US, including Beth Israel Deaconness Medical Center[112] and HCA Healthcare[113]	Taking place due to the COVID-19 pandemic	• Top executives could lead by example to accept the biggest share of the cuts • Size of pay cuts could correspond with income level, i.e. highest-paid employees receive the largest pay cut and vice versa

[111] Facher, L. (2020, April 1). Private equity-backed company slashes doctor benefits amid Covid-19. Retrieved from https://www.statnews.com/2020/04/01/slashes-benefits-for-doctors-coronavirus/
[112] Mathews, A. W., & Evans, M. (2020, April 1). Hospitals, Doctors Feel Financial Squeeze as Coronavirus Sweeps U.S. Retrieved from https://www.wsj.com/articles/hospitals-doctors-feel-financial-squeeze-as-coronavirus-sweeps-u-s-11585768706
[113] Ibid

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Place non-essential staff on furlough with no pay.	Numerous hospitals across the US, including Atrius Health[114] and Boston Medical Center[115]	Taking place due to the COVID-19 pandemic	• Need to communicate such measures with sensitivity to affected staff • Need to be transparent in decision-making process and provide a platform to clarify all questions

PRACTICE #4	ORGANISATION	CONTEXT	CONSIDERATIONS
Rely on financial support or funds from the government. Some governments are offering to foot the bill of infected patients (e.g. Singapore) while others are paying to integrate private hospital resources into the public hospital pandemic response (e.g. Australia).	Singapore[116], Australia[117]	Singapore is footing the bill for infected patients at public hospitals, except for outpatient expenses, while in Australia the federal and state governments bear the costs of integrating private hospital resources with that of public hospitals	Might not be feasible for all hospitals to be able to rely on their governments for sufficient financial support, as some governments have more resources than others

[114] Bebinger, M. (2020, March 28). Furloughs, Retirement Cuts And Less Pay Hit Mass. Doctors And Nurses As COVID-19 Spreads. Retrieved from https://www.wbur.org/commonhealth/2020/03/27/doctors-nurses-mass-coronavirus-infections-pay-benefits
[115] McCluskey, P. D. (2020, March 31). Boston Medical Center furloughs 10 percent of its workforce as part of cutbacks across the health care industry - The Boston Globe. Retrieved from https://www.bostonglobe.com/2020/03/31/business/boston-medical-center-furloughs-10-percent-its-workforce/
[116] Ting, C. Y. (2020, February 12). Coronavirus: Singapore Government to foot bills of infected patients at public hospitals, except outpatient expenses. Retrieved from https://www.straitstimes.com/singapore/health/coronavirus-government-to-foot-bills-of-infected-patients-at-public-hospitals
[117] Davey, M., Butler, B., & Hurst, D. (2020, March 31). Australian government will pay half to integrate private hospitals into Covid-19 response. Retrieved from https://www.theguardian.com/australia-news/2020/mar/31/federal-government-pay-half-integrate-private-public-hospitals-covid-19-response

6.1.2
Area: Finance
Risk area: Management of hospital budget
Issue: Need an agile approach to forecast potential earnings and losses in a crisis

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use a rolling forecast method, so that instead of forecasting the budget once every year, the budget forecast is continually extended each month to maintain a 12-month forecast throughout the year.	Mission Health, US[118]	This practice was adopted by Mission Health in 2014 in place of the normal annual budgeting process, as they wanted to be more flexible in a rapidly changing healthcare environment	• May require some time to adjust to a new budget forecasting approach • May require training and educating key players, such as senior leadership, the financial planning team, and the board of directors

[118] How Strata is Pioneering a Rolling Forecast in Healthcare. (2013, October 29). Retrieved from https://www.stratadecision.com/article/pioneering-a-rolling-forecast/

IV. REVIEW OF DEPARTMENT-SPECIFIC PRACTICE AREAS

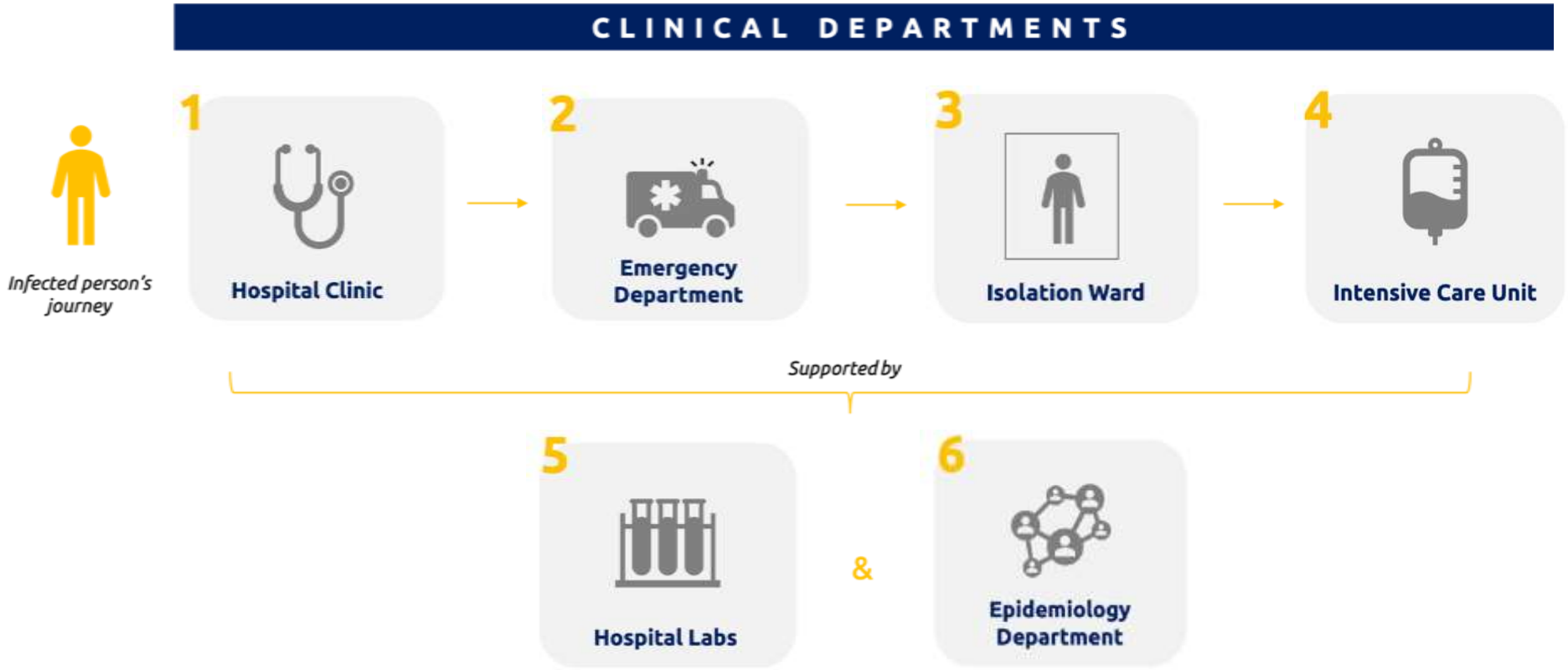
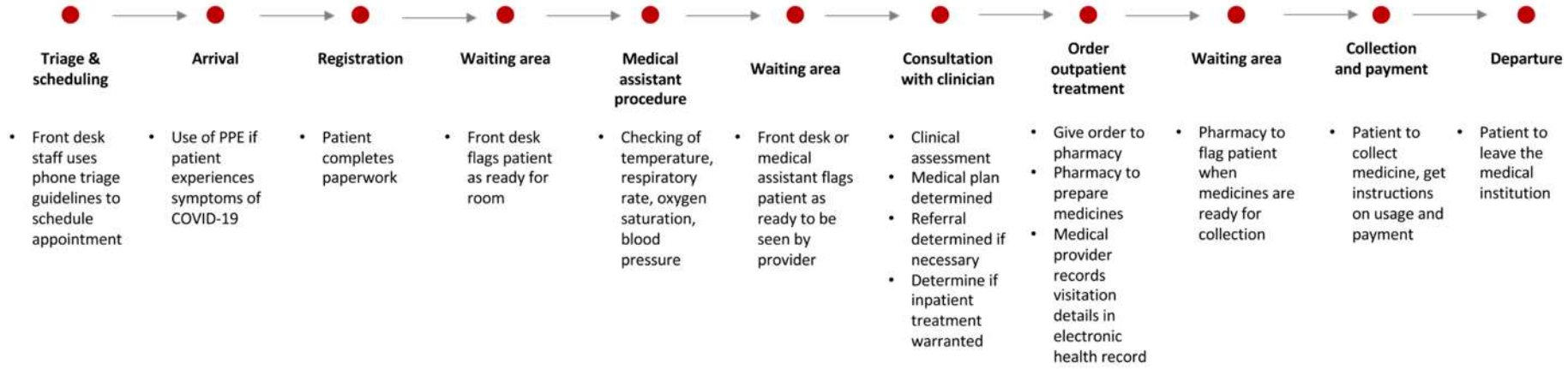


Figure 7. Department-specific practice areas in a hospital setting

1. Hospital Clinics

Hospital Clinic workflow



Workflow as described by the Agency for Healthcare Research and Quality (AHRQ)[119].

[119] Agency for Healthcare Research and Quality . "Primary Care Workflow Diagrams." Agency for Healthcare Research and Quality , Jan. 2018. Retrieved from www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/quality-resources/tools/cap-toolkit/pc-workflowdiagrams.pdf.

Identified key risk areas within Hospital Clinic workflow

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
1.1 Arrival	1.1.1	Insufficient PPE for frontline staff during an epidemic	• High potential for infection because of increased exposure to virus for staff without PPE	• Reduce PPE required by frontline staff • Obtain PPE from other departments and clinical facilities
	1.1.2	High risk of infection due to lack of hygiene compliance	• High potential for infection when patients and staff do not follow hygiene etiquette	• Ensure patients are compliant in precautions to reduce transmission • Establish personal hygiene/cough etiquette guidelines
	1.1.3	Insufficient hygiene precaution preparation when receiving patients	• High potential for infection for healthcare workers from exposure to patients	• Use of physical barriers • Encourage patients to call clinic beforehand • Use of telemedicine
1.2 Consultation with clinician	1.2.1	Spread of virus due to limited testing opportunities and infected patients going to clinics where other patients are unprotected	• High potential for infection due to limited testing which makes it difficult to identify infected people • High risk of manpower shortage due to necessary testing of large volumes of patients	• Establish remote testing sites • Mass testing even for people who are asymptomatic

1.2.2	Through improper removal of PPE, healthcare workers have a higher risk of contamination	• High potential for infection due to possible exposure to virus with improper PPE use • High potential for error due to variations in PPE use and lack of standards	• Protocol for PPE donning and removal
1.2.3	High risk of occupational accidental exposure to COVID-19	• High potential for infection due to direct contact of healthcare worker to fluids, bodily secretions, faecal matter of patients	• Implement remedial action upon occupational exposure to infected bodily fluids

Divergent practices identified

1.1.1 SURGE CAPACITY STAGE
Department: Hospital Clinic
Risk area: Arrival
Issue: Insufficient PPE for frontline staff during an epidemic

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Reduce the number of PPE used by frontline staff: • Staff should be assigned to carry out procedures in designated areas to reduce excessive PPE sets used. • Assign staff to swabbing procedures in dedicated swabbing area. • While swabbing patients, healthcare personnel can use same respirator for several patients for a maximum of 4 hours without having to remove it, as long as it is not damaged or soiled, unless manufacturer explicitly advises against this. • Use of runners to hand over items that medical staff have forgotten instead of needing to change out of PPE to get item. • Provide N95 masks only to staff who are directly entering patient rooms to limit the number of people in contact with infectious patients.	European Center for Disease Prevention and Control[120] Boston Medical Center[121]	Measures are taken when insufficient PPE is available for staff	• Need to designate which roles are acceptable for longer PPE usage • Need to designate location to conduct swabbing to limit spread of infection within clinic • This method may limit number of healthcare practitioners who may be able to treat infected patients • It also requires strategy and coordination between medical staff

[120] European Center for Disease Prevention and Control. (2020, March). Infection prevention and control for COVID-19 in healthcare settings. ECDC Technical Report . doi: https://www.ecdc.europa.eu/sites/default/files/documents/COVID-19-infection-prevention-and-control-healthcare-settings-march-2020.pdf
[121] Hopkins, C. (2020, March 23). "We are desperate": Trump's inaction has created a crisis with protective medical gear. Retrieved from https://www.vox.com/2020/3/22/21189896/coronavirus-in-us-masks-n95-respirator-doctors-nurses-shortage-ppe

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Obtain PPE from other departments and clinical facilities: • All hospitals, ambulatory surgery centers, outpatient clinics, dental clinics, and veterinary clinics with surplus PPE supplies need to notify the state's PPE coordinator to arrange for handoff. • Vets, dentists, and other healthcare practitioners are ordered, by law, to participate in the reallocation of their excess equipment to nurses and doctors directly treating patients. • Any person found to be violating order would be subject to penalties of a Class C misdemeanour.	Oregon Government, US[122]	Measures are activated during shortage of PPE resources	• Require compliance by other industries and departments • Require collection and distribution point for excess PPE

1.1.2
Department: Hospital Clinic
Risk area: Arrival
Issue: High risk of infection due to lack of hygiene compliance

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Ensure patients are compliant in precautions to reduce transmission: • Put up a sign at hospital entrance that instructs patients with symptoms of respiratory infection to immediately put on a mask and keep it on during physician assessment, to cover mouth and nose when coughing or sneezing, and practice hand hygiene after contact with respiratory secretions.	CDC[123]	Used as a reminder for patients to use mask to reduce spread of virus and practice proper sanitation	• Registration front desk needs to remind patient of guidelines • Need to provide masks and hand sanitizer at entrance • Ensure sufficient soap and water are available for handwashing • Have a no-touch waste receptacle in clinic

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish personal hygiene/cough etiquette guidelines: • Educate healthcare facility staff, patients, and visitors. • Posted signs in languages appropriate to the population served, with instructions to patients and accompanying family members or friends. • Source control measures (e.g. covering the mouth/nose with a tissue when coughing and prompt disposal of used tissues, using surgical masks on the coughing person). • Hand hygiene after contact with respiratory secretions.	CDC[124]	These guidelines are targeted at patients and accompanying family members and friends with undiagnosed transmissible respiratory infections	Ensure compliance with these guidelines for healthcare workers and patients by conducting regular checks and reminders

[123] CDC. (2020). CDC. Comprehensive Hospital Preparedness Checklist for Coronavirus Disease 2019 (COVID-19). Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/downloads/HCW_Checklist_508.pdf
[124] CDC. (2019). 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

• Spatial separation, ideally >3 feet, of persons with respiratory infections in common waiting areas when possible.		when entering a healthcare facility	

1.1.3
Department: Hospital Clinic
Risk area: Arrival
Issue: Insufficient preparation when receiving patients

SURGE CAPACITY STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Minimize risk of infection from patients to frontline staff: • Use physical barriers such as glass or plastic windows to reduce exposure to COVID-19 in healthcare setting where patient will first present, such as in triage areas, registration desk, or pharmacy window. • Restrict healthcare workers from entering rooms of COVID-19 patients if not involved in direct care. • Bundle activities to minimize number of times the room is entered.	WHO[125], CDC[126]	Protocol is activated when PPE is limited and to prevent further spread of COVID-19 in healthcare settings	• Hospitals need to establish a telemedicine platform to provide efficient service to patients • Manpower allocation strategy is needed to ensure that minimal number of staff enter room while maintaining service standard

[125] World Health Organization. (2020, February 27). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19) . Interim Guidance. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf
[126] CDC. (2020, March 14). Healthcare Supply of Personal Protective Equipment. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/hcp/healthcare-supply-ppe.html

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Encourage patients to call clinic beforehand so staff are prepared to receive patient using appropriate infection control practices and PPE. • Healthcare practitioners in pre-examination triage and general outpatient department should be equipped with disposable surgical cap, disposable surgical mask, work uniform, disposable latex gloves and disposable isolation clothing if necessary.	CDC[127], Zhejiang University School of Medicine[128]	It has been observed during COVID-19 that many unwell people with symptoms of infection are visiting clinics without calling beforehand to give healthcare practitioners sufficient time to receive them properly	• Hospitals need to provide instructions for patients to call them beforehand through website and other media platforms • Hospitals need to provide a readily available hotline number for people to call before they arrive

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Use of telemedicine to evaluate suspected cases of COVID-19, minimizing the need for these individuals to go to healthcare facilities for evaluation. • Onboarding entire workforce of physicians to deliver remote consultations via video • Registered nurses and others who can help with workload are also requested to support telehealth services	Cleveland Clinic's Express Care Online[129]	Created in response to increase in demand for telehealth visits during COVID-19 pandemic	• Need to conduct training for healthcare practitioners to use telehealth consultations to handle large patient volumes • Need high speed internet connection to ensure smooth streaming of video consultations • Telehealth payment systems should be set up for ease of payment collection

[127] CDC. (2020, February 29). Interim Guidance for Healthcare Facilities: Preparing for Community Transmission of COVID-19 in the US. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/guidance-hcf.html
[128] Zhejiang University School of Medicine. (2020). Handbook of COVID-19 Prevention and Treatment .
[129] Brodwin, E., Ross, C., Brodwin, E., Ross, C., Brodwin, E., Brodwin, E., … National Technology Correspondent. (2020, March 19). Patients overwhelm telehealth services amid coronavirus pandemic. Retrieved from https://www.statnews.com/2020/03/17/telehealth-services-overwhelmed-amid-coronavirus-pandemic/

1.2.1
Department: Hospital Clinic
Risk area: Consultation with clinician
Issue: Spread of virus due to limited testing opportunities and infected patients going to clinics where other patients are unprotected

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement drive-through testing where patients do not have to leave their cars and are tested by healthcare practitioners in hazmat suits, to reduce the time taken for testing of virus and reduces risk of patients contaminating healthcare facility.	Goyang Health Center, South Korea[130]	Possible spread of infection or contracting infection when in testing waiting rooms	• Require an appropriate area to host the testing • Implement organized collection of data and phone numbers to contact patients their result • Need sufficient human resource to carry out numerous drive-by sites

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Carry out large scale testing even for people without any symptoms: • Iceland's large scale testing is backed up by a biotechnology firm deCode Genetics who have offered to perform the testing • This effort is to gather insight into the spread of coronavirus within the Icelandic community	Government of Iceland[131]	Mass testing of virus in Iceland	• Requires collaboration with a medical research company or institution with mass testing capabilities • This strategy worked in Iceland primarily due to the

[130] Watson, I., & Jeong, S. (2020, March 3). South Korea pioneers coronavirus drive-through testing station. Retrieved from https://edition.cnn.com/2020/03/02/asia/coronavirus-drive-through-south-korea-hnk-intl/index.html
[131] Nardelli, A., & Ashton, E. (2020, March 27). Everyone In Iceland Can Get Tested For The Coronavirus. Here's How The Results Could Help All Of Us. Retrieved from https://www.buzzfeed.com/albertonardelli/coronavirus-testing-iceland

			small population size of 364,000

1.2.2
Department: Hospital Clinic
Risk area: Consultation with clinician
Issue: Through improper removal of PPE, healthcare workers have a higher risk of contamination

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS

Consider implementing protocols for PPE use:
• Implement 8-step protocol for donning PPE
  • Put on special work clothes and work shoes
  • Wash hands
  • Put on disposable surgical cap
  • Put on medical protective mask (N95)
  • Put on inner disposable nitrile/latex gloves
  • Put on goggles and protective clothing
  • Put on disposable latex gloves
  • Donning completed
 	
• Implement 7-step protocol for removal of PPE
  • Replace the outer gloves with new ones
  • Remove protective clothing along with outer gloves
  • Remove goggles
  • Remove mask
  • Remove cap
  • Remove inner disposable latex gloves
  • Removal completed
	Zhejiang University School of Medicine[132]	Standardized hospital protocol for effective wearing and removal of PPE	• Need to ensure sufficient disinfectant supply
			
			• Need training for cleaning team
			
			• Need a method to track adherence to strict cleaning practices

[132] Zhejiang University School of Medicine. (2020). Handbook of COVID-19 Prevention and Treatment.

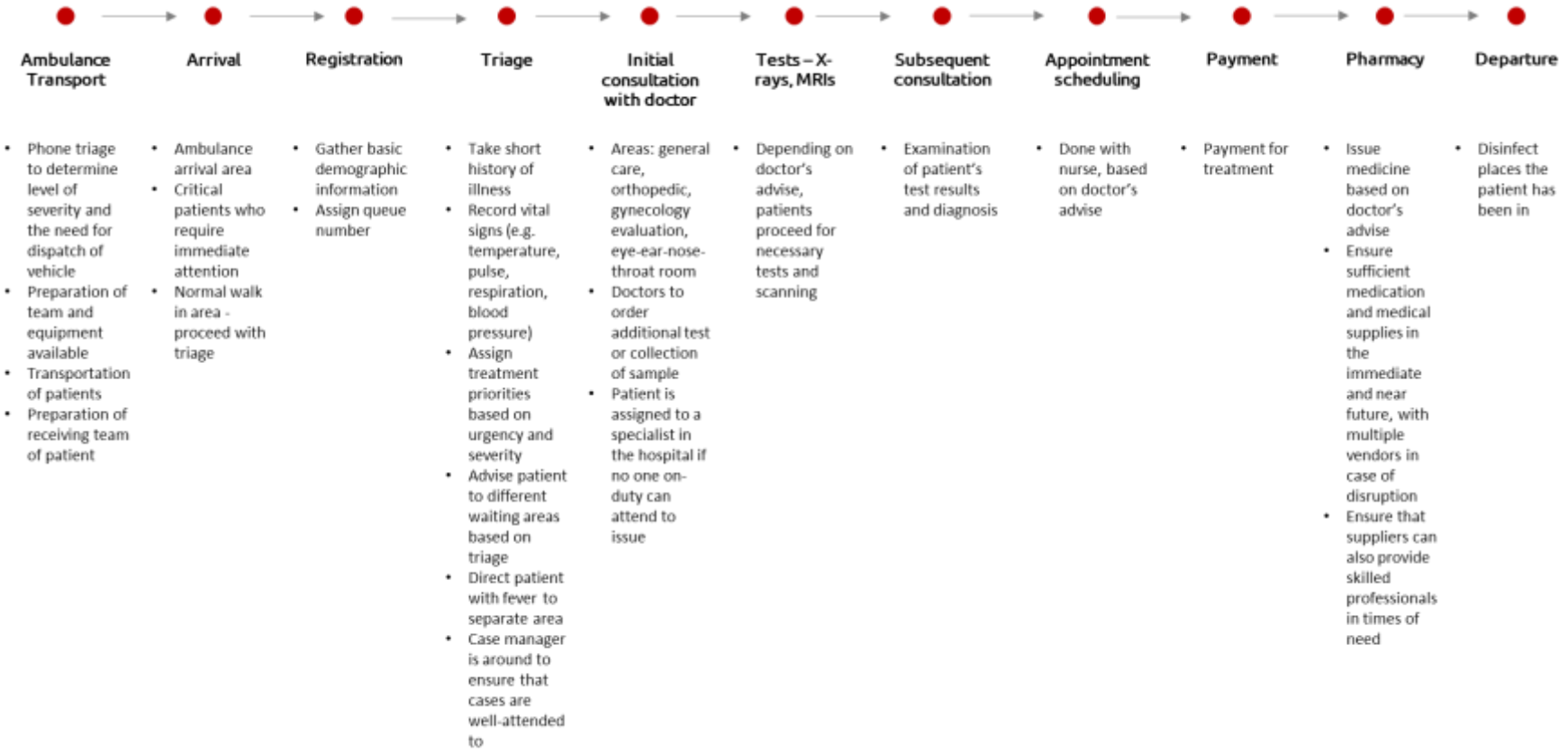
1.2.3
Department: Hospital Clinic
Risk area: Consultation with clinician
Issue: High risk of occupational accidental exposure to COVID-19

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Take remedial steps after exposure to infected bodily fluids: • Upon skin exposure (where skin is directly contaminated by a large amount of visible bodily fluids, blood, secretions or faecal matter from patient), remove the contaminants with clean tissues or gauze, then apply 0.5% iodophor or 75% alcohol to the skin and let the solution sit for at least 3 minutes for disinfection, thoroughly flush with running water. • Upon exposure of mucous membranes such as eyes and respiratory tract that are directly contaminated by visible bodily fluids, blood, secretions, or faecal matter from patient, flush with plenty of normal saline or 0.05% iodophor for disinfection. • Upon sharp object injury, such as piercing of the body by sharp objects that were directly exposed to the patient's bodily fluids, blood, secretions or faecal matter, squeeze the blood out from proximal end to distal end and flush the wound with running water, then disinfect with 75% alcohol or 0.5% iodophor. • Upon direct exposure to respiratory tract, such as falling off of mask, exposing the mouth or nose to a confirmed patient (1 meter away) who is not wearing a mask, immediately leave the isolation area, gargle with plenty of normal saline or 0.05% iodophor. Dip a cotton swab in 75% alcohol, and wipe in a circular motion gently the nasal cavity. • After the above, evacuate from the isolation area and enter the designated isolation room, report to relevant departments, and isolate and observe people with exposures other than intact skin exposure for 14 days. • In case of symptoms, report to the relevant departments in a timely manner.	Zhejiang University School of Medicine[133]	Procedures for taking remedial actions against occupational exposure to COVID-19	• Training of team required • Adherence to strict cleaning practices • Policies and work environment should encourage healthcare workers to speak up if such incidents happen to them, instead of hiding them in fear of repercussions or being forced to take leave

[133] Zhejiang University School of Medicine. (2020). Handbook of COVID-19 Prevention and Treatment.

2. Emergency Department

Emergency Department workflow



While the workflow for Emergency Departments differ slightly based on institution, this workflow is adapted from National Health Service – Northern Devon Healthcare[134] and the Irish Association for Emergency Medicine.[135]

[134] Emergency Department Operational Standard Operating Procedure. National Health Services, Northern Devon Healthcare. Retrieved from https://www.northdevonhealth.nhs.uk/wp-content/uploads/2019/06/Emergency-Department-SOP-V4.1.pdf.
[135] Standards for Emergency Department Deign and Specification for Ireland 2007. Irish Association for Emergency Medicine. Retrieved from http://www.iaem.ie/wp-content/uploads/2013/02/iaem_standards_for_ed_design__specification_for_ireland_300907.pdf.

Identified key risk areas within the Emergency Department

RISK AREA	ISSUES		RISK FACTORS	EXISTING PRACTICES
2.1 Ambulance transport	2.1.1	Disinfection measures for vehicles are at times insufficient, especially at the outbreak of new infectious diseases	• High potential for infection as infectious pathogens remain on surfaces	• Apply thorough disinfecting protocols for general and terminal decontamination • Use ultraviolet germicidal irradiation for non-visible spoilage
	2.1.2	Insufficient protection of healthcare workers when faced with novel and developing circumstances	• High potential for error as healthcare workers are not aware of the level of protection needed • High potential for infection as healthcare workers do not don sufficient PPE in the course of their work	• Ensure high protective measures for vehicle, healthcare workers, and patients • Use potable isolation unit that seals the patients from healthcare workers and surrounding environment
2.2 Arrival	2.2.1	Infected patients who are unaware of isolation protocols are entering ED facilities for check-ups even when they may be contagious	• High potential for infection as infectious patients interacts and inhabit same spaces as others	• Implement precautionary measures such as temperature checks, travel screening, private isolation rooms, separate triage tents • Develop separate fever zone as part of ED Department • Establish telemedicine procedures
2.3 Triage	2.3.1	Existing methods of triage, which involves the subjective judgment of nurses based on various standards (e.g. Emergency Severity Index) to triage patients,	• High potential for error as triage techniques are not standardized and updated accordingly • High potential for infection as patients	• Use a data-driven electronic tool to guide triage • Establish Medical Team Evaluation (MTE) concept • Conduct regular refresher triage

		leads to reduced effectiveness of patient streamlining	whose sickness are overestimated or undermined may infect others • High risk to public reputation as ineffective triage may lead to long waiting time in hospitals • High risk of mass panic as ineffective triage may lead to mistrust in hospital processes	
	2.3.2	New and changing protocols on case identification and treatment make it difficult for frontline healthcare staff to keep up and comply with new guidelines	• High potential for error as healthcare workers are unable to comply to new protocols • High potential for infection as infectious patients are not detected thoroughly • High risk to public reputation as ineffective triage may lead to long waiting time in hospitals • High risk of mass panic as ineffective triage may lead to mistrust in hospital processes	• Incorporate automatic prompts related to the infection into the electronic medical record • Adopt the Front-Line Ownership (FLO) approach to increase compliance

2.4 Tests/X-rays/MRIs	2.4.1 The movement of a patient from the Emergency Department to test rooms/x-rays leads to heightened exposure of the public to potentially infected patients	• High potential for infection as hospital environments and the public are exposed to infected patients	• Set aside dedicated pathways, elevators, equipment for patients • Use portable medical devices
	2.4.2 Pathogens from infected patients may be found on the surfaces of medical devices	• High potential for infection as infectious pathogens remain on surfaces of equipment	• Apply thorough disinfection protocol
	2.4.3 Delays in treatment may occur amongst increase in patients who require testing and limited facilities	• High potential for infection as it may take some time to detect patients with the virus • High potential for fatality as patients are not treated in time	• Adapt other types of equipment, such as ultrasound, to complement early detection and confirmation of patients

Divergent practices identified

2.1.1
Department: Emergency Department
Risk area: Ambulance Transport
Issue: Disinfection measures for vehicles are at times insufficient, especially at the outbreak of new infectious diseases

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Practice general ambulance disinfection: • A well-ventilated location for decontamination and disinfection. • Primary care healthcare workers involved in patient transportation responsible for disinfection, donned in full PPE. • Stretcher and other equipment to be decontaminated if visibly soiled. • Any gross contamination (blood or bodily fluids) to be treated for 90 seconds with a fresh household bleach solution (1:10 mix ration) 0.5% hypochlorite concentration before soaking up fluid with absorbent materials, which are placed in leakproof container. • Equipment to be disinfected with an EPA-registered hospital-grade disinfectant or a fresh household bleach solution (1:100 mix ratio) 0.05% hypochlorite concentration. Practice terminal ambulance disinfection: • Barrier drapes to be removed; full bags will be closed with a gooseneck technique, outer surfaced disinfected with an EPA-registered disinfectant or 0.05% hypochlorite concentration. • All surfaces in patient compartment will be disinfected with a fresh household bleach solution (1:100 mix ratio) 0.05% hypochlorite concentration. • Stretched and medical equipment to be disinfected a second time. • All exterior of waste bags to be disinfected. • All waste to be transferred to hospital isolation unit for disposal.	Center for Disease Control (CDC), in collaboration with Emory University. Published in Annals of emergency medicine.[136]	Developed as guidelines for cases of extremely infectious disease, such as Ebola, where patients are excreting bodily fluids	Healthcare workers need determine the level of disinfection required depending on triage of patients, and to ensure minimal disinfection between patients, such as by disinfecting critical surfaces, cleaning up spillage, or clearing any waste

[136] Isakov, A., Miles, W., Gibbs, S., Lowe, J., Jamison, A., & Swansiger, R. (2015). Transport and management of patients with confirmed or suspected Ebola virus disease. Annals of emergency medicine, 66(3), 297-305.

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Use ultraviolet germicidal irradiation to decontaminate to destroy bonds between the amino acids in the organism's DNA, stopping its ability to replicate. Doses required for different viruses: • E. Coli - 6,600 microjoules • Influenza A - 6,600 microjoules • HIV - 36,000 microjoules • Hepatitis - 8,000 microjoules • C. Diff - 38,500 microjoules Daily use in ambulance of 10-15 minutes recommended.	University of Iowa Health Care, United States[137]	Research on practice to complement mechanical disinfection of ambulances, reducing both risk of infection to healthcare workers as well as number of healthcare workers required for cleaning	• This is a rather costly method for disinfection, but reduces manpower needs, infection risks, and allows for thorough cleaning of hard-to-reach surfaces • Worth considering for highly infectious diseases, for terminal disinfection daily

[137] University of Iowa Health Care. (2017) Independent Comparative Study Conducted by University of Iowa Hospitals & Clinics on our TURBO-UV. Retrieved from https://www.mrsa-uv.com/uploads/8/9/7/2/8972491/turbo_uv_report_mh-f.pdf

2.1.2
Department: Emergency Department
Risk area: Ambulance Transport
Issue: Protective measures adopted for healthcare workers are at times insufficient, especially at the outbreak of new infectious diseases

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Prepare protective measures for vehicle: • Ventilation in driver compartment has fan on high, exhaust vent in patient compartment turned on. • Driver compartment sealed from patient compartment; patient compartment draped in disposable barriers. • Litter stanchions removed before draping. • Stretch protected with impervious barrier. • Medical gear and equipment stowed in patient compartment and sealed. Prepare protective measures for transport team: • Healthcare workers, 1 team leader, 1 EMS physician. • Healthcare workers: Hands-free radio, footed impervious suit, N-95 mask, eye protection, double gloves. • Team leader and EMS physician act as coordinator and oversight of patient care, will don higher-level PPE if needed. Prepare protective measures for patient: • If patient is ambulatory: asked to wear impervious suit, surgical mask, gloves. • If patient is nonambulatory: shrouded in impervious sheet, and surgical mask will be applied.	Center for Disease Control (CDC), in collaboration with Emory University, published in Annals of Emergency Medicine[138]	Developed in response to highly infectious disease such as Ebola, when transporting patients with severe symptoms e.g. vomiting, diarrhea	• While this practice is applied specifically in the context of highly-infectious disease, it is a comprehensive set of tools to combat against patients with severe symptoms • Phone triage plays a crucial role in the process, as it will help to determine the level of preparedness needed by ambulance staff

[138] Isakov, A., Miles, W., Gibbs, S., Lowe, J., Jamison, A., & Swansiger, R. (2015). Transport and management of patients with confirmed or suspected Ebola virus disease. Annals of emergency medicine, 66(3), 297-305. Retrieved from https://web.mhanet.com/SQI/Emergency%20Preparedness/Infectious%20Diseases/Transport%20and%20Management%20of%20Patients%20with%20Confirmed%20or%20Suspected%20EVD.PDF.

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
• Use portable isolation unit that has a negative airway system to ensure that infectious pathogens remain within the pod, allowing protection for the public, healthcare workers, and a comfortable environment for the patient. • Portable isolation unit allows healthcare workers to still take care of patients with gloved compartments, allowing for patient care with ease.	Johns Hopkins Hospital[139], US Hospitals in Taiwan	Developed in response to Ebola, when transporting patients with severe symptoms e.g. vomiting, diarrhoea	• Portable isolation unit requires prior training for healthcare workers to ensure correct usage • Portable isolation unit has also been used in air transfer of patients, where there is less known protocol for vehicle disinfection and protection

[139] Johns Hopkins Medicine. (2014, November 17th). Ebola Patient Transport Drill – Johns Hopkins Medicine and Lifeline. Retrieved from https://www.youtube.com/watch?v=RRdxNzLXvhQ.

2.2.1 **SURGE CAPACITY STAGE**
Department: Emergency Department
Risk area: Arrival
Issue: Infected patients who are unaware of isolation protocols are entering ED facilities for check-ups even when they may be contagious

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Implement precautionary measures for when patient is suspected of having COVID-19: • If a patient who may have COVID-19 or who show signs of flu walks in unannounced, health care workers will immediately provide mask. • Establish temperature checks and health record/travel history checks before triage to pull out suspect cases; sometimes this is done outside the A&E. • Patients are placed in private isolation exam room, which has a ventilation system that pumps the room's air to the outdoors six times an hour, reducing circulation within hospitals. • Separate triage tents are also available for staff members to quickly detect any symptoms amongst healthcare workers[140].	Cleveland Clinic, US[141] Hospitals in Massachusetts, US[142]	In response to overloaded A&E department with potentially high infection rate	• Requires the capacity for space, manpower, infrastructure, health equipment • Can be coupled with pre-triage over the phone to identify potentially suspected cases

[140] Badhelia, N. (2020, March 27th). Teleconference with Eden Strategy Institute.
[141] Christ G., Washington J. (2020, February 23rd). Protecting patients, health care workers priorities as Cleveland Clinic, MetroHealth and UH prepare for coronavirus. Cleveland. Retrieved from https://www.cleveland.com/business/2020/02/cleveland-hospitals-prepare-for-potential-novel-coronavirus-cases.html
[142] This has only become a general practice during the time of COVID-19.

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Create separate area for patients with fever upon arrival for immediate quarantine of infectious patients to ensure minimal cross-infection.	Singapore General Hospital, Singapore[143]	To avoid the risk of cross-infection between patients/staff/public especially in times of infectious diseases; in this case, SGH has set up permanent infrastructure to deal with feverish patients during time of normal capacity	Requires existing capacity in A&E; hospital planning should consider space capacity to be turned into holding space for the spike of any potential infectious disease

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish telemedicine procedures to reduce people heading down in person: • Enable video consultations so that doctors can see the patients' health status • Develop apps for mobile devices for automated checking of symptoms • Home monitoring • Mobile treatment	Hospitals across Denmark[144], Chinese telemedicine services (Ali Health, JD Health, WeDoctor)[145]	Denmark has been trialing telemedicine for the past few years, while in China, with the COVID-19 outbreak, collaborations have been struck between mobile services providers and telehealth companies[146] to provide better services and quality of care	The success of telemedicine requires familiarity from healthcare providers, which necessitates training. During outbreaks of infectious disease, telemedicine can be conducted in the form of calls for pre-screening and pre-triage to advise infectious patients on quarantine measures and guidelines

[143] Singapore General Hospital. Retrieved from https://www.sgh.com.sg/patient-care/visiting-specialist/emergency-care-singapore-general-hospital
[144] Healthcare Denmark. (2018, March 1st). Denmark – a telehealth nation. Retrieved from https://www.healthcaredenmark.dk/media/r2rptq5a/telehealth-v1.pdf.
[145] The Economist (2020, March 5th). Millions of Chinese, cooped up and anxious, turn to online doctors. Retrieved from https://www.economist.com/business/2020/03/05/millions-of-chinese-cooped-up-and-anxious-turn-to-online-doctors
[146] Paul G. (2020, January 28th). ZTE and China Telecom enabled the first remote diagnosis of coronavirus via a 5G telehealth system. Business Insider. Retrieved from https://www.businessinsider.com/zte-china-telecom-build-5g-telehealth-system-for-coronavirus-2020-1?IR=T.

2.3.1
Department: Emergency Department
Risk area: Triage
Issue: Existing methods of triage, which involves the subjective judgement of nurses based on various standards (e.g. Emergency Severity Index) to triage patients, leads to reduced effectiveness of patient streamlining

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Improve triage outcomes using an electronic tool, based on data from 200,000 patients to predict the patient's severity of illness. The tool uses an algorithm, taking into account how symptoms were treated and likelihood for fatality, intensive care and requirement of emergency procedure.	Johns Hopkins Hospital, United States[147]	• 10% of patients triaged to ESI Level 3 should have been in Level 1 and 2, leading rise to the need for this study to intervene in existing methods of conducting triage • As a result of the system, 10% of those triaged at Level 3 were then categorized to Levels 1 and 2, while more patients were assigned to lower priorities as well • The system was able to win the trust of healthcare workers within the hospital because it was built using data from Johns Hopkins own emergency ward	• Change management for staff is required, as it takes nurses time to get used to the system • This is helpful as a way to increase triage overall, to enhance operational processes in case there is a surge

[147] Castellucci M. (2017, October 14th). Johns Hopkins uses electronic tool to improve triage of ED patients. Modern Healthcare. Retrieved from https://www.modernhealthcare.com/article/20171014/NEWS/171019915/johns-hopkins-uses-electronic-tool-to-improve-triage-of-ed-patients.

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish Medical Team Evaluation (MTE) concept, which involves team triage, quick registration, redesign of triage rooms and electronic medical records. The triage team involves a registered nurse teaming up with an additional ED physician, and they use the Emergency Severity Index (ESI) for triage.	Currently on academic trial in hospitals in Switzerland[148]	Method was developed to improve accuracy of triage so as to reduce bed-stay of patients	• Require sufficient manpower to introduce, but may be worth considering to overall enhance the quality of triage and thus reduce waiting time for patients • Trials can be done in preparedness stage to identify effectiveness for respective healthcare institutions

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Conduct regular refresher triage training (4 training sessions over a month, 20 minutes each, consisting of 10 slides), help to minimize inconsistent triage; constant monitoring of success and failure of triage methods and coordination at a larger level is important for quality control.	Currently on academic trial, Published in Clinical Nurse Specialist.[149]	Method was developed in response to general issues seen in triage due to lack of professional upgrading and refreshers for nurses	• Important practice to put in place so that healthcare workers can maintain effective triage even in times of surge • During surge time, it can be helpful to have check-ins and refreshers at the start of the week to minimize disruption to healthcare workers

[148]Lauks, J., Mramor, B., Baumgartl, K., Maier, H., Nickel, C. H., & Bingisser, R. (2016). Medical team evaluation: effect on emergency department waiting time and length of stay. PloS one, 11(4). Retrieved from https://pdfs.semanticscholar.org/f97d/15e5c8954433e328d1de2fcec086f0d25cd0.pdf
[149] Brosinski, C. M., Riddell, A. J., & Valdez, S. (2017). Improving triage accuracy: a staff development approach. Clinical Nurse Specialist, 31(3), 145-148.

2.3.2
Department: Emergency Department
Risk area: Triage
Issue: New and changing protocols on case identification and treatment make it difficult for frontline healthcare staff to keep up and comply with new guidelines

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Incorporate automatic prompts related to the virus (travel history, symptoms) into electronical medical records; to be implemented onto computers during registration process, as well as when medical health workers are taking calls from the public.	Cleveland Clinic[150]	There is a need to ensure that there is no lapse in triage procedure that may lead to misdiagnosis	• Alliance and collaboration with healthcare facility providers and vendors is key to the fast implementation of this system • Particularly useful during pandemic outbreaks as information about disease spread is still evolving

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Adopt the Front-Line Ownership (FLO) approach to enhance ownership and effective communication practices between frontline staff, IPC specialists, and managers: • Includes participatory peer learning, experiential or action-based learning, through the use of social proof; the key is that local community member must identify the practices themselves, allowing for faster buy-in and dissemination of practices.	Recommendation published in Healthcare Papers, and practice is adopted in selected	Research-based workshops to increase compliance of healthcare workers to IPC procedures, showed promising improvement	FLO can be adopted as a pre-pandemic, normal capacity measure to ensure high standards of healthcare; may be difficult to roll out during the outbreak of a pandemic

[150] Christ G., Washington J. (2020, February 23rd). Protecting patients, health care workers priorities as Cleveland Clinic, MetroHealth and UH prepare for coronavirus. Cleveland. Retrieved from https://www.cleveland.com/business/2020/02/cleveland-hospitals-prepare-for-potential-novel-coronavirus-cases.html

• Communication and connectivity between varying levels of the organization is crucial for effective organizational change, allowing healthcare workers to quickly and openly raise concerns they see on the front-line. • Embrace change within the organization and allow change to be an opportunity for members on the front-line to step up and take ownership of the situation.	Canadian Hospitals[151]		

[151] Zimmerman, B., Reason, P., Rykert, L., Gitterman, L., Christian, J., & Gardam, M. (2013). Front-line ownership: generating a cure mindset for patient safety. Healthc Pap, 13(1), 6-22. Retrieved from https://pdfs.semanticscholar.org/a30f/63a5c4166ee3bbafd322e344e318fc15c501.pdf?_ga=2.44008805.1900567441.1585215661-1409620267.1585215661

2.4.1
Department: Emergency Department
Risk area: Tests/X-rays/MRIs
Issue: The movement of a patient from the A&E to test rooms/x-rays leads to heightened exposure of the public to potentially infected patients

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Build dedicated pathways, elevators, and equipment for patients who are suspected of an infectious disease: • Patients do not need to wear barriers to transportation; patients will travel through a dedicated elevator, taken directly to place of testing; if patient cannot go into the room, porter will bring patient back to his/her room through the same way. • Stretchers and wheelchairs to have designated use; if designated equipment is unavailable, equipment from hospital supply pool can be used but must be wiped down thoroughly after.	Mount Sinai Hospital, Canada[152]	Minimize exposure of infectious patients with other people in the hospital	• Pre-planning and design of hospitals before the outbreak of a pandemic, with designated equipment and infrastructure • In cases where this is not possible, designated paths should be marked out to minimize exposure

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Use portable x-ray machines to minimize patients' movement in between places, even for cases that are suspect but unconfirmed.	Cleveland Clinic, United States[153]	During high season of infection spreading	Ensure the thorough wipe-down of equipment after usage, as studies have shown how infectious pathogens remain on devices

[152] Mount Sinai Hospital. Procedures for transportation of patients in vre/mrsa precautions. Retrieved from https://eportal.mountsinai.ca/Microbiology/protocols/pdf/k2biv.pdf.
[153] Christ G., Washington J. (2020, February 23rd). Protecting patients, health care workers priorities as Cleveland Clinic, MetroHealth and UH prepare for coronavirus. Cleveland. Retrieved from https://www.cleveland.com/business/2020/02/cleveland-hospitals-prepare-for-potential-novel-coronavirus-cases.html

2.4.2
Department: Emergency Department
Risk area: Tests/X-rays/MRIs
Issue: Pathogens from infected patients may be found on the surfaces of medical devices

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Disinfect medical devices thoroughly: • The portable radiography unit is stored in a "cold" area outside the containment room(s) when not in use. • The x-ray detector is double-bagged by using fluid-impermeable plastic material. • The radiologic technologist dons PPE in the designated donning area. • A clinician inside the containment room wearing PPE handles the double-bagged detector and is the only one to touch the patient. • The clinician wipes down the outer bag twice with disinfectant wipes, then takes the double-bagged detector to the threshold between the containment room and the anteroom and removes and discards the outside bag while the anteroom nurse pulls the single-bagged detector out of the bag. • The single bag covering is wiped down twice with disinfectant wipes. • The detector is then removed from the single bag and wiped down twice with isopropyl alcohol (other disinfectants may damage the detector). • The portable radiography unit is wiped down twice with disinfectant wipes and rolled over a mat saturated with disinfectant and returned to another room, where it is treated with HPV before storage and subsequent use.	CDC guidelines Published in Radiology.[154]	Practices were created in the wake of Ebola, where rate of infection and fatality was extremely high	• Extent of infection and bodily fluids that are coming out of the patient, which determines the infectiousness of the process • Should be standard practice for the disinfection of devices used on confirmed patients • Consider having equipment reserved for the use of one particular infection to reduce cross-spreading

[154] Mollura, D. J., Palmore, T. N., Folio, L. R., & Bluemke, D. A. (2015). Radiology preparedness in Ebola virus disease: guidelines and challenges for disinfection of medical imaging equipment for the protection of staff and patients. Radiology, 275(2), 538-544.

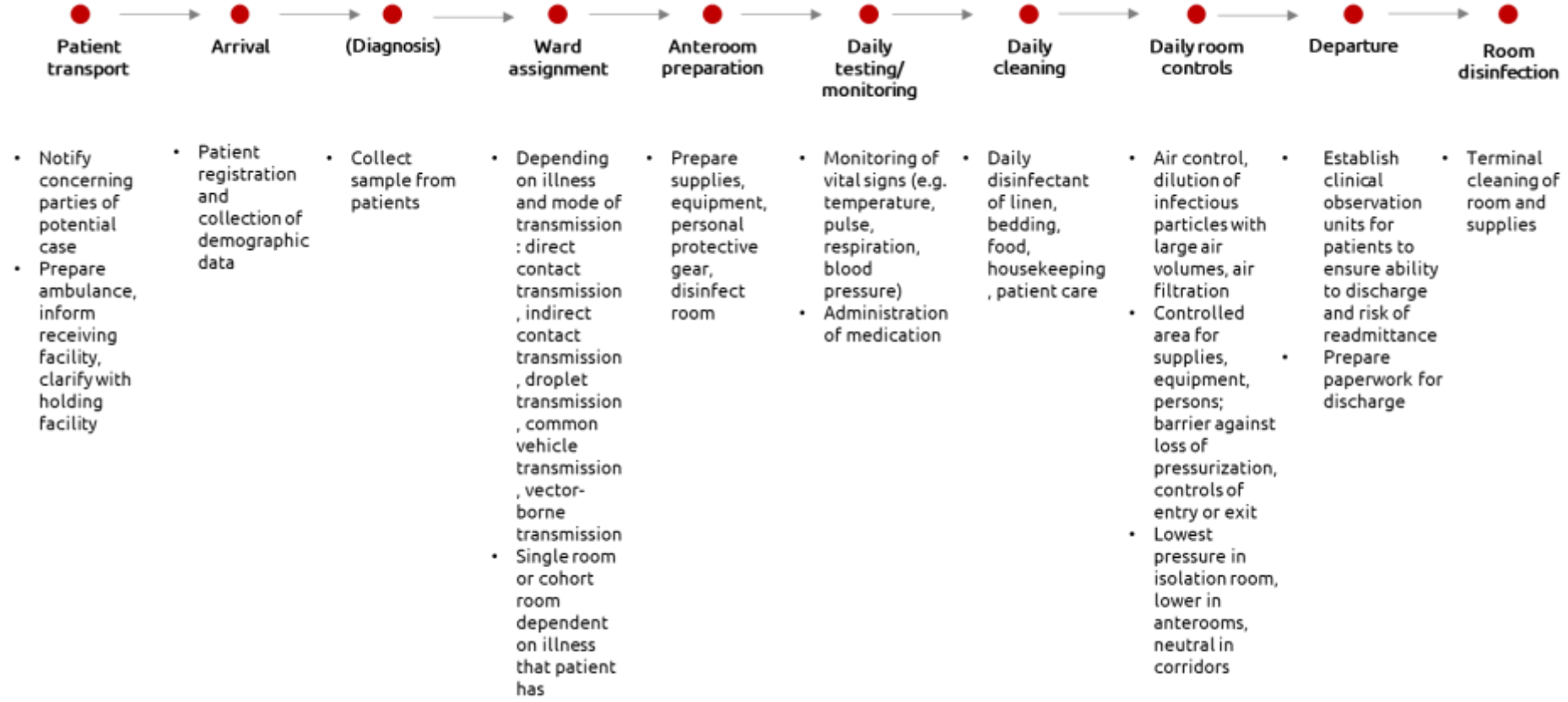
2.4.2
Department: Emergency Department
Risk area: Tests/X-rays/MRIs
Issue: Adapt other types of equipment, such as ultrasound, to complement early detection and confirmation of patients

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use ultrasound for early detection and confirmation of potential COVID-19 patients in case there is limited test kit or a long waiting list for being tested: • Ultrasound allows healthcare workers to immediately see an image of the lungs, which helps them to confirm patients who already exhibit symptoms/have travel history • Ultrasound also reduces radiation exposure to patients, in comparison to x-rays • Ultrasound takes a shorter amount of time and resources, in comparison to other tests such as CT scans	Thomas Jefferson University Hospital, US.[155]	Amidst increase in patients who require testing and limited equipment and resources, as well as time required for test results to come out, doctors have been using ultrasound to observe images of the lungs to detect patients with COVID-19	• A much cheaper and faster complement to COVID-19 testing, with a certain level of accuracy • Method should be used with discretion as doctors have yet to conclude during which stage (e.g. triage, monitoring) and for whom this method works best for

[155] Lewiss, R. E. (2020, April 18). I'm an emergency medicine doctor: Here's how we're using ultrasound in innovative ways to combat COVID-19. Fast Company. Retrieved from https://www.fastcompany.com/90492442/im-an-emergency-medicine-doctor-heres-how-were-using-ultrasound-in-innovative-ways-to-combat-covid-19

3. Isolation Ward

Isolation Ward Workflow



Workflow defined by CDC Isolation Guidelines[156] and National Health Services[157].

[156] Siegel, J. D., Rhinehart, E., Jackson, M., & Chiarello, L. (2007). 2007 Guideline for isolation precautions preventing transmission of infectious agents in healthcare settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

[157] National Health Services, National Services Scotland. (2015). Transmission Based Precautions Literature Review: Patient Placement (Isolation/Cohorting). Retrieved from https://hpspubsrepo.blob.core.windows.net/hps-website/nss/1725/documents/1_tbp-lr-isolation-and-cohorting-v1.0.pdf.

Identified key risk areas within Isolation Wards

RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
3.1 Bed placement	3.1.1	Inaccurate bed placement of infected individuals results in higher rate of healthcare-based infection	• High potential for infection as patients who are highly infectious may interact with others who are not confirmed with the illness	• Ensure sufficient single isolation rooms and assign patients with highly infectious symptoms to these rooms
3.2 Medicine administration	3.2.1	Aerosolized medication administration may generate a high volume of respiratory aerosols propelling over a longer distance	• High potential for infection due to high level and propensity of droplets produced through process	• Ensure the healthcare workers don sufficient protective gears; for aerosol-generating procedures, ensure healthcare workers further don a fit-tested N95 respirator
3.3 Daily room controls	3.3.1	Constantly maintaining positive/negative room pressure to ensure containment of infectious pathogens	• High potential for infection as poor control of room pressure results in spreading of infectious pathogens to other areas • High cost generator to implement controls, if not already existing	• Install permanent visual device to monitor air pressure
	3.3.2	Isolation rooms without high-quality air filters and regular air changes may be ineffective in removing air-borne contaminants	• High potential for infection as the recirculation of air results in increasing exposure to infectious pathogens	• Follow international air filtration and monitoring standards • Use pre-filters upstream to remove larger air particles

	3.3.3	During peak of epidemic with increasing number of patients who need isolation, there may not be sufficient isolation wards for containment of infected patients	• High potential for infection as interactions lead to a higher chance of cross-infection	• Create temporary negative pressure rooms with portable HEPA filter • Repurpose hospital smoke zones into isolation zones
3.4 Disinfection	3.4.1	Outer packaging of commonly used medical equipment is contaminated with infectious pathogens due to extended exposure in isolation wards	• High potential for infection as infectious pathogens remains on surfaces • High consumption of supplies due to the necessary disposal of infected supplies	• Decontaminate isolation areas twice a day with disinfectant solution • Use UV light and HPV for disinfection of non-visible spoilage

3.1.1
Department: Isolation Ward
Risk area: Bed placement
Issue: Inaccurate bed placement in isolation ward of infected individuals results in higher rate of healthcare-based infection

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
• Where possible, in new hospitals, 100% of isolation units should be single rooms, with a minimum requirement of 50% of rooms being single rooms. • If patients have symptoms that signify high-spread, immediately place in single room; specific high-spread symptoms to look out for: diarrhoea, vomit, high fever. • Patient can subsequently be placed in cohort isolation upon progress in medical state/confirmed diagnosis of illness.	National Health Services (NHS), Health Protection Scotland[158]	General hospital planning and layout guidelines to ensure minimal spread of highly-infectious diseases	Initial planning and design of hospitals must take into account sufficient numbers of single rooms in case of highly-infectious diseases

[158] National Health Services, National Services Scotland. (2015). Transmission Based Precautions Literature Review: Patient Placement (Isolation/Cohorting). Retrieved from https://hpspubsrepo.blob.core.windows.net/hps-website/nss/1725/documents/1_tbp-lr-isolation-and-cohorting-v1.0.pdf.

3.2.1
Department: Isolation Ward
Risk area: Daily testing and monitoring
Issue: Aerosolized medication administration may generate a high volume of respiratory aerosols propelling over a longer distance

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
For any suctioning practices, such as endotracheal intubation, on patients with suspected or proven infections transmitted by respiratory aerosols, don personal protective equipment, mask, goggles, and face shield. For aerosol-generating procedures, a fit-tested N95 or higher respirator, in addition to the above, are highly recommended.	Centers for Disease Control and Prevention (CDC), United States[159]	General hospital guidelines to ensure that healthcare workers do not get infected in the process of treating patients	Because understanding of pandemics is ongoing, it is important to take extreme precautions when it comes to high-contact procedures to avoid healthcare workers compromising their wellbeing

[159] Siegel, J. D., Rhinehart, E., Jackson, M., & Chiarello, L. (2007). 2007 Guideline for isolation precautions preventing transmission of infectious agents in healthcare settings.

3.3.1
Department: Isolation Ward
Risk area: Daily room controls
Issue: Constantly maintaining positive/negative room pressure to ensure containment of infectious pathogens

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Install permanent visual device in each isolation room to constantly monitor the air pressure differential of the room, such as: • Flutter strip. • Calibrated ball in tube. • Electronic pressure monitor, with audible and visual alarms to warn staff when room pressurization is lost, with time delay to avoid alarms going off when staff is entering and leaving the room .	Guidelines by American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE's) Standard 170, Ventilation of Health Care Facilities[160]	Isolation room air pressure controls to ensure correct airflows	• In the case where isolation rooms are being developed to deal with surge capacities, it is recommended to implement monitoring efforts that require less infrastructure set-up, such as flutter strips or regular smoke test to observe air flows • In designing new isolation rooms, electronic pressure monitor with alarms should be ensured

[160] Herrick M. (2017, February 1st). Planning and maintain hospital air isolation rooms. Health Facilities Management Magazine. Retrieved from https://www.hfmmagazine.com/articles/2671-planning-and-maintaining-hospital-air-isolation-rooms.

3.3.2
Department: Isolation Ward
Risk area: Daily room controls
Issue: Isolation rooms without high-quality air filters and regular air changes may be ineffective in removing air-borne contaminants

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Follow guidelines to ensure effective air filtering system in isolation room: • Central or point-of-use HEPA (99.97% efficiency) filters capable of removing particles 0.3 µm in diameter for supply (incoming) air. • Proper construction of windows, doors, and intake and exhaust ports. • Ceilings: smooth, free of fissures, open joints, crevices. • Walls sealed above and below the ceiling. • Ventilation to maintain ≥12 ACH. • Pressure differential of >2.5 Pa [0.01" water gauge].	CDC Infection Control Guidelines, United States[161]	Guidelines for filtering of air in isolation wards	• Standardized practice in international isolation guidelines should be followed to strictly • Standardized implementation may be costly due to initial infrastructure investment, but is important to deal with any infectious disease outbreak

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
While air filtering is a recognized necessity for isolation rooms, the high cost of this technology may deter adoption, leading to ineffective construction of isolation rooms. To minimize high cost and rate of replacement for HEPA filters, use pre-filters upstream to remove larger particles, such as using MERV 14 (>90% efficiency), which will extend the life of HEPA filers by 900%.	National Air Filtration Association Guidelines,	Guidelines for filtering of air in isolation wards, using different technologies	• Especially useful for hospitals with a lower budget that need to reduce cost of replacement of infrastructure due to overuse

[161] Siegel, J. D., Rhinehart, E., Jackson, M., & Chiarello, L. (2007). 2007 Guideline for isolation precautions preventing transmission of infectious agents in healthcare settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

	United States[162]		• Might be useful to compare the lifespan and cost of various practices to see which one maintains effectiveness at lower cost

[162] Palmer B., Clark L. (2016). Recommended practices for filtration for airborne infections containment rooms in health care facilities. National Air Filtration Association. Retrieved from https://www.nafahq.org/wp-content/uploads/Airborne-Infections-Containment-Rooms-in-Health-Care-Facilities-Secured.pdf.

3.3.3 SURGE CAPACITY STAGE

Department: Isolation Ward
Risk area: Daily room controls
Issue: During peak of epidemic with increasing number of patients who need isolation, there may not be sufficient isolation wards for containment of infected patients

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Create a temporary negative pressure room with portable HEPA filter; ideally, a portable anteroom should also be set up, big enough to accommodate function (e.g. Change clothes, hang PPE, dispose of waste, etc.): • Step 1: Select a room, ideally without transfer grilles; if grilles exist, completely seal grilles to promote negative pressure. • Step 2: Set up pre-constructed window adapter that provides an airtight fit • Step 3: Set up HEPA machine. • Step 4: Seal return air grille. • Step 5: Turn on HEPA machine and adjust air flow – standard pressure differentials apply; pressure should be monitored daily with a hand-held digital pressure gauge. Other things to note: Ensure that curtains are set up for the room, using strong tape, and fire-rated plastic to ceiling.	Minnesota Department of Health Guidelines, United States[163]	Methods for ensuring quality room pressure, especially in cases of surge/need for portable air filtration	• Need to implement measures to monitor air quality and room pressure of make-shift isolation wards through practices mentioned in 3.3.1 • Materials need to be wiped down frequently (curtains, makeshift doors), and process can be time consuming

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Repurpose hospital smoke zones, which have in-built airtight barriers to prevent smoke movement between zones, for isolation purposes; use portable HEPA filter machines to ensure negative pressure, with similar guidelines and protocols applied for pressure level.	Minnesota Department of Health Guidelines,	Methods for ensuring quality room pressure, especially in cases of surge/need for portable air filtration	• Need to implement measures to monitor air quality and room pressure of make-shift isolation wards through

[163] Minnesota Department of Health – Office of Emergency Preparedness. Airbone Infectious Disease Management – Methods for Temporary Negative Pressure Isolation. Retrieved from https://www.health.state.mn.us/communities/ep/surge/infectious/airbornenegative.pdf.

	United States[164]		practices mentioned in 3.3.1 • This can be an immediate, short-term improvisation in the case when hospitals are unable to offload their patients elsewhere

[164] Minnesota Department of Health – Office of Emergency Preparedness. Airbone Infectious Disease Management – Methods for Temporary Negative Pressure Isolation. Retrieved from https://www.health.state.mn.us/communities/ep/surge/infectious/airbornenegative.pdf.

3.4.1
Department: Isolation Ward
Risk area: Room disinfection
Issues: Outer packaging of commonly used medical equipment is contaminated with infectious pathogens due to extended exposure in isolation wards

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Decontaminate patient isolation rooms and areas twice daily using the following methods: • A combined detergent/disinfectant solution at a dilution of 1,000 parts per million available chlorine (ppm available chlorine (av.cl.)); or • A general-purpose neutral detergent in a solution of warm water followed by disinfection solution of 1,000ppm av.cl.	National Health Services, Health Protection Scotland[165]	Methods to ensure the decontamination of environmental aspects in isolation wards, which may carry infectious pathogens	While mechanical disinfection may be cost-friendly and easy to implement, measures should be considered to complement mechanical disinfection, such as the monitoring of hygiene quality and no-touch cleaning technology

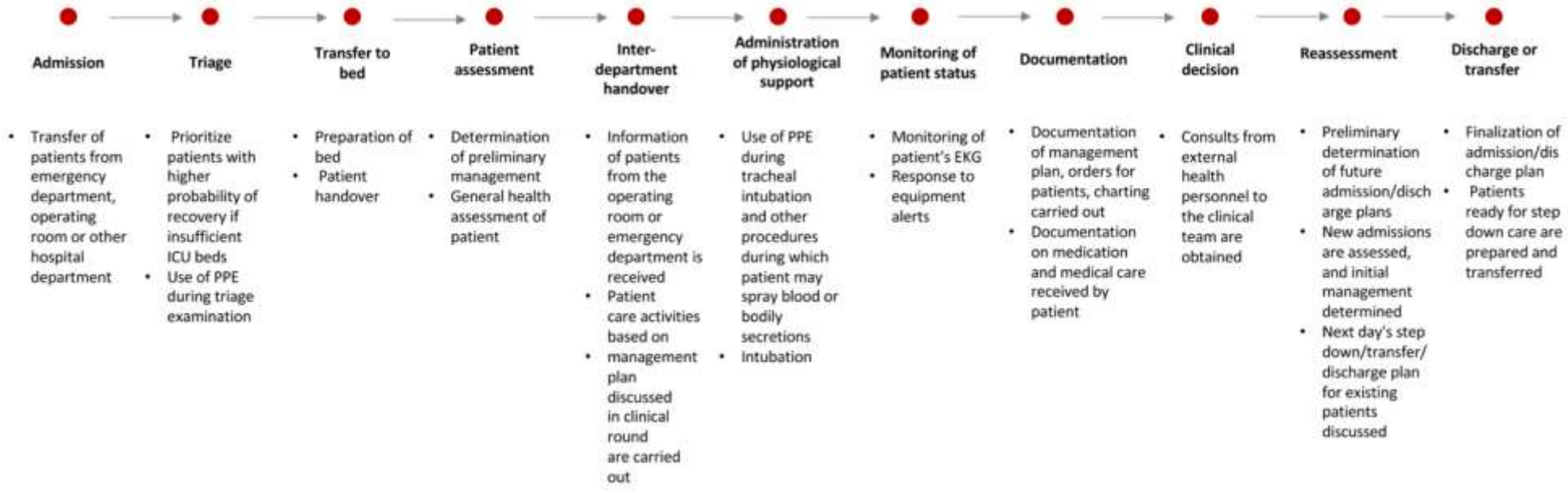
PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Use of UV light and HPV for disinfection: • Use of UV light, which requires up to 15 minutes per room OR use of emitting robots/ HPV emitting robots (2-5 hours) after mechanical cleaning. • While HPV cleaning is fairly comprehensive, UV light cleaning must be done with mechanical cleaning as it doesn't clean off dust.	Johns Hopkins Hospital, recommended by ISID[166]	Disinfecting of highly contaminated rooms	• Works best for single room isolation wards as it would require the evacuation of personnel in the room - hard to be done when patients are coming in in high volume; most suited for terminal cleaning

[165] National Health Services, National Services Scotland. (2015). Transmission Based Precautions Literature Review: Patient Placement (Isolation/Cohorting). Retrieved from https://hpspubsrepo.blob.core.windows.net/hps-website/nss/1725/documents/1_tbp-lr-isolation-and-cohorting-v1.0.pdf.
[166] Gonzalo M.L. et al. (2018 June). Disinfection in the Hospital Environment. Guide to Infection control in the Hospital. Retrieved from https://isid.org/wp-content/uploads/2018/06/ISID_Infection_Guide_Chapter10.pdf

			• UV light cleaning can be considered to complement mechanical cleaning as it requires less time to complete

4. Intensive Care Unit

Intensive Care Unit workflow



Workflow as defined by Journal of Biomedical Informatics[167], Liverpool Hospital[168], Critical Care Medicine Journal[169].

[167] Malhotra, Sameer, et al. "Workflow Modeling in Critical Care: Piecing Together Your Own Puzzle." Journal of Biomedical Informatics, vol. 40, no. 2, Apr. 2007, pp. 81–92. Science Direct. Retrieved from https://www.sciencedirect.com/science/article/pii/S1532046406000633.
[168] Liverpool Hospital. Clinical Guidelines: Receiving a Patient into ICU . Liverpool Hospital, Feb. 2014. Retrieved from www.aci.health.nsw.gov.au/__data/assets/pdf_file/0008/306449/liverpoolReceiving_a_patient_to_ICU.pdf.
[169] Nates, Joseph L, et al. "ICU Admission, Discharge, and Triage Guidelines: A Framework to Enhance Clinical Operations, Development of Institutional Policies, and Further Research." Critical Care Medicine, vol. 44, no. 8, Aug. 2016, pp. 1553–1602. Critical Care Medicine , doi:10.1097/CCM.0000000000001856.

Identified key risk areas within Intensive Care Unit

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
3.5 Admission	4.1.1	Insufficient ICU beds due to high surge demand	• High risk of fatality as large volumes of critical stage coronavirus patients require intensive care to breathe	• Implement ICU triage guidelines during a pandemic • Establish more areas for use as ICU wards • Tap on state resources to create more ICU capacity
	4.1.2	General ICU wards are manpower intensive and costly to patients and hospitals	• High risk of manpower shortage as general ICU wards require more manpower than general wards or step down units	• Create Step-Down Units to relieve manpower demands as well as reduce cost of stay
	4.1.3	Infections to healthcare workers that are spread by direct or indirect contact with the patient or the patient's environment	• High potential for infection due to high frequency of contact spread and difficulty in disinfecting surfaces to prevent spread	• Consider contact precaution guidelines and room considerations for infected patients
3.6 Transfer to bed	4.2.1	Possible spread of infection upon transferring patient	• High potential for infection from contact or droplet spread when patient moves within hospital	• Limit patient movement to only when necessary
3.7 Administration of physiological support	4.3.1	Insufficient ventilators due to limited hospital stockpile	• High risk of fatality as ventilators are necessary for survivability of critical care stage coronavirus patients	• Apply for national stockpile equipment

4.3.2	Insufficient ventilators due to large period of time patients are on ventilators	• High risk of fatality as limited number of patients has access to ventilators due to prolonged duration of ventilator use required	• Wean patients off ventilator in a faster time using non-sedating medication, physical therapy, and increasing patient mobility
4.3.3	Respiratory therapists may not have skills to operate stockpiled ventilators	• High risk of fatality when patients are not able to use stockpiled ventilators	• Train current population of respiratory therapists
4.3.4	Limited respiratory therapists	• High risk of manpower shortage as respiratory therapists are required to operate ventilators and monitor patients during influenza pandemic	• Hospital strategies to recruit more respiratory therapists during critical period • Increase wages of respiratory therapists • Increase course offerings in schools
4.3.5	High risk of occupation exposure during sputum suction	• High potential for infection of healthcare workers due to accidental direct exposure to infected patient's sputum	• Implement hygiene and safety precautions before sputum suctioning • Use comprehensive PPE protection
4.3.6	Exposure to aerosol generating procedures (e.g. endotracheal intubation, suctioning) is associated with transmission of infection to large numbers of healthcare personnel	• High potential for infection of healthcare worker when conducting aerosol generating procedures due to greater frequency of opportunity for infection	• Use of CDC's Standard Precautions, Contact Precautions, and Airborne Precautions • Consider droplet precaution guidelines and room considerations for infected patients

4.4 Discharge or transfer	4.4.1	Spread of virus to operating room during surgery if required	• High risk of fatality as patients are more vulnerable and have lower immune systems when in ICU or operating room	• Perform some surgery in ICU ward
	4.4.2	Contamination upon patient death	• High potential for infection upon improper handling of infected corpse	• Ensure staff are donning full PPE • Fill openings of corpse with cotton balls dipped in disinfectant • Wrap the corpse with double layer cloth sheet soaked in disinfectant
	4.4.3	Risk of discharging patient who is still infectious	• High potential for infection if patients are released when still infectious	• Discharge patient even if they test positive for COVID-19 on the 13th day due to updates in WHO regulations

Divergent practices identified

4.1.1 **SURGE CAPACITY STAGE**
Department: Intensive Care Unit
Risk area: Admission
Issue: Insufficient ICU beds due to high surge demand

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Apply triage guidelines during a pandemic: • Implementing a critical care triage protocol during event of influenza pandemic or mass disaster. • Developing fair and equitable policies may require restricting ICU services to patients most likely to benefit. • ICU care and treatments may have to be withheld from patients likely to die, even with ICU care, and withdrawn after a trial in patients who do not improve or deteriorate. • Triage of patients for ICU should be based on those who are likely to benefit most or a 'first come, first served' basis.	European Society of Intensive Care Medicine[170]	Deciding which patients to allocate available ICU beds to during pandemic situation with over demand of health services	• Triage criteria should be objective, ethical, transparent, applied equitably and be publicly disclosed • A triage officer should apply inclusion and exclusion criteria to determine patient qualification for ICU admission

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish more areas for use as ICU wards by • Evaluating areas in the hospital that can be converted to ICUs to accommodate the likely rise in critical care patients. Hospital areas to convert could be departments and wards that are in low use due to the cancelation of elective surgeries. • Converting existing facilities such as dormitories and nursing homes into makeshift hospitals.	Providence hospitals in Washington, Swedish Medical Center in Seattle[171]	Converting hospital areas to create more ICU bed supply as well as freeing up more manpower to handle ICU care	• Identify which hospital areas and departments to close down to make space for ICU units • Hospitals in areas where there is community

[170] Christian, M. D., Joynt, G. M., Hick, J. L., Colvin, J., Danis, M., & Sprung, C. L. (2010, April 1). Chapter 7. Critical care triage. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. Intensive Care Medicine. doi: 10.1007/s00134-010-1765-0
[171,171] Scott, D. (2020, March 17). US hospitals are struggling to respond to the Covid-19 pandemic. Retrieved from https://www.vox.com/policy-and-politics/2020/3/17/21183263/coronavirus-us-hospitals-elective-surgeries-icu-masks

			transmission should postpone elective surgeries

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Tap on external resources such as from state and federal agencies: • The US Military has thousands of physicians who could help treat patients, they could create new hospitals if needed or repurpose current ones, for example by converting parts of hospitals into intensive care units.	Los Angeles County-USC Medical Center, New York, Maryland, US Military[172]	This strategy considers financial support by government bodies in times of emergency	• Training of military physicians on how to care for COVID-19 patients is essential

4.1.2 **PREPAREDNESS STAGE**

Department: Intensive Care Unit
Risk area: Admission
Issue: General ICU wards are manpower intensive and costly to patients and hospitals

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use of Step Down Units (SDUs) to relieve demand on regular ICU ward capacity: • A Turkish study found that inappropriate ICU admission was 55.9% which can be reduced by instilling a lower level of ICU (ICU level 1) as existing beds could be utilized more effectively as lower level ICUs require less cost and manpower to operate. • An NYU Stern study also found that creation of Step Down Units (SDU), similar to Level 1 ICU will transfer patients who can afford a lower level of care than standard ICUs to relieve cost and staffing capacity as SDUs require a lower staffing requirement to normal ICU wards. • SDU care has the potential to affect hospital throughput and ICU use and therefore may be a prime focus for hospitals looking to restructure their care to be more efficient. • Single-center studies have shown that the establishment of an SDU may allow for more overall critical care admissions without an increase in mortality, may shorten ICU length of stay without increasing ICU readmissions, and may decrease the proportion of stepdown patients residing in ICU beds.[173]	Turkish Journal of Anaesthesiology and Reanimation[174] NYU Stern[175]	Study on effective use of ICU beds in Turkish hospitals to relieve ICU over capacity	• Important to determine whether palliative patients require ICU care, for those that are stable enough, they can be placed in home care • Determine which patients can be placed in SDUs instead

[173] Prin, M., & Wunsch , H. (2014). The Role of Stepdown Beds in Hospital Care. American Journal of Respiratory and Critical Care Medicine, 190(11). Retrieved from https://www.atsjournals.org/doi/full/10.1164/rccm.201406-1117PP
[174] Şimşek, E. M., İzdeş, S., Parpucu, Ü. M., Ulus, F., Cırık, M. Ö., & Ünver, S. (2019). How Effective are Intensive Care Unit Beds Used in Our Region? Turkish Journal of Anaesthesiology and Reanimation, 47(6), 485–491. doi: 10.5152/TJAR.2019.65289
[175] Armony, M., Chan, C. W., & Zhu, B. (n.d.). NYU Stern, New York.

4.1.3
Department: Intensive Care Unit
Risk area: Admission
Issue: Infections to healthcare workers that are spread by direct or indirect contact with the patient or the patient's environment

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Consider guidelines on Contact Precautions recommended by the CDC: • Wearing a gown and gloves for all interactions that may involve contact with the patient or potentially-contaminated areas in the patient's environment. • Donning PPE upon room entry and discarding before exiting the patient room is done to contain pathogens, especially those that have been implicated in transmission through environmental contamination.	CDC[176]	Precaution necessary when dealing with infectious virus that transmits upon contact	Requires sufficient PPE and training to healthcare workers

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Apply rooming considerations for infected patients: • A single-patient room is preferred for patients who require Contact Precautions. • In multi-patient rooms, ≥3 feet spatial separation between beds is advised to reduce the opportunities for inadvertent sharing of items between the infected/colonized patient and other patients.	CDC[177]	Reduce spread of virus by isolating patient as much as possible	Requires sufficient individual room availability

[176,50] CDC. (2019). 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

4.2.1
Department: Intensive Care Unit
Risk area: Transfer to bed
Issue: Possible spread of infection upon transferring patient

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Minimize spread of infection through limiting patient movement and using PPE properly: • Limit transport and movement of patients outside of the room to medically-necessary purposes. • When transporting patient, ensure that infected areas of the patient's body are contained and covered. • Remove and dispose of contaminated PPE and perform hand hygiene prior to transporting patients on Contact Precautions. • Don clean PPE to handle the patient at the transport destination.	CDC[178]	Limiting spread of virus within hospital during patient movement	Have own hospital guidelines as to what constitutes medically necessary purposes to decide on whether to transport infected patient

[178] CDC. (2019). 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

4.3.1
Department: Intensive Care Unit
Risk area: Administration of physiological support
Issue: Insufficient ventilators due to limited hospital stockpile

SURGE CAPACITY STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Apply for equipment from the national stockpiles: • To meet excess demand of ventilators, the CDC Strategic National Stockpile (SNS) stores and maintains mechanical ventilators that can be deployed on request through appropriate channels. • Hospitals can request for extra resources through their incident command system.	CDC and Johns Hopkins[179]	Hospital are only able to request through Incident Command System when internal ventilators are at full capacity	Hospitals require sufficient ICU beds and nurses to care for patient alongside ventilator availability

[179] Johns Hopkins Center for Health Security . (2020). Ventilator Stockpiling and Availability in the US F. Johns Hopkins Center for Health Security. Retrieved from http://www.centerforhealthsecurity.org/resources/COVID-19/200214-VentilatorAvailability-factsheet.pdf

4.3.2
Department: Intensive Care Unit
Risk area: Administration of physiological support
Issue: Insufficient ventilators due to large period of time patients are on ventilators

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Wean patients off ventilators faster: • Use non-sedating medications to allow for earlier weaning. • Increasing patient mobility encourages earlier weaning. • Mechanical ventilation setting of between 20 and 25 breathes per minute to prevent patient diaphragm from getting weaker. • Physical therapy to prevent muscle atrophy when lying in bed for long periods of time.	RT Magazine[180]	Decreasing patient time on ventilator to increase ventilator access to greater number of patients	• Greater medical and nursing attention required to improve patient recovery • Recent findings show that the use of ventilators may not be suitable for all patients as it might lead to dependency; thus, some patients may be reassessed to be put on ventilators to begin with[181]

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Use of computerized weaning systems which can collect data to make more informed decisions:	Cochrane[182]	Inefficient weaning may result in a prolonged time on a ventilator, putting patients	• Requires knowledge on how to interpret data from weaning systems

[180] RT. (2019, December 10). Ventilator Weaning: Its About Technology and Teamwork. Retrieved from https://www.rtmagazine.com/department-management/clinical/ventilator-weaning-technology-teamwork/
[181] Aloisi, S., Beasley, D., Borter, G., Escritt, T., & Kelland, K. (2020, April 23). Special Report: As virus advances, doctors rethink rush to ventilate. Reuters. Retrieved from https://www.reuters.com/article/us-health-coronavirus-ventilators-specia/special-report-as-virus-advances-doctors-rethink-rush-to-ventilate-idUSKCN2251PE
[182] Rose , L., Schultz, M. J., Cardwell, C. R., Jouvet, P., McAuley, D. F., & Blackwood, B. (2014, June 10). Do ventilators that manage the reduction of ventilator support (weaning) reduce the duration of weaning compared to strategies managed by clinicians? Retrieved from https://www.cochrane.org/CD009235/EMERG_do-ventilators-manage-reduction-ventilator-support-weaning-reduce-duration-weaning-compared

• Computerized weaning systems resulted in the average time required for a person to be weaned off the ventilator to be reduced by 30%. • The overall time on the ventilator was reduced by 10% and the length of stay in ICU by 8%.		at risk of lung injury, pneumonia and death.	

4.3.3 SURGE CAPACITY STAGE

Department: Intensive Care Unit
Risk area: Administration of physiological support
Issue: Respiratory therapists may not have skills to operate stockpiled ventilators

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Train respiratory therapists to operate stockpiled mechanical ventilators: • A study found that the limiting factor during a pandemic-level crisis would be the number of respiratory therapists than ventilators. • AARC partnered with the CDC SNS to train respiratory therapists on operating stockpiled mechanical ventilators during a public health emergency. • AARC also provides information on the SNS allocation process, training manuals for the 3 stockpiled mechanical ventilator types, and regular online learning sessions.	American Association for Respiratory Care (AARC)[183]	Limited number of healthcare practitioners who know how to operate stockpiled ventilators	Regular education and training programs required for respiratory therapists and non-respiratory therapy healthcare workers to prepare for times in crisis

[183] Johns Hopkins Center for Health Security . (2020). Ventilator Stockpiling and Availability in the US F. Johns Hopkins Center for Health Security . Retrieved from http://www.centerforhealthsecurity.org/resources/COVID-19/200214-VentilatorAvailability-factsheet.pdf

4.3.4
Department: Intensive Care Unit
Risk area: Administration of physiological support
Issue: Limited respiratory therapists

SURGE CAPACITY STAGE

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Recruit enough respiratory therapists through hiring new graduates, bringing back recent retirees and pulling in therapists from other part of the health care system, including those who would have been treating patients of now-cancelled elective surgeries.	Central New York hospitals[184]	Limited respiratory therapists during pandemic	Active sourcing and hiring respiratory therapists during peak period

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Pay respiratory therapists similar wages as nurses to increase the attractiveness of the job. • Apart from insufficient ventilators in healthcare institutions, one other major current problem is insufficient respiratory therapists who are the healthcare workers specialized in operating ventilators • Most of the respiratory therapists are baby boomers, and in this current workforce, not as many medical students want to specialize in respiratory therapy[185] • However, in the coming future, pandemics will be more frequent, and if they are of an influenza nature, there will be great demand for ventilators, and the healthcare workers who operate them	Syracuse[186]	In Central New York, the median wage of respiratory therapists is $10,000 less than registered nurses although many respiratory therapists have bachelor's degrees and deserve to be paid similarly to nurses	Hospitals need to adjust wages or provide bonus packages for pandemic related frontline staff to attract talent

[184] Coin, G. (2020, March 24). Coronavirus: Cuomo wants more ventilators, but are there enough specialists to run them? Retrieved from https://www.syracuse.com/coronavirus/2020/03/coronavirus-cuomo-wants-more-ventilators-but-are-there-enough-specialists-to-run-them.html

[185] Corn, D. (2020, March 19). The ventilator situation is actually worse than you think. Retrieved from https://www.motherjones.com/politics/2020/03/ventilator-crisis-enough-respiratory-therapists/

[186] Coin, G. (2020, March 24). Coronavirus: Cuomo wants more ventilators, but are there enough specialists to run them? Retrieved from https://www.syracuse.com/coronavirus/2020/03/coronavirus-cuomo-wants-more-ventilators-but-are-there-enough-specialists-to-run-them.html

• To prepare ourselves for the next waves of pandemics, healthcare institutions should boost the attractiveness of a respiratory therapy career, to meet the demand of the future			

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Increase number of schools with Respiratory therapist course offerings.	The City, non-profit news outlet[187]	Only 13 schools in New York offer respiratory therapy programs, leaving too few graduates to fill available positions	• Schools could increase respiratory therapist programs due to possible increase and frequency in pandemics in the future • Hospitals and schools can market the profession as being more respectable and well paid

[187] Choi, A., & Velasquez, J. (2020, March 20). Trained Operators for Coronavirus Patient Ventilators Scarce in New York. Retrieved from https://thecity.nyc/2020/03/trained-operators-for-coronavirus-ventilators-scarce-in-nys.html

4.3.5
Department: Intensive Care Unit
Risk area: Administration of physiological support
Issue: High risk of occupation exposure during sputum suction

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Follow hygiene and safety precautions for healthcare workers before sputum suctioning procedure: • CDC recommends patients and caregivers get current immunizations. • Proper handwashing before performing procedure. • Sterile suctioning technique used. • Disinfect and clean all equipment through mechanical cleaning with detergent and water.	Respiratory Care Journal (Clinical practice guidelines)[188]	Used with patients with highly infectious diseases during sputum suction procedure	Adequate resources and equipment as disinfection process takes time

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Wear protective face screen based on Level II protection while collecting respiratory specimens from suspected or confirmed patients. Level II Protection involves: • Disposable surgical Cap • Medical protective mask (N95) • Work uniform • Disposable medical protective uniform • Disposable latex gloves • Goggles	Zhejiang University School of Medicine[189]	COVID-19 Related Personal Protection Management	This practice requires sufficient disinfectant supply, training healthcare team and adherence to strict cleaning practices

[188] McInturff, S. L., Make, B. J., Robart, P., & Saposnick, A. B. (1999). AARC Clinical Practice Guideline, Suctioning of the Patient in the Home. Respiratory Care, 44(1), 99–104. Retrieved from http://www.rcjournal.com/cpgs/sotpithcpg.html
[189] Zhejiang University School of Medicine. (2020). Handbook of COVID-19 Prevention and Treatment.

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
When conducting sputum suction, use a closed sputum suction system, including closed suction catheter and closed disposable collection bag to reduce the formation of aerosol and droplets.	Zhejiang University School of Medicine[190]	Sputum suction procedure to limit exposure to droplets	• Practice requires sufficient closed suction catheters and closed disposable collection bag • Training of nurses and ICU staff needed to conduct sputum suction with less risk of exposure

[190] Zhejiang University School of Medicine. (2020). Handbook of COVID-19 Prevention and Treatment.

4.3.6
Department: Intensive Care Unit
Risk area: Administration of physiological support
Issue: Exposure to aerosol generating procedures (e.g. endotracheal intubation, suctioning) was associated with transmission of infection to large numbers of healthcare personnel

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Follow CDC precautions: • CDC recommends Standard Precautions, with emphasis on the use of hand hygiene. • Contact Precautions with emphasis on environmental cleaning due to the detection of SARS CoV RNA by PCR on surfaces in rooms occupied by SARS patients. • Airborne Precautions, including use of fit-tested NIOSH approved N95 or higher level respirators, and eye protection.	CDC[191]	Standard practices to reduce exposure to transmission based on SARS case study	Requires sufficient PPE, and training and compliance of healthcare staff and professionals

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Don a mask when within six to 10 feet of the patient or upon entry into the patient's room, especially when exposure to emerging or highly virulent pathogens is likely during other interactions (e.g., intubation). Use of gloves, gown, and face shield or mask and goggles is necessary.	CDC[192]	Protection required when in close proximity to coronavirus or infectious patient	Sufficient notice as to which patient is infectious and whether supplies such as masks are available

[191,70] CDC. (2019). 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

4.4.1
Department: Intensive Care Unit
Risk area: Discharge or transfer
Issue: Spread of virus to operating room during surgery if required

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Perform surgery in ICU rather than the operating room as benefits include cost savings, elimination of risks of transporting critically ill patients, and avoidance of OR availability concerns.	Division of Trauma and Surgical Critical Care, Vanderbilt University Medical Centre[193]	Greater acceptance by surgeons and intensivists that procedures once thought to be performed exclusively in the operating room (OR) may be safely and easily performed in the ICU	• Bedside procedures should be reserved for two situations as follows: Lesser procedures for which transport to OR is not justified, because of difficulties of transport, OR expense, OR availability and lifesaving, emergency procedures for patients too unstable for transport. • Low complexity procedures that are ideal for the ICU setting, include placement of percutaneous tracheostomy, percutaneous endoscopic gastrostomy (PEG) and inferior vena cava filters (IVCFs). • More emergent procedures, such as exploratory laparotomy

[193] Dennis B, Gunter O. Surgical procedures in the intensive care unit: A critical review. OA Critical Care 2013 May 01;1(1):6.

			and damage control orthopaedics are also possible at the bedside.

4.4.2
Department: Intensive Care Unit
Risk area: Discharge or transfer
Issue: Contamination upon patient death

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Properly handle an infected corpse: • Staff PPE: The staff must make sure they are fully protected by wearing work clothes, disposable surgical caps, disposable gloves and thick rubber gloves with long sleeves, medical disposable protective clothing, medical protective masks(N95) or powered air purifying respirators (PAPRs), protective face shields, work shoes or rubber boots, waterproof boot covers, waterproof aprons or waterproof isolation gowns, etc. • Human remains: Fill all openings or wounds the patient may have, such as mouth, nose, ears, anus and tracheotomy openings, by using cotton balls or gauze dipped in 3000-5000 mg/L chlorine-containing disinfectant or 0.5% peroxyacetic acid. • Wrapping: Wrap the remains with a double-layer cloth sheet soaked with disinfectant, and pack it into a double-layer, sealed, leak-proof corpse wrapping sheet soaked with chlorine containing disinfectant.	Zhejiang University School of Medicine[194]	Procedures for Handling Bodies of Deceased Suspected or Confirmed Patients	Sufficient disinfectant supply, training of cleaning team and adherence to strict cleaning practices

[194] Zhejiang University School of Medicine. (2020). Handbook of COVID-19 Prevention and Treatment .

4.4.3
Department: Intensive Care Unit
Risk area: Discharge or transfer
Issue: Risk of discharging patient who is still infectious

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
A recent report by WHO stated that if patients have passed 14 days of treatment, the chances of them infecting others is zero. Even if tests come back positive, this is due to virus shedding or fragments of the dead virus, and hence patients with a positive test after 14 days are good to be released from the hospital.	WHO[195]	Discharge Standards and Follow-up Plan for COVID-19 Patients	Ensure that protocol is closely followed to prevent risk of discharging contagious and infected patient to the public

195 Hermesauto. (2020, May 27). Covid-19 patients will be discharged even if they test positive after 14 days, says Malaysia's health chief. Retrieved May 28, 2020, from https://www.straitstimes.com/asia/se-asia/covid-19-patients-will-be-discharged-even-if-they-test-positive-after-14-days-says

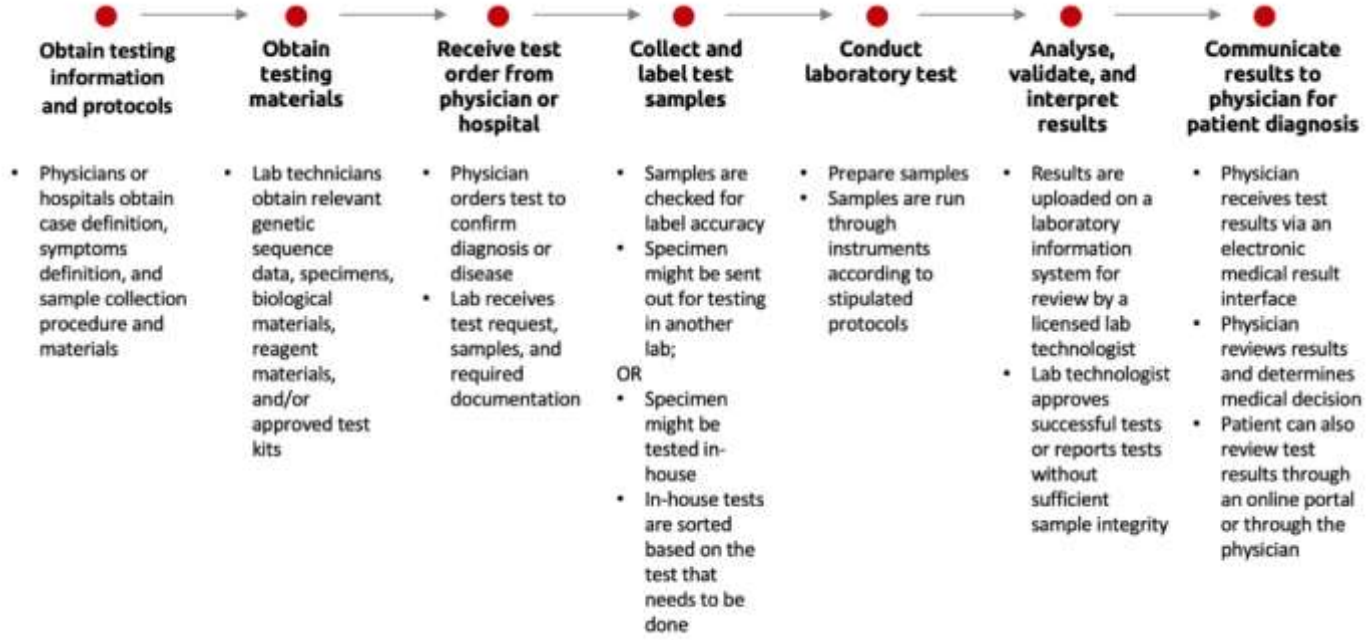
PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Discharge patient based on Italian guidelines by the Ministero della salute, Consiglio Superiore di Sanità: • A COVID-19 patient can be considered cured after the resolution of symptoms and 2 negative tests for SARSCoV-2 at 24-hour intervals. • For patients who clinically recover earlier than 7 days after onset, an interval of 7 days between the first and the final test is advised. Note: Virus clearance is defined as viral RNA disappearance from bodily fluids of symptomatic and asymptomatic persons, accompanied by appearance of specific IgG.	Ministero della salute, Consiglio Superiore di Sanità[196]	Discharge Standards and Follow-up Plan for COVID-19 Patients	Ensure that protocol is closely followed to prevent risk of discharging contagious and infected patient to the public

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Discharge patient based on Singaporean guidelines by the National Centre for Infectious Diseases: • Discharge patient with advisory and clinic follow-up if indicated and with daily wellness calls until day 14 after last possible exposure, under the following conditions: - Afebrile ≥ 24 hours - 2 respiratory samples tested negative for SARSCoV-2 by PCR in ≥ 24 hours - Day of illness from onset ≥ 6 days OR Alternative aetiology found (e.g. influenza, bacteraemia) OR Not a close contact of a COVID-19 case - Does not require in-patient care for other reasons.	National Centre for Infectious Diseases[197]	Discharge Standards and Follow-up Plan for COVID-19 Patients	Ensure that protocol is closely followed to prevent risk of discharging contagious and infected patient to the public

[196] European Centre for Disease Prevention and Control. (2020, March 10). Novel coronavirus (SARS-CoV-2) - Discharge criteria for confirmed COVID-19 cases. Retrieved from https://www.ecdc.europa.eu/en/publications-data/novel-coronavirus-sars-cov-2-discharge-criteria-confirmed-covid-19-cases
[197] Ibid

5. Hospital Lab

Hospital Lab workflow



Workflow is described based on information from Joint Commission International[198], College of American Pathologists[199], ISO[200], and pharmaceutical journals[201].

[198] JCI Accreditation Standards for Hospitals, 7th Edition. (2019). Joint Commission International. Retrieved from https://store.jointcommissioninternational.org/assets/3/7/proposed_jci_7th_edition_standards.pdf
[199] Guide to CAP Accreditation. (2018). College of American Pathologists. Retrieved from https://documents.cap.org/documents/2018-guide-to-accreditation.pdf
[200] ISO 15189:2012. (2014, August 1). Retrieved from https://www.iso.org/standard/56115.html
[201] Ezzelle, J., Rodriguez-Chavez, I. R., Darden, J. M., Stirewalt, M., Kunwar, N., Hitchcock, R., … D'Souza, M. P. (2008, January 7). Guidelines on good clinical laboratory practice: bridging operations between research and clinical research laboratories. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/18037599

Identified key risk areas within Hospital Lab

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
5.1 Obtain testing materials	5.1.1	Long waiting time for testing kits to be authorized for use	• High potential for widespread infection if there is a lack of authorized testing kits available	• Obtain urgent-use approval for test kits
	5.1.2	Limited availability of test kit reagents to conduct the laboratory test during a pandemic	• High consumption of supplies required for mass testing • High potential for infection if testing process is slow rate if test accuracy is reduced by using other reagents	• Diversify sources of reagents • Reject test requests that do not meet testing criteria • Rely on stockpiled reagents
5.2 Collecting and labelling test samples	5.2.1	Need for a standardized procedure for healthcare practitioners to collect samples for testing	• High potential for error if samples are mishandled or not collected systematically	• Establish standardized sampling and testing guidelines within the healthcare setting
5.3 Conducting laboratory test	5.3.1	Long time required to obtain test results	• High potential for infection as infected persons are not identified and isolated quickly enough	• Develop rapid lateral flow immunoassay tests • Develop rapid point-of-care molecular assay tests

Divergent practices identified

5.1.1
Department: Hospital Lab
Risk area: Obtaining testing materials
Issue: Long waiting time for testing kits to be authorized for use

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Obtain urgent-use approval of test kits to accelerate the availability of diagnostic test kits for novel pathogens developed by laboratories and commercial manufacturers during a public health emergency.	• Food and Drug Administration, US[202] • Ministry of Food and Drug Safety, South Korea[203] • National Medical Products Association, China[204]	These urgent-use approvals (e.g. the Emergency Use Authorization in the US and urgent-use license in South Korea) for test kits were given during the COVID-19 pandemic to speed up the regulatory process of novel test kits	Need to ensure quality and reliability of results are not compromised

[202]U.S. Food and Drug Administration (2020). Emergency Use Authorization. Retrieved from https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization
[203] Lee, G. (2020). South Korea approves first four COVID-19 test kits under urgent-use license. Retrieved from https://www.bioworld.com/articles/433783-south-korea-approves-first-four-covid-19-test-kits-under-urgent-use-license
[204] Usdin, S. (2020). WHO reports China making 1.6M COVID-19 diagnostic kits per week, describes therapy and vaccine R&D priorities. Retrieved from https://www.biocentury.com/article/304545/who-china-makes-and-deploys-1-6-million-covid-19-tests-week-the-u-s-is-just-starting-to-ramp-up-capacity

5.1.2 **SURGE CAPACITY STAGE**
Department: Hospital Lab
Risk area: Obtaining testing materials
Issue: Limited availability of test kit reagents to conduct the laboratory test during a pandemic

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Diversify sources of reagents, for example, by seeking donations from basic research laboratories instead of relying on commercial supply chains.	University of Virginia[205] (UVA)	UVA conducted a call for needed reagents and technology to develop its own COVID-19 tests, and quickly received donations from basic research laboratories	If reagents used differ from those stipulated in standard testing protocols, labs would need to perform clinical and analytical validation before administering the tests, and will need to file for approval from the relevant Food and Drug Authority thereafter[206]

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Screen test request forms and reject testing requests where relevant clinical and travel history are not justified.	Various laboratories in Australia[207]	Occurred during COVID-19 pandemic	The screening process needs to be rigorous so that positive cases are not erroneously rejected from testing

[205] Hester, W. P. (2020, March 20). UVA Health Independently Develops New COVID-19 Tests. Retrieved from https://news.virginia.edu/content/uva-health-independently-develops-new-covid-19-tests
[206] Modern Healthcare. (2020). Labs face challenges creating diagnosis testing for COVID-19. Retrieved from https://www.modernhealthcare.com/technology/labs-face-challenges-creating-diagnosis-testing-covid-19
[207] Knaus, C. (2020, March 16). Australian health department says supply of key component in coronavirus testing under strain. Retrieved from https://www.theguardian.com/world/2020/mar/16/australian-doctors-warn-coronavirus-testing-compromised-by-failure-to-stockpile-key-chemical-reagent

PRACTICE #3	ORGANISATION	CONTEXT	CONSIDERATIONS
Use stockpiled reagents, which should be replenished on a regular basis to ensure that they are not expired	South Australia[208]	South Australia spent the past decade stockpiling a supply of the reagent needed to test a range of illnesses, including influenza, in case of a crisis. However, it is uncertain whether the amount stockpiled is sufficient to deal with the current COVID-19 surge in the country.	• There should be a central body to coordinate national-level responses in a crisis, as variable stocking of reagents across different territories and states may result in some jurisdictions facing supply issues while others are well-prepared • For reagents with short shelf-life, form arrangements with reagent producers to invest in idle capacity

[208] Knaus, C. (2020). Australian health department says supply of key component in coronavirus testing under strain. Retrieved from https://www.theguardian.com/world/2020/mar/16/australian-doctors-warn-coronavirus-testing-compromised-by-failure-to-stockpile-key-chemical-reagent

5.2.1
Department: Hospital Lab
Risk area: Collecting and labelling test samples
Issue: Healthcare practitioners collecting samples for testing must use a standardized procedure within their healthcare setting

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Establish clear guidelines for all healthcare professionals regarding: • Which part of the body the sample should be collected from • What type of sample should be collected • What material should be used for the collection of a particular type of sample • How to store the collected sample • How specimens should be labelled • How sampling documentation should be submitted • What environmental conditions are required for sample shipping • How to ship collected samples for testing (following IATA instructions for air freight)	CDC[209], WHO[210]	The parameters for these guidelines were developed in response to COVID-19, and should be standardized within the healthcare institution's healthcare setting. A standard, detailed procedure for COVID-19 testing is provided by the CDC and WHO.	It should be noted that the protocols for diagnostics using RT-PCR published on WHO's webpage is for guidance and not an exhaustive list. Various institutions and governments have chosen to develop their own protocols that might not be publicly available or published on WHO's webpage[211].

[209] Centers for Disease Control and Prevention (2020). Clinical Specimens: Novel Coronavirus (2019-nCoV). Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/lab/guidelines-clinical-specimens.html
[210] World Health Organisation (2020). Coronavirus disease (COVID-19) technical guidance: Laboratory testing for 2019-nCoV in humans. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/laboratory-guidance
[211] Yap, J. et al. (2020). COVID-19 Science Report: Diagnostics. ScholarBank@NUS Repository. doi:10.25540/e3y2-aqye

5.3.1
Department: Hospital Lab
Risk area: Conducting laboratory test
Issue: Long time required to obtain test results

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use a rapid lateral flow immunoassay that relies on diagnostic antibodies to produce a visually detectable signal if the virus is present in the patient. In this test, a patient's sample flows down the test stick and is captured by a line of diagnostic antibodies. If the target antigen is present in sufficient concentrations in the sample, it will bind to specific antibodies fixed to a paper strip encased in a plastic casing and generate a visually detectable signal, usually between 10 to 30 minutes.	As of 8 April 2020, WHO does not currently recommend the use of antigen-detecting rapid diagnostic tests for patient care, although research into their performance and potential diagnostic utility is highly encouraged[212]	Such point-of-care tests are being developed by multiple diagnostic test manufacturers to deal with the COVID-19 pandemic[213], though the clinical accuracy of rapid tests needs to be further evaluated before they are authorised for the mass screening of COVID-19.	Based on experience with antigen-based RDTs for other respiratory diseases such as influenza, in which affected patients have comparable concentrations of influenza virus in respiratory samples as seen in COVID-19, the sensitivity of these tests might be expected to vary from 34% to 80%[214], and thus should be complemented by PCR testing until their sensitivity is sufficiently high. While such tests are traditionally not as accurate as the PCR method and may produce false positives, this problem can be minimised by finding the most specific antibodies through screening millions of antibodies to select the few that are best at binding to

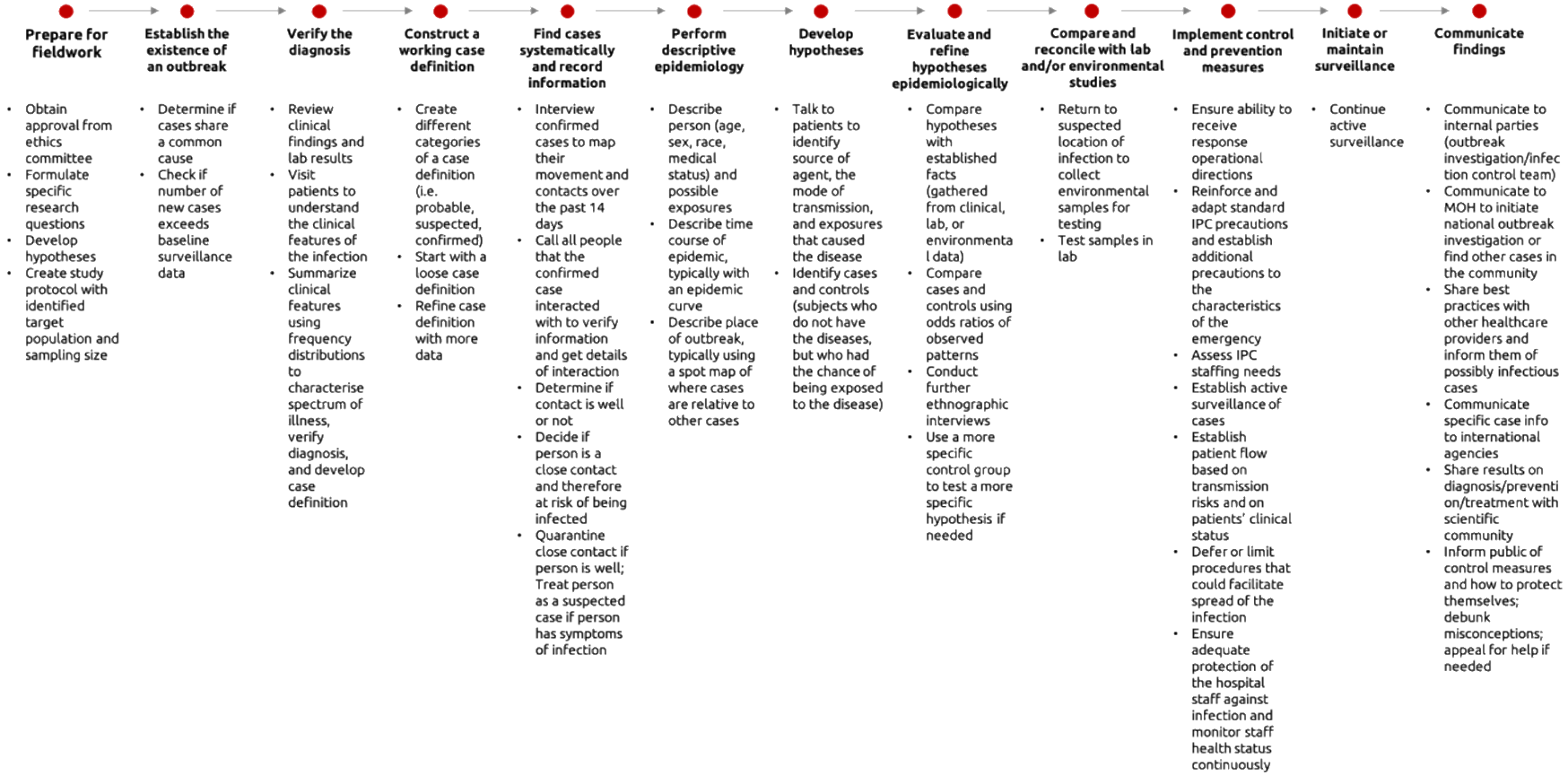
[212] World Health Organisation (2020, April 8). Advice on the use of point-of-care immunodiagnostic tests for COVID-19. Retrieved from https://www.who.int/news-room/commentaries/detail/advice-on-the-use-of-point-of-care-immunodiagnostic-tests-for-covid-19
[213] Vashist, S. K. (2020). In Vitro Diagnostic Assays for COVID-19: Recent Advances and Emerging Trends. Retrieved from https://www.mdpi.com/2075-4418/10/4/202
[214] Ibid

			the virus and not other molecules. Adequately performing tests could potentially be used as triage tests to rapidly identify patients who are very likely to have COVID-19 to reduce or eliminate the need for expensive molecular confirmatory testing.
PRACTICE #2	**ORGANISATION**	**CONTEXT**	**CONSIDERATIONS**
Develop extremely rapid point-of-care molecular assays that amplify isothermal nucleic acid or multiple regions of the viral genome from a nasopharyngeal swab, nasal wash, or aspirate specimens from suspects. Such tests typically require only a few minutes for sample preparation, which are then put into a cartridge and inserted into a benchtop analyser. Such tests range from 5 minutes to 2.5 hours to produce results[215].	The US has granted several of such test kits emergency use authorisation under the Food and Drug Administration, and they are being deployed across all states to be used by doctors, urgent care centres, and temporary testing sites like drive-through parking lots[216]	Multiple rapid RT-PCR assays have already been developed by companies and researchers worldwide in response to the COVID-19 pandemic. These test kits can be used in any location, such as hospitals, clinics, physicians' offices, or in outbreak hotspots[217].	Need to stringently validate such tests to ensure test accuracy and sensitivity before they are commercially distributed for widespread testing

[215] Vashist, S. K. (2020). In Vitro Diagnostic Assays for COVID-19: Recent Advances and Emerging Trends. Retrieved from https://www.mdpi.com/2075-4418/10/4/202
[216] Japsen, B. (2020, April 15). Abbott Labs Has Shipped 566,000 Rapid COVID-19 Tests To All 50 U.S. States. Retrieved from https://www.forbes.com/sites/brucejapsen/2020/04/14/abbott-labs-has-shipped-566000-rapid-covid-19-tests-to-all-50-us-states/#2c8656f33205
[217] Ibid

6. Epidemiology

Epidemiology Department workflow



Workflow is described by the Centers for Disease Control and Prevention (US)[218].

[218] Centers for Disease Control and Prevention (2016). Principles of Epidemiology. Retrieved from https://www.cdc.gov/csels/dsepd/ss1978/lesson6/section2.html#step5

Identified key risk areas within Epidemiology Department

KEY RISK AREA	ISSUES		RISK FACTORS	SUMMARY OF EXISTING PRACTICES
6.1 Verifying the diagnosis	6.1.1	Insufficient data to develop accurate early estimates of key epidemiological, clinical, and virological parameters of a novel infectious pathogen	• High potential for error due to lack of available data • Highly manpower-intensive process as it requires the expertise of multiple experts from various fields	• Initiate First Few 100 (FFX) testing protocol • Rely on crowdsourced data
6.2 Finding cases systematically and recording information	6.2.1	Insufficient resources to carry out contact tracing manually as number of cases increases	• High potential for infection if close contacts of infected cases are not tracked down and isolated	• Use phone applications to track individual travel histories for contact tracing
	6.2.2	Potential contacts may be unwilling to disclose any kinds of exposures/identify close contacts due to fear or stigma	• High potential for error due to incomplete information received • Time-intensive process due to extensive probing and trust-building required	• Explain rationale and importance of contact tracing • Allow influential community members to conduct the investigative process
	6.2.3	High degree of contact required during epidemiological interviews between interviewee and suspected or confirmed case to establish rapport and obtain quality data	• High potential for infection due to close contact with case patient	• Practice standard safety protocols for interviewing suspected or infected cases

6.3 Communicating findings	6.3.1	Communicating risks effectively during an outbreak to ensure the least possible disruption to society	• High risk of mass panic due to improper risk communication • High potential for infection if information is conveyed incorrectly or ineffectively	• Follow standard risk communication guidelines by WHO
	6.3.2	Communicating and sharing epidemiological findings rapidly with other healthcare institutions, government agencies, and the public to curb the spread of the infection	• High potential for infection if information is not shared quickly enough	• Use a web-based dashboard to communicate updated findings rapidly • Disseminate regular updates through text message alerts or social media channels

Divergent practices identified

6.1.1
Department: Epidemiology
Risk area: Verifying the diagnosis
Issue: Insufficient data to develop accurate early estimates of key epidemiological, clinical, and virological parameters of a novel infectious pathogen

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Initiate the FFX (first few 100) investigation to systematically collect epidemiological exposure data and biological samples of at least the first 100 confirmed cases of any nascent pandemic. This data will then be shared rapidly in a format that can be easily aggregated and analysed globally until a satisfactory characterization of the pathogen is achieved. When this data is analysed with FF100-specific algorithms, estimates of pathogen transmissibility and virulence are obtained, enabling timely identification of the pandemic scenario that best characterizes an actual outbreak.	WHO[219]	This protocol is supposed to be the primary protocol initiated in the first days after the arrival in Country X of a confirmed case of a novel virus	High level of coordination and sharing of information in real time will be needed at both country and global levels, involving epidemiologists, modelers, virologists, statisticians, clinicians, and public health experts

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Use crowdsourced data from news media and social networks for early epidemiological analysis of a novel pathogen, to help reconstruct the progression of an outbreak and provide detailed patient-level data in a health emergency.	Fogarty International Center, US National Institutes of Health[220]	Researchers carried out this study during the COVID-19 epidemic by searching DXY.cn (a health-care-oriented social network that streams news reports on COVID-19 from Chinese health agencies), global news media sources, health agencies, and national governments to assess trends in the epidemiology of COVID-19	As the outbreak progresses, social media and news reports will likely capture only a diminishing fraction of COVID-19 cases globally due to reporting fatigue and overwhelmed healthcare systems

[219] World Health Organisation (2020). The First Few X (FFX) Cases and contact investigation protocol for 2019-novel coronavirus (2019-nCoV) infection. Retrieved from https://www.who.int/docs/default-source/coronaviruse/20200129-generic-ffx-protocol-2019-ncov.pdf?sfvrsn=595eb313_2&download=true
[220] Sun, K., Chen, J., & Viboud, C. (2020). Early epidemiological analysis of the coronavirus disease 2019 outbreak based on crowdsourced data: a population-level observational study. The Lancet Digital Health.

6.2.1 SURGE CAPACITY STAGE
Department: Epidemiology
Risk area: Finding cases systematically and recording information
Issue: Insufficient resources to carry out contact tracing manually as number of cases increases

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use phone applications to track people's whereabouts via GPS, so that contact tracers do not have to rely on a person's memory to find out their travel history and identify other close contacts who have been in the same area.	Ministry of Health, Singapore[221], Korea Centres for Disease Control and Prevention[222], Chinese government[223]	Apps with such functions were launched in South Korea, China, and Singapore to curb the spread of COVID-19. Many of these apps also come with functions that allow users to update their health status, so that the government can keep tabs on anyone who might be ill. Some of these apps also make use of the GPS function to alert local police and officials if anyone breaches their home quarantine notice.	As these apps closely track the movement of individuals for law enforcement purposes, there is a need to ensure that sufficient data privacy protection is still in place so that this information is not abused

[221] Kit, T. S. (2020, March 21). Singapore launches TraceTogether mobile app to boost COVID-19 contact tracing efforts. Retrieved from https://www.channelnewsasia.com/news/singapore/covid19-trace-together-mobile-app-contact-tracing-coronavirus-12560616
[222] Law, E., & Choon, C. M. (2020, April 6). How China, South Korea and Taiwan are using tech to curb coronavirus outbreak. Retrieved from https://www.straitstimes.com/asia/east-asia/how-china-s-korea-and-taiwan-are-using-tech-to-curb-outbreak
[223] Ibid

6.2.2
Department: Epidemiology
Risk area: Finding cases systematically and recording information
Issue: Potential contacts may be unwilling to disclose any kinds of exposures/identify close contacts due to fear or stigma

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Contact tracers and supervisors should explain the importance of contact tracing, the support that will be provided to contacts under monitoring, and explain the situation and public health importance of contact tracing.	Multiple organizations (WHO, CDC, Liberia Ministry of Health, Liberia International Rescue Community)[224]	Recommendation is based on lessons learned during the West Africa Ebola outbreak	Some countries may mandate that the cost of non-compliance with contact tracing efforts is punishable by law

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Include respected community members, local officials, and/or religious figures in the investigative process to foster trust, reduce fear, and engage marginalised groups.	CDC[225]	This was a practice observed in West African countries during the 2014-15 Ebola outbreak, where in certain communities, naming a contact-person has been perceived as assigning that person to a 'death list'	Need to understand potential fears an informant might have based on their nationality, income level, sensitive affiliations etc., and find the right person to reach out to them to establish trust

[224] Wolfe, C. M., Hamblion, E. L., Schulte, J., Williams, P., Koryon, A., Enders, J., ... & Laney, A. S. (2017). Ebola virus disease contact tracing activities, lessons learned and best practices during the Duport Road outbreak in Monrovia, Liberia, November 2015. PLoS neglected tropical diseases, 11(6), e0005597.
[225] Greiner, A. L., Angelo, K. M., McCollum, A. M., Mirkovic, K., Arthur, R., & Angulo, F. J. (2015). Addressing contact tracing challenges—critical to halting Ebola virus disease transmission. International Journal of Infectious Diseases, 41, 53-55.

6.2.3
Department: Epidemiology
Risk area: Finding cases systematically and recording information
Issue: High degree of contact required during epidemiological interviews between interviewee and suspected or confirmed case to establish rapport and obtain quality data

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Measures to minimize spread of virus depending on the interview setting: • If interview is taking place at the patient's home, the interviewer should ensure that the patient is wearing a mask, and the interviewer should wear a respirator (after entering the home so as not to draw attention from outsiders). • If interview is taking place in an airborne infection isolation room, the patient should not be asked to wear a mask in this situation but should be instructed to cover his or her mouth with disposable tissue while coughing. Any person entering the room should wear a personal respirator (e.g. N-95). • If interview is in a clinic setting, the patient should be immediately triaged into an isolation room. A surgical mask should be given to the patient for use as he or she proceeds through the clinic, and the patient should be instructed to cover his or her mouth with disposable tissue while coughing.	Recommended by CDC[226]	Recommendation is designed specifically for interviews conducted with tuberculosis patients	The use of a surgical mask or a personal respirator may affect the rapport between interviewer and patients; interviewer should thus explain the need to put on the respirator and also only put it on after entering the house, so as not to attract attention from outsiders

[226] Centers for Disease Control and Prevention (2006). Effective TB Interviewing for Contact Investigation: Self-Study Modules. Retrieved from https://www.cdc.gov/tb/publications/guidestoolkits/interviewing/tbinterviewing_ssmodules.pdf

6.3.1
Department: Epidemiology
Risk area: Communicating findings
Issue: Communicating risks effectively during an outbreak to ensure the least possible disruption to society

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Measures to ensure effective communication with the public: • Conduct an assessment of existing public communication capacity and existing research of community understanding, including demographics, literacy levels, language spoken as well as socio-economic and cultural backgrounds. • Identify likely public communication partners and develop a communication coordination mechanism. • Put in place a national level policy or guideline on the public announcement and ongoing release of information in the event of a verified or suspected infectious disease risk. • Develop a system for ongoing information gathering during an outbreak about public knowledge, attitudes and behaviors related to infectious disease risks, interventions and involved organizations. • Ensure there is an evaluation mechanism to identify public communication strengths and weaknesses during and following infectious disease events. • Capturing the previous steps, develop a written outbreak or emergency communication plan. • Ensure readiness by establishing a risk communication training program, including simulations and exercises to test the emergency public communication plan and its components.	Recommended by WHO[227]	This is a standard protocol for infectious disease risk communication by WHO	Such a protocol also needs to also be accompanied by an element of empathy and trust between the communicator and audience, so that the information communicated is readily absorbed and ingrained by the audience

[227] World Health Organisation (2008). Outbreak Communication Planning Guide. Retrieved from https://www.who.int/ihr/elibrary/WHOOutbreakCommsPlanngGuide.pdf

6.3.2
Department: Epidemiology
Risk area: Communicating findings
Issue: Communicating and sharing epidemiological findings rapidly with other healthcare institutions, government agencies, and the public to curb the spread of the infection

PRACTICE #1	ORGANISATION	CONTEXT	CONSIDERATIONS
Use an interactive web-based dashboard to track the spread of COVID-19 in real time. • Every 15 min, the cumulative case counts are updated from DXY (online community for physicians, health care professionals, pharmacies and facilities for all provinces in China and for other affected countries and regions. • For regions outside China, case numbers are manually updated throughout the day when new cases are identified, using sources like Twitter feeds, online news services, and direct communication sent through the dashboard. • Before manually updating the dashboard, case numbers are confirmed with regional and local health departments, including the respective centres for disease control and prevention (CDC) of China, Taiwan, and Europe, the Hong Kong Department of Health, the Macau Government, and WHO, as well as city-level and state-level health authorities.	Johns Hopkins University[228]	Data collection was largely focused on China's and surrounding countries' outbreak situation as this dashboard was developed before the epidemic became widespread Europe	Need to consider resource- and time-intensiveness of manually updating data and cross checking with official sources before each update as the pandemic becomes progressively more widespread

PRACTICE #2	ORGANISATION	CONTEXT	CONSIDERATIONS
Disseminate regular updates through text message alerts or social media channels. Singapore's Ministry of Health provided daily updates on new case numbers during the COVID-19 pandemic, including data on imported cases, community cases,	Ministry of Health, Singapore[229]	These regular daily updates were carried out to alert the public of new clusters or developments in COVID-19	Such updates may not be accessible to the elderly population, or to those who are less digitally savvy and

[228] Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. The Lancet Infectious Diseases. Retrieved from https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30120-1/fulltext
[229] Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. The Lancet Infectious Diseases. Retrieved from https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30120-1/fulltext

percentage of unlinked cases, active cases, cases in intensive care, fatalities, and discharged cases. These updates were released daily on their website, as well as through the Gov.sg Telegram channel.		prevention measures, as the nature of the disease and its epidemiology was not well-known at the time of the outbreak.	do not know how to subscribe to receive such updates automatically.

SINGAPORE'S RESPONSE TO THE COVID-19 PANDEMIC

This section collates some practices that Singapore has found helpful in in dealing with the COVID-19 outbreak as of June 2020, which have been possible given its enabling context. Since its initial success in handling the COVID-19 outbreak, Singapore has been confronted with a new wave of infections, coming primarily from dormitories that house foreign workers. Despite this misstep, Singapore has been quick to put into place mitigating measures to contain the situation. We hope that this collection of practices will cast light on how Singapore has been managing this crisis, and inspire international audiences to consider if any of these practices may be applicable to their home countries. While individual practices that Singapore has implemented are interesting and worth considering for other cities and nations, the circumstances and available resources of each location will define the extent of success. Some of these practices can be directly adopted in other settings, while others may less appropriate due to differences in resource availabilities, local culture, population demographics, and other contextual factors. Some of Singapore's unique circumstances include:

- Availability of financial resources. With decades of high economic growth, Singapore has accumulated considerable financial reserves that its government can tap on during such times of need. Many of the practices that the Singapore government employs, such as paying for the hospital bills of all those infected with COVID-19, giving financial support to those under quarantine, and creating thousands of new employment positions to enforce safe distancing, can be costly. Some nations have been fairly conservative in allocating budgets to contain COVID-19, while Singapore's approach to date has been arguably less constrained by cost.

- Advanced technological infrastructure. Over the past decade, Singapore has been committing resources to building up its connectivity and information

technology infrastructure across various sectors. Since its last 5-year plan, Singapore has committed to invest SGD 20 billion into R&D until 2020. In times of a pandemic, this allows research labs and institutions to tap on their allocated budgets to innovate and trial test kits and vaccines, and also supports contact tracing efforts with existing technological and policing networks, a built-up talent pool of software developers, as well as a government agency GovTech that has many software engineers on staff. In addition, Singapore's investment into its IT infrastructure has allowed alternative ways of learning and working such as e-learning and telecommuting to succeed, due to strong broadband and telecommunication networks, widespread access to personal computers, and efforts to improve the technological literacy of its population. Such investment into technological infrastructure and capability building was crucial in building up the preparedness of Singapore and its people.

- Compact size of nation. With under six million people and a land area of less than 800 square kilometres, Singapore's infection containment efforts are relatively easier to implement compared to bigger, more populous countries. Within a matter of days, public officers were able to canvas all public spaces in Singapore to mark out crosses at eateries, markets, shopping malls, and stadiums to deter people from being too close to one another. These officers also installed barriers and signage to guide safe distancing measures, and Safe Distancing Ambassadors were also deployed at entries of parks and wet markets to disperse large groups of people. Free masks and hand sanitizers were distributed to all citizens through the network of community centers across Singapore.

- Strong relationship between the government and national supply chains. Unlike many other countries whose key services are run by the private sector, many of Singapore's key institutions are have strong relationships with the government. Singapore's longstanding tripartite model of co-operative relationships between the government, trade unions, and employers supported a comprehensive, whole-of-government approach to tackling the virus, while ensuring compliance and order within the community. Singapore's largest supermarket chain, NTUC Fairprice – which is a source of well-stocked, price-controlled essential food and household supplies to all households – is run by the National Trades Union Congress of Singapore. The largest hospitals in Singapore – the main players fighting COVID-19 – are public hospitals. The national newspaper, traditionally supportive of government initiatives, has published public service announcements every day on its front page. This has allowed for quick actions and measures to be implemented effectively across various key sectors of Singapore, in alignment with the policies and decisions made by the government.

- Dominant governing figure. One of the key factors of success in Singapore is the swiftness with which it is able to take action – in implementing new laws, passing new bills, and enforcing new regulations. This swiftness is enabled by a relatively stable political climate in Singapore, where citizens are generally trusting of their government. Additionally, Singapore's minimal bureaucratic processes within its government allows for efficiency and transparency in implementing new measures to tackle the virus.

PUBLIC HEALTH

Maintain national supply of healthcare essentials

- The government maintains a national stockpile of PPEs and N95 masks, to ensure enough supply for healthcare workers. This stockpile can be drawn from by public hospitals as well as clinics in the event that their own supply chains are disrupted.[230]
- Given the recent increase in supply consumption and the barring of mask exports from China and Taiwan, Singapore has outsourced its mask production to other countries, as well as ramped up on local productions. While Singapore does not have local production capacity for surgical masks, it houses a facility that produces N95 respirators. A local company have also stepped forward to offer to produce masks.

Distribute disposable and reusable masks to all households

- At the beginning of the COVID-19 outbreak, the government distributed four disposable surgical masks per individual. This was carried out at community centers and residential committees centers, which are common public facilities in public housing estates where 90 percent of Singaporeans reside.[231]
- As community spread increased in Singapore, and new evidence showed that the virus can spread even when patients are asymptomatic, Singapore held a second distribution drive to give out reusable cloth masks to every individual, including non-citizens with long term passes. The shift from distributing disposable to reusable masks helped ensure sufficient supply of disposable masks for healthcare workers, amidst a global supply shortage. The mode of distribution was the same as above.[232]
- To make it easier for the public to collect their masks, the government leveraged technology and developed online portals (www.maskgowhere.sg) to help people identify the nearest locations for convenient mask collection.

Gradually adjust safe distancing measures in line with need and evidence

- Singapore's policies towards safe distancing tightened gradually as the severity and speed of community spread increased:

[230] Lim, J. (2020, March 8). Singapore's stockpile of masks replenished from many sources. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/health/singapores-stockpile-of-masks-replenished-from-many-sources
[231] Khalik, S., & Goh, T. (2020, February 3). Wuhan virus: Each Singapore household to get 4 free masks for contingencies. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/health/each-spore-household-to-get-4-free-masks-for-contingencies
[232] Wei, T. T. (2020, April 3). Coronavirus: Singapore Govt will no longer discourage wearing of masks, to give reusable masks to all households. Retrieved from https://www.straitstimes.com/singapore/health/coronavirus-govt-will-no-longer-discourage-wearing-of-masks-to-give-reusable-masks

- When COVID-19 broke out in Singapore, there were general guidelines regarding social distancing (maintaining at least 1 meter from other parties in public) and refraining from crowded places.
- As the spread worsened and more information was gathered about the virus and how it spreads, Singapore began to introduce stricter measures, such as the closure of entertainment places, restrictions on the number of people who can congregate, and encouraging businesses to allow telecommuting where possible. There were also visual guidelines in public spaces to ensure that people did not sit or stand too close to each other, accompanied by legal enforcement of these regulations.[233]
- With more surges in positive COVID-19 cases in Singapore, the government implemented a two-month 'circuit breaker' where all Singaporeans were urged to stay at home as much as possible, unless going out to work in essential services, buy food or groceries, seek urgent medical treatment, or exercise. A rule was introduced making it mandatory for workers at food service outlets and patrons of wet markets and supermarkets to put on masks. This gradually became stricter and an updated rule was introduced, specifying that everyone over two years old had to wear a mask outside their homes, unless they were engaging in strenuous exercise. The penalty for non-compliance at the start of the circuit breaker was a written warning and a fine for repeat offenders, but this escalated to an immediate SGD 300 fine, even for first-time offenders.
- Coming out of the circuit breaker, Singapore chose to reopen in three phases, so as to ensure that infection rate does not spike upon normalcy of businesses and social activities.[234] Each phase would last for at least four weeks, with the most essential activities being allowed to resume first. Schools are also reopened gradually, with some students only going to school on alternate weeks. This approach gave the government time to roll out new measures to combat any potential areas of risk, such as on public transport or in schools.

- To make it easier for the public to maintain safe distancing, the Singapore government introduced mobile apps that inform on the level of crowds in parks and shopping malls. Safe Distance Parks, for example, allows the public to see in real-time the level of crowdedness in parks across the country so they can avoid the crowds.[235]
- In an effort to increase compliance to distancing measures, 'social distancing' was also rebranded as 'safe distancing' prior to the circuit breaker, so as to emphasize the link of such measures to individual and community safety.

[233] Stricter safe distancing measures to prevent further spread of Covid-19 cases. Ministry of Health. Retrieved from https://www.moh.gov.sg/news-highlights/details/stricter-safe-distancing-measures-to-prevent-further-spread-of-covid-19-cases
[234] Ending circuit breaker: phased approach to resuming activities safely. (2020, May 28). Retrieved from https://www.gov.sg/article/ending-circuit-breaker-phased-approach-to-resuming-activities-safely
[235] Zheng, Z. (2020, April 4th). NParks develops nifty real-time map showing crowd levels at most green spaces in S'pore. (n.d.). Retrieved from https://mothership.sg/2020/04/nparks-map-parks-crowd-level/

Conduct testing for those who may be at risk of infection

- At the start of the outbreak, testing was selectively performed for all identified to be at risk of COVID-19. This categorization of risk has evolved according to the changing circumstances of transmission:
    - Since news of the virus emerged, border checks have been strengthened to detect and isolate cases before they come into contact with the rest of Singapore. For example, temperature screening, health checks, and DNA swabs have been progressively implemented at all checkpoints.
    - Travellers who meet the suspect case definition are taken directly to hospital with testing performed at the National Centre for Infectious Disease, while those showing symptoms and some selected travellers are swabbed as a precautionary measure.
    - Recovering patients are also rigorously tested before they are discharged back into the community. Patients need to test negative for the virus twice over twenty-four hours, before they are released from quarantine[236].
- With the spike in cases from foreign worker dormitories, Singapore began to implement mass testing for all of those living in dormitories, even if they did not show any symptoms.[237] Following from this, the government proceeded to conduct mass testing for other sectors that may be at risk, such as nursing homes and pre-school facilities. In preparation for more mass testing moving forward, drive-through testing facilities have been set up in selective locations around Singapore.

Implement nationwide measures specifically for epidemics

- In the aftermath of Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, Singapore put in place various public health measures in anticipation of the next epidemic. These measures are put in place to maximize transparency and communication with the public, as well as to ramp up healthcare services as demand increases. Some key measures in public health pandemic preparedness include:
    - The development of Disease Outbreak Response System Condition (DORSCON), which involves four levels assessing the disease situation and corresponding guidelines on necessary actions to prevent further spread.
    - The development of the Public Health Preparedness Clinics (PHPCs) networks, together with polyclinics, which give special subsidies to residents with respiratory illnesses. The information on eligible clinics is made available on https://www.flugowhere.gov.sg/. This network is activated upon widespread transmission of the sickness, so as to provide widespread healthcare access to the public, yet in select locations to limit further spread.

Foot the medical bill for patients who are tested positive

[236] Kok, X., Sim, D.(2020, March 25th). Singapore's eight-step plan to combat the coronavirus. (2020, March 25). South China Morning Post. Retrieved from https://www.scmp.com/week-asia/health-environment/article/3076926/singapore-way-eight-steps-fight-coronavirus-thousands
[237] Sin, Y. (2020, May 14). All foreign workers in dorms to be tested for Covid-19. Retrieved from https://www.straitstimes.com/singapore/all-foreign-workers-in-dorms-to-be-tested-for-covid-19

- To ensure that those the public will come forward to get tested, the Singapore government covered the cost of testing as well as treatment for all suspected patients.
    - When COVID-19 first broke out and quarantine orders were being issued, the Singapore government also provided financial support to self-employed people under quarantine by giving them SGD 100.00 for each day that they were quarantined, compensating them for loss of income in an effort to encourage compliance.[238]

FOOD SUPPLY

Diversify food sources

- Given that Singapore imports the majority of its food supply, many measures are put in place to ensure food sustainability in the event of a crisis.[239] This includes:
    - Importing food from 170 countries and regions around the world, to complement local production efforts
    - Maintaining key source suppliers that can be activated quickly in case of sudden disruption

Create national stockpiles of key items

- Singapore maintains a national stockpile of key items: Rice, infant milk powder, and other proteins, with enough supplies for at least a few months. The Rice Stockpile Scheme, for example, requires importers of white rice, basmati rice, ponni rice and parboiled rice to pre-commit the quantity that they wish to import each month to sell in Singapore. Then, they would have to stockpile twice that quantity by keeping it in a government-designated warehouse, and to replace the stockpile with new stock as the rice cannot be kept in the warehouses for more than a year. While the rice importers own the rice, the government has the right to acquire the rice during an emergency, with compensation.
- Maintain access to regional stockpiles, such as the ASEAN Plus Three Rice Reserves.

[238] Khalik, S. (2020, February 3). Wuhan virus: $100 a day for those quarantined; severe penalties for people who flout quarantine orders. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/health/100-a-day-for-those-quarantined-severe-penalties-for-people-who-flout-quarantine
[239] Sen, N. J. (2020, March 22). The Big Read: Singapore has been buttressing its food security for decades. Now, people realise why. Channel News Asia. Retrieved from https://www.channelnewsasia.com/news/singapore/covid19-coronavirus-singapore-food-security-stockpile-national-12563280

LAW AND ORDER

Enforce multiple legal measure to minimize widespread infection

- Like many other countries, Singapore implemented a self-quarantine scheme for potentially-infected individuals early in the outbreak. As the epidemic worsened, the measures were heightened to ensure that the public takes the necessary precautions. Some of these measures include:
    - Enforcement of Stay-home-notices (SHN) of 14 days for those who have travelled back from high-risk regions. Under SHN, individuals cannot leave their homes even for daily essentials, and will have meals delivered to them if they live alone. As the outbreak became more severe, this would change to a more stringent quarantine measure to prevent the spread of the virus within households: Those who return from abroad would be quarantined in hotels for 14 days before they are allowed to return home.
    - Enforcement of medical leave quarantine. Anyone who visited a clinic with a respiratory issue would receive a five-day medical certificate, which mandated that the person remains within his/her home throughout the period.
    - To deter people from going overseas, Singapore implemented a range of measures, which include denying re-entry for student pass and work pass holders, removing COVID-19 healthcare subsidies for those who still choose to travel despite strong urging not to, as well as cancelling the passports of individuals who violate any quarantine enforcement or leave the country when not allowed to.
    - To increase the effectiveness of contract tracing, lying to investigators was made a punishable offense that could lead to jail time or thousands of dollars in fines.

Creation of taskforces to ensure compliance to new regulations and policies

- With many new regulations and norms being put in place to counter the spread of COVID-19, the government created taskforces to ensure compliance amongst the public. This involved appointing roving SG Clean Ambassadors and Safe Distancing Ambassadors to remind people about the expected new norms in public behaviours, especially regarding hygiene and physical interaction. Interestingly, these ambassadors were made up of a wide range of individuals from different industries, including those whose jobs were no longer required during times of lockdown, such as pilots and air stewardesses.[240]

[240] Hermesauto. (2020, April 6). Pilot's 'soft skills' useful as SG Clean Ambassador. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/pilots-soft-skills-useful-as-sg-clean-ambassador

TRANSPORT AND TELECOMMUNICATIONS

Sustain public transport as the key mode of travel

- Unlike many other countries, Singapore has not discouraged or closed down public transport. Measures have instead been directed at reducing crowds in public transport, which include encouraging work-from-home arrangements and staggering office hours.
- Stricter measures to reduce potential spread on public transport include the mandatory wearing of masks on buses and trains.

FINANCE AND INSURANCE

Enhance insurance coverage for customers

- The Development Bank of Singapore (DBS) partnered with Chubb Insurance Singapore to off its customers complimentary insurance coverage from COVID-19. The policy provides daily cash benefits for hospital confinement, and a lump sum payout for ICU confinement for COVID-19 positive patients. Such community support measures aim to cushion affected patients' healthcare expenses during this time.

EDUCATION

Prepare schools and institutes of higher learning for eventual school closure

- To prepare for eventual school closures, the government mandated institutes of higher learning (IHLs) and schools to trial one day of home-based learning (HBLs) for all students, so that teething issues could be sorted out before schools were officially closed.

Make exceptions for parents working in essential services

- While Singapore closed schools and childcare facilities starting from 8th April 2020, due to the nature of the circuit-breaker where some parents in essential services still go to work, exceptions have been made for these households to still leave their children with schools or grandparents when alternative arrangements cannot be made.

PRIVATE SECTOR

Leverage on private sector networks and resources

- Media: With the outbreak of COVID-19, The Straits Times, Singapore's official newspaper under Singapore Press Holdings (SPH) has been featuring important governmental regulation changes and hygiene-related advice on its cover pages to support virus containment efforts.
- Infrastructure: With the rapid increase in the number of cases and stricter quarantine measures, many private and commercial facilities have been converted into quarantine facilities.[241] This includes convention centres and hotels, which are currently underutilised in this time. In addition, to ease the crowded situation of foreign worker dormitories, there has also been cross-ministry collaboration to convert old housing estates that are uninhabited into housing options, as well as the usage of commercial cruise ships to house foreign workers.
- In the long term, to avoid similar outbreaks, the government will also work closely with the construction sector to enhance the quality of housing for their foreign workers.

Support private sector in complying with restrictions

- With the implementation of safe distancing and work-from-home orders, many businesses were put in jeopardy, especially those in the service sector. As Small and Medium Enterprises (SMEs) in Singapore make up 99 percent of total businesses and employ up to 65 percent of the workforce, many budgetary measures have been focused on supporting businesses:
    - Singapore announced three additional budgets over the past few months, besides its annual budget, namely the Resilience Budget (SGD 48 billion), the Solidarity Budget (SGD 5.1 billion), and the Fortitude Budget (SGD 33 billion). These budgets coincide with the introduction of new containment measures for COVID-19, so as to help businesses ease the difficulties in complying with and implementing these measures
    - Some key support for businesses in these three support budgets includes subsidizing rent for businesses in government-owned property, subsidizing wages for businesses, enhanced support for sectors most affected by COVID-19, creation of jobs to make up for business closure, and so on.[242]

[241] Singapore Expo being prepared to house COVID-19 patients who have recovered but may still be infectious: Gan Kim Yong. (2020, April 5). Retrieved from https://www.channelnewsasia.com/news/singapore/covid19-singapore-expo-community-care-facility-12611318
[242] Singapore Budget 2020. Retrieved from https://www.gov.sg/features/budget2020

HOSPITAL PRACTICES

Implement strict guidelines for team arrangements to minimize cross-infection amongst healthcare workers

- Many hospitals across Singapore put in place internal policies to maintain the physical and mental wellbeing of healthcare workers since the early days of the outbreak:
    - Separate staff caring for COVID-19 patients and those caring for other patients to reduce the risk of in-hospital transmission.
    - Staff who had cared for COVID-19 patients continued with usual clinical work with a surgical mask on and monitored themselves for fever and respiratory symptoms.
    - If inadequate personal protective equipment (PPE) was worn at the time of close contact, the staff member was taken off duty while an infectious diseases team assessed the risk of transmission and planned subsequent management.
    - Temperatures of all staff were taken twice daily using hospital-issued oral digital thermometers, and entered into electronic records monitored by administrative personnel. Web-based forms were created to facilitate ease of entry using personal smartphones.
    - Staff members who developed a fever or respiratory symptoms were screened at the staff clinic.[243]

- Hospitals also segregated staff who work in multiple healthcare institutions to reduce cross-infection:
    - The anaesthesia division staffs a tertiary hospital and a smaller regional hospital. Staff were segregated between the two to reduce cross infection between hospitals.
    - Locum employment and large group meetings were suspended.
    - Web-based conferencing was used to enable communication. Attendance was taken at all face-to-face meetings to facilitate contact tracing should the need arise.[244]

Provide thorough training on the use of PPE for all healthcare workers

- A comprehensive program for the use of PPE was enforced. Healthcare personnel were medically cleared and trained in the use of PPE. They were also taught how to clean, disinfect, store, and inspect their PPE for any damage. All staff were fitted with the National Institute of Occupational Safety and Health (NIOSH)-certified N95 respirators. If staff did not fit into available N95 masks, they would use the

[243] Wong, J., Goh, Q. Y., Tan, Z., & Sui, A. L. (2020, March 11). Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. Retrieved from https://link.springer.com/article/10.1007/s12630-020-01620-9
[244] Ibid.

CleanSpaceR HALOTM PAPR (CleanSpace Technology Pty Ltd, Artarmon, NSW, Australia). Personal goggles (model 9302-245; Uvex, Germany) were also issued to every member of staff.

- Refresher training for the use and maintenance of the powered air-purifying respirator (PAPR) was conducted. Educators from the Department of Occupational and Environmental Medicine trained designated trainers within the department who then went on to train the 180 anesthesia staff members (consultants and trainees) on the Jupiter and Proflow PAPR models (3M, St Paul, MN, United States of America). In addition, mask fitting was done for all users of the CleanSpaceR HALOTM.[245]

Establish clear open communication within hospital staff

- Communication channels including a COVID-19 website were set up and daily email updates were sent to all staff.
- Staff used social media, such as Workplace from Facebook and encrypted instant messaging, to approach senior management with ideas or concerns.[246]

Expedite contact tracing to ensure quick identification and isolation of those who might be at risk

- Contact tracing is done at the hospital level and at the ministry level. Hospital contact tracers are supposed to do immediate contact traces within two hours from when the case is reported. This information will be sent to the Ministry of Health (MOH), who will then take on the responsibility of doing community contact tracing and communications to the public.[247]
- As community spread increased in Singapore, the government introduced a mobile application called TraceTogether, which uses Bluetooth technology to identify people who have been within two meters of a coronavirus patients for at least 30 minutes. The government has since made the source code for this app freely available to developers around the world.[248]
- In response to the lower rate of adoption of TraceTogether, which hinders its effectiveness, the government is looking to distribute a Bluetooth tracking token to all Singaporean residents, and make it mandatory for residents to carry this around at all times. The token works similarly to TraceTogether, and would allow for quick contact tracing when required.

[245] Ibid.
[246] Wong, J., Goh, Q. Y., Tan, Z., & Sui, A. L. (2020, March 11). Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. Retrieved from https://link.springer.com/article/10.1007/s12630-020-01620-9
[247] 'Drop everything, scramble': Singapore's contact trackers fight COVID-19. (2020, March 13). Retrieved from https://www.channelnewsasia.com/news/singapore/coronavirus-contact-tracing-close-contacts-quarantine-covid-19-12535754
[248] Baharudin, H. (2020, April 6). Coronavirus: S'pore Government to make its contact-tracing app freely available to developers worldwide. Retrieved from https://www.straitstimes.com/singapore/coronavirus-spore-government-to-make-its-contact-tracing-app-freely-available-to

- In a complementary measure, the Singapore government unrolled SafeEntry,[249] an application that allows all visitors to sign in when they enter a premise. SafeEntry has become mandatory for all businesses that were returning to the workplace, schools, commercial establishments, as well as parks and hospitals. This allows authorities to quickly conduct contact tracing should a case be discovered in these vicinities.

Transfer patients from public to private hospitals to increase capacity for higher-risk patients

- The SGH isolation ward has 24 single negative pressure rooms that were purpose-built to handle patients with different types of infectious diseases such as tuberculosis, chicken pox and any other emerging infectious diseases. All major public hospitals in Singapore have isolation rooms so patients with suspected infectious diseases will not spread them to others.
- Previously, all confirmed cases were admitted to public hospitals and would remain there until they tested negative twice. However, as 80 percent of COVID-19 cases are mild to moderate cases and only require limited medical care, COVID-19 patients are being moved to private hospitals and public care facilities where they remain in quarantine and care until they were no longer shedding the virus.[250]

[249] Yee, Y. W. (2020, May 11). Coronavirus: SafeEntry applications surge ahead of reopening of businesses. Retrieved from https://www.straitstimes.com/tech/safeentry-applications-surge-ahead-of-reopening-of-businesses
[250] Khalik, S. (2020, March 24). Coronavirus: 49 patients moved to private hospitals to free up capacity at public facilities. Retrieved from https://www.straitstimes.com/singapore/49-patients-moved-to-private-hospitals-to-free-up-capacity-at-public-facilities

APPENDICES

TOOLKITS

A. PANDEMIC PREPAREDNESS CHECKLIST[251]

Items	Completed	In-Progress	Not Started
Identification of BCP Leaders and Core Skills Identify a pandemic coordinator and/or team (including backup staff) with defined roles and responsibilities for preparedness and response planning. The planning process should include input from union representatives. Identify essential employees and other critical inputs (e.g. raw materials, suppliers, sub-contractor services/ products, and logistics) required to maintain business operations by location and function during a pandemic. Plan for impact on financials. Train and prepare ancillary workforce (e.g. contractors, employees in other job titles/ descriptions, retirees). (In-house cross training) Develop and plan for scenarios likely to result in an increase or decrease in demand for healthcare services during a pandemic (e.g. effect or restriction on mass gatherings, need for hygiene supplies, travel restrictions).			

[251] Adapted from Missouri Department of Health and Senior Services. Pandemic Influenza Business Planning Toolkit. Retrieved from https://health.mo.gov/emergencies/panflu/pdf/panflubusinesstoolkit.pdf

Implement an exercise/drill to test your plan, and revise periodically. Set-up authorities, triggers, and procedures for activating and terminating the company's response plan. Plan for Absenteeism (10% to 50%) Forecast and allow for staff absences during a pandemic due to factors such as personal illness, family member illness, community containment measures and quarantines, school and/or business closures, and public transportation closures. Establish policies for employee compensation and sick leave absences unique to a pandemic (e.g. nonpunitive, liberal leave), including policies on when a previously ill person is no longer infectious and can return to work after illness. Establish policies for flexible worksite (e.g. telecommuting) and flexible work hours (e.g. staggered shifts). Establish policies for staff who have been exposed to pandemic influenza, are suspected to be ill or become ill at the worksite (e.g. infection control response, immediate mandatory sick leave). Protection of staff health Find up-to-date, reliable pandemic information from community public health, emergency management and other sources and make sustainable links. Implement guidelines to modify the frequency and type of face-to-face contact (e.g. hand-shaking, seating in			

meetings, office layout, shared workstations) among staff and between staff and patients or visitors. Encourage and track annual influenza vaccination for staff. (Post vaccination sites & locations). Evaluate staff access to and availability of occupational and mental health and social services during a pandemic, including corporate, community, and faith-based resources, and improve services as needed. (Post contact details of services available) Identify staff and key customers with special needs and incorporate the requirements of such persons into your preparedness plan. (Implement a separate Guest Register for special needs). Establish policies for preventing influenza spread at worksites (e.g. promoting respiratory hygiene/ cough etiquette, and prompt exclusion of people with influenza symptoms). Increase awareness and attend training workshops. Provide sufficient and accessible infection control supplies (e.g. hand-hygiene products, tissues and receptacles for their disposal) in all business locations. Assemble requirements, monitor inventory. Develop and disseminate programs and materials covering pandemic fundamentals (e.g. signs and symptoms of influenza, modes of transmission), personal and family protection and response strategies (e.g. hand hygiene, coughing/sneezing etiquette, contingency plans). Anticipate staff fear and anxiety, rumors and misinformation and plan communications accordingly.			

Provide information for the at-home care of ill staff and family members. Intelligence & Communications Establish an emergency communications plan and revise periodically. This plan includes identification of key contacts (with back-ups), chain of communications (including suppliers and customers), and processes of tracking and communicating business and staff status. (See Other Tools below) Enhance communications and information technology infrastructure as needed to support staff telecommuting and remote access where possible. Ensure that communications are culturally and linguistically appropriate. Disseminate information to employees about your pandemic preparedness and response plan. Develop platforms (e.g. hotlines, dedicated websites) for communicating pandemic status and actions to staff, vendors, suppliers, patients, and the public inside and outside worksites in a consistent and timely way, including redundancies in the emergency contact system. Update employee contact information (Company website to be accessible to obtain updates). Identify community sources for timely and accurate pandemic information (local and international) and resources for obtaining counter-measures (e.g. vaccines and anti-virals).			

Collaborate with MOH, other institutions within the cluster, other clusters, insurers, and suppliers to share your pandemic plans and understand their capabilities and plans. Collaborate with MOH and other hospitals and community health providers to participate in their planning processes, share your pandemic plans and understand their capabilities and plans. Collaborate with MOH and other hospitals and community health providers about the assets and/or services your organization could contribute to the community. Share best practices with other hospitals, community organizations, chambers of commerce, and safe workplace associations to improve community response efforts. Purchase required suggested quantities of masks, thermometers, gloves and alcohol-based hand sanitizer. Quantities are based on estimated occupancy rates X number of patients per room, plus staff for the estimated pandemic period. Establish staff bulletin board to be utilized as a central location for sharing of Avian Pandemic Information. Distribute handouts pertaining to Pandemic information. Develop sign off sheet to confirm each staff has received all “handouts”. Maintain in master file and copy Corporate Office. Confirm information awareness sessions have taken place at the property level including a signed attendance list.			

Post available website information on staff bulletin board for ease of access and a tool of reference for individual research. Offer anonymous Questions and Answers section on Staff Bulletin Boards. Prepare staffing model for surges in occupancies and potential of reduced personnel. Research and access national Emergency Response Plans. Retrieve and post the following information on Staff Bulletin Boards: • Acute Care Facilities • Vaccination Clinic Sites • Potential sites for triage sites (temporary emergency centres) • Know what is in place for in our geographical area (i.e. western part of Singapore) Develop good habits and prepare a check list of hard surface and public areas that need to be sanitized frequently. i.e. door handles, elevator buttons, stair railings. Prepare a Train-the-Trainer team who will attend pandemic planning workshops. Update employee emergency contact list including e-mail addresses (maintain hardcopy and electronic). …			

B. BUSINESS RECOVERY TEAM & OTHER ESSENTIAL STAFF

Full name	Job Role	Phone Numbers (Work, Home, Mobile))	Service Supported	Alternate Contact	Phone Numbers (Work, Home, Mobile)
	Chairperson	(W): (H): (M):			(W): (H): (M):
	Incident Manager	(W): (H): (M):			(W): (H): (M):
	Alternate Incident Manager	(W): (H): (M):			(W): (H): (M):
		(W): (H): (M):			(W): (H): (M):
		(W): (H): (M):			(W): (H): (M):
		(W): (H): (M):			(W): (H): (M):
		(W): (H): (M):			(W): (H): (M):
		(W): (H): (M):			(W): (H): (M):
		(W): (H): (M):			(W): (H): (M):

C. ESSENTIAL SERVICES / FUNCTIONS RESPONSE PRIORITY LIST

Priority (A, B, C)	Service / Function	No. of Staff	No. of Staff Remaining at 40% Absenteeism	Surge Increase Potential (Y/N)	Cluster Backup Assistance (Y/N)	Private Sector Assistance (Y/N)	Work Performed at Home (Y/N)

D. KEY VENDORS / SUPPLIERS

Company	Contacts Primary Alternate	Position	Phone Numbers (Work, Home, Mobile)	Email Address	Criticality (High, Mid, Low)	Backup / Stockpile Arrangements	Notes
			(W): (H): (M):				
			(W): (H): (M):				
			(W): (H): (M):				
			(W): (H): (M):				
			(W): (H): (M):				
			(W): (H): (M):				
			(W): (H): (M):				
			(W): (H): (M):				
			(W): (H): (M):				

E. CRITICAL PARTNERS / CUSTOMERS

Organization	Contacts (Primary, Alternate)	Position	Phone Numbers (Work, Home, Mobile)	Email Address	Notes
e.g. MOH			(W): (H): (M):		
e.g. Cluster clinic			(W): (H): (M):		
			(W): (H): (M):		
			(W): (H): (M):		
			(W): (H): (M):		
			(W): (H): (M):		
			(W): (H): (M):		
			(W): (H): (M):		
			(W): (H): (M):		

BIBLIOGRAPHY

Agency for Healthcare Research and Quality . “Primary Care Workflow Diagrams.” Agency for Healthcare Research and Quality , Jan. 2018. Retrieved from www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/quality-resources/tools/cap-toolkit/pc-workflowdiagrams.pdf.

Aloisi, S., Beasley, D., Borter, G., Escritt, T., & Kelland, K. (2020, April 23). Special Report: As virus advances, doctors rethink rush to ventilate. Reuters. Retrieved from Aloisi, S., Beasley, D., Borter, G., Escritt, T., & Kelland, K. (2020, April 23). Special Report: As virus advances, doctors rethink rush to ventilate. Reuters. Retrieved from https://www.reuters.com/article/us-health-coronavirus-ventilators-specia/special-report-as-virus-advances-doctors-rethink-rush-to-ventilate-idUSKCN2251PE

Andrew, S. (2020, March 27). Duke researchers are decontaminating N95 masks so doctors can reuse them to treat coronavirus patients. Retrieved from https://edition.cnn.com/2020/03/27/health/n95-respirator-rewear-coronavirus-duke-trnd/index.html?fbclid=IwAR2bgePgnMGcBWjl5izU4AL5udHI7mqquiSTFnBrIubzPSuEFuDrcD9sxdw

Anthes, E. (2020, March 22nd). Pandemics spread in hospitals. Changes in design and protocol can save lives. The Palm Beach Post. Retrieved from https://www.palmbeachpost.com/opinion/20200322/anthes-pandemics-spread-in-hospitals-changes-in-design-and-protocols-can-save-lives

Armony, M., Chan, C. W., & Zhu, B. (n.d.). NYU Stern, New York.

Badhelia, N. (2020, March 27th). Teleconference with Eden Strategy Institute.

Baharudin, H. (2020, April 6). Coronavirus: S'pore Government to make its contact-tracing app freely available to developers worldwide. Retrieved from https://www.straitstimes.com/singapore/coronavirus-spore-government-to-make-its-contact-tracing-app-freely-available-to

Baker, M., and Fink, S. (2020, March 31st). At the Top of the Covid-19 Curve, How do Hospitals Decide Who Gets Treatment? The New York Times. Retrieved from https://www.nytimes.com/2020/03/31/us/coronavirus-covid-triage-rationing-ventilators.html

Bannow, T., & Castellucci, M. (2020, March 30). Hospitals redeploy specialists to COVID-19 front lines. Retrieved from https://www.modernhealthcare.com/hospitals/hospitals-redeploy-specialists-covid-19-front-lines

BBC News (2020, March 19th).Coronavirus: Hospitals across southern England impose visitor restrictions. BBC News. Retrieved from https://www.bbc.com/news/uk-england-51962793

Bebinger, M. (2020, March 28). Furloughs, Retirement Cuts And Less Pay Hit Mass. Doctors And Nurses As COVID-19 Spreads. Retrieved from https://www.wbur.org/commonhealth/2020/03/27/doctors-nurses-mass-coronavirus-infections-pay-benefits

Brent, and One Council . HR Pandemic Policy. Jan. 2015, democracy.brent.gov.uk/documents/s29645/pandemic policy.pdf.

Brodwin, E., Ross, C., Brodwin, E., Ross, C., Brodwin, E., Brodwin, E., … National Technology Correspondent. (2020, March 19). Patients overwhelm telehealth services amid coronavirus pandemic. Retrieved from https://www.statnews.com/2020/03/17/telehealth-services-overwhelmed-amid-coronavirus-pandemic/

Brosinski, C. M., Riddell, A. J., & Valdez, S. (2017). Improving triage accuracy: a staff development approach. Clinical Nurse Specialist, 31(3), 145-148.

Carville , O., Court, E., & Brown, K. V. (2020, March 31). Hospitals Tell Doctors They'll Be Fired If They Speak Out About Lack of Gear. Retrieved from https://www.bloomberg.com/news/articles/2020-03-31/hospitals-tell-doctors-they-ll-be-fired-if-they-talk-to-press?utm_medium=social&utm_content=politics&utm_campaign=socialflow-organic&cmpid=socialflow-facebook-politics&utm_source=facebook&fbclid=IwAR39KGL3GAmtZ-ESh5qiVIYn4XMVWcuueXPhzAoIvsmKNa0y-juQRJ6y94Y

Castellucci M. (2017, October 14th). Johns Hopkins uses electronic tool to improve triage of ED patients. Modern Healthcare. Retrieved from https://www.modernhealthcare.com/article/20171014/NEWS/171019915/johns-hopkins-uses-electronic-tool-to-improve-triage-of-ed-patients.

CBC. Lift barriers to accredit foreign-educated doctors quickly, report's author urges. Yahoo! News. Retrieved from https://sg.news.yahoo.com/lift-barriers-accredit-foreign-educated-120100722.html

Centers for Disease Control and Prevention. (2006). Effective TB Interviewing for Contact Investigation: Self-Study Modules. Retrieved from https://www.cdc.gov/tb/publications/guidestoolkits/interviewing/tbinterviewing_ssmodules.pdf

Centers for Disease Control and Prevention. (2016). Principles of Epidemiology. Retrieved from https://www.cdc.gov/csels/dsepd/ss1978/lesson6/section2.html#step5

Centers for Disease Control and Prevention. (2016, January 5). PPE Supply Considerations. Retrieved from https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/supplies.html

Centers for Disease Control and Prevention. (2016, January 21). PPE Calculator. Retrieved from https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/calculator.html

Centers for Disease Control and Prevention. (2019). 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

Centers for Disease Control and Prevention. (2019). 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

Centers for Disease Control and Prevention. (2020). CDC. Comprehensive Hospital Preparedness Checklist for Coronavirus Disease 2019 (COVID-19). Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/downloads/HCW_Checklist_508.pdf

Centers for Disease Control and Prevention. (2020). Clinical Specimens: Novel Coronavirus (2019-nCoV). Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/lab/guidelines-clinical-specimens.html

Centers for Disease Control and Prevention. (2020, February 29). Interim Guidance for Healthcare Facilities: Preparing for Community Transmission of COVID-19 in the US. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/guidance-hcf.html

Centers for Disease Control and Prevention. (2020, March 14). Healthcare Supply of Personal Protective Equipment. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/hcp/healthcare-supply-ppe.html

Centers for Disease Control and Prevention. (2020, March 12). Stop the Spread of Rumors. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/share-facts.html

ChannelNewsAsia, 'Drop everything, scramble': Singapore's contact trackers fight COVID-19. (2020, March 13). Retrieved from https://www.channelnewsasia.com/news/singapore/coronavirus-contact-tracing-close-contacts-quarantine-covid-19-12535754

Chen, Q., Liang, M., Li, Y., Guo, J., Fei, D., Wang, L., ... & Wang, J. (2020). Mental health care for medical staff in China during the COVID-19 outbreak. The Lancet Psychiatry, 7(4), e15-e16.

Chen, Yu-Ju, et al. "Stockpile Model of Personal Protective Equipment in Taiwan." Health Security, vol. 15, no. 2, 2017, doi: 10.1089/hs.2016.0103. Retrieved from https://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC5404251&blobtype=pdf

Choi, A., & Velasquez, J. (2020, March 20). Trained Operators for Coronavirus Patient Ventilators Scarce in New York. Retrieved from https://thecity.nyc/2020/03/trained-operators-for-coronavirus-ventilators-scarce-in-nys.html

Christ G., Washington J. (2020, February 23rd). Protecting patients, health care workers priorities as Cleveland Clinic, MetroHealth and UH prepare for coronavirus. Cleveland. Retrieved from https://www.cleveland.com/business/2020/02/cleveland-hospitals-prepare-for-potential-novel-coronavirus-cases.html

Christian, M. D., Joynt, G. M., Hick, J. L., Colvin, J., Danis, M., & Sprung, C. L. (2010, April 1). Chapter 7. Critical care triage. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. Intensive Care Medicine. doi: 10.1007/s00134-010-1765-0

Cleveland Clinic (2018). Code Lavender: A tool for staff support. Retrieved from https://my.clevelandclinic.org/-/scassets/files/org/locations/hillcrest-hospital/spiritual-services/code-lavender.ashx?la=en

Coin, G. (2020, March 24). Coronavirus: Cuomo wants more ventilators, but are there enough specialists to run them? Retrieved from https://www.syracuse.com/coronavirus/2020/03/coronavirus-cuomo-wants-more-ventilators-but-are-there-enough-specialists-to-run-them.html

Corn, D. (2020, March 19). The ventilator situation is actually worse than you think. Retrieved from https://www.motherjones.com/politics/2020/03/ventilator-crisis-enough-respiratory-therapists/

Dailey, A. M., Mitchell, J. O., & Bruce , J. M. (2020, March 10). Helping Human Resources Managers Prepare for Coronavirus Pandemic. Retrieved from https://www.natlawreview.com/article/helping-human-resources-managers-prepare-coronavirus-pandemic

Dancer, S. J. (2014). Controlling hospital-acquired infection: focus on the role of the environment and new technologies for decontamination. Clinical microbiology reviews, 27(4), 665-690. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4187643/

Davey, M. (2020, March 31st). Australian government will pay half to integrate private hospitals into Covid-19 response. The Guardian. Retrieved from https://www.theguardian.com/australia-news/2020/mar/31/federal-government-pay-half-integrate-private-public-hospitals-covid-19-response

Davey, M., Butler, B., & Hurst, D. (2020, March 31). Australian government will pay half to integrate private hospitals into Covid-19 response. Retrieved from https://www.theguardian.com/australia-news/2020/mar/31/federal-government-pay-half-integrate-private-public-hospitals-covid-19-response

De Las Heras-Pedrosa, C., Rando-Cueto, D., Jambrino-Maldonado, C., & Paniagua-Rojano, F. J. (2020). Analysis and study of hospital communication via social media from the patient perspective. Cogent Social Sciences, 6(1), 1718578.

Dennis B, Gunter O. Surgical procedures in the intensive care unit: A critical review. OA Critical Care 2013 May 01;1(1):6.

Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. The Lancet Infectious Diseases. Retrieved from https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30120-1/fulltext

Emergency Department Operational Standard Operating Procedure. National Health Services, Northern Devon Healthcare. Retrieved from https://www.northdevonhealth.nhs.uk/wp-content/uploads/2019/06/Emergency-Department-SOP-V4.1.pdf.

Ending circuit breaker: phased approach to resuming activities safely. (2020, May 28). Retrieved from https://www.gov.sg/article/ending-circuit-breaker-phased-approach-to-resuming-activities-safely

European Center for Disease Prevention and Control. (2020, March). Infection prevention and control for COVID-19 in healthcare settings. ECDC Technical Report . doi: https://www.ecdc.europa.eu/sites/default/files/documents/COVID-19-infection-prevention-and-control-healthcare-settings-march-2020.pdf

European Centre for Disease Prevention and Control. (2020, March 10). Novel coronavirus (SARS-CoV-2) - Discharge criteria for confirmed COVID-19 cases. Retrieved from https://www.ecdc.europa.eu/en/publications-data/novel-coronavirus-sars-cov-2-discharge-criteria-confirmed-covid-19-cases

Ezzelle, J., Rodriguez-Chavez, I. R., Darden, J. M., Stirewalt, M., Kunwar, N., Hitchcock, R., … D'Souza, M. P. (2008, January 7). Guidelines on good clinical laboratory practice: bridging operations between research and clinical research laboratories. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/18037599

Facher, L. (2020, April 1). Private equity-backed company slashes doctor benefits amid Covid-19. Retrieved from https://www.statnews.com/2020/04/01/slashes-benefits-for-doctors-coronavirus/

Forman, H., et al. (2020, March 12th). Health Care Priorities For A COVID-19 Stimulus Bill: Recommendations To The Administration, Congress, And Other Federal, State And Local Leaders From Public Health, Medical, Policy And Legal Experts. Health Affairs. Retrieved from https://www.healthaffairs.org/do/10.1377/hblog20200312.363618/full/

Frieden, T. (2020, April 12). What the C.D.C. Can Do to Slow This Pandemic. Retrieved from https://www.nytimes.com/2020/04/12/opinion/cdc-coronavirus.html?action=click&module=Opinion&pgtype=Homepage

#GetUsPPE. (n.d.). #GetUsPPE - Getting Protective Equipment to our Healthcare Heroes. Retrieved from https://getusppe.org/

Gonzalo M.L. et al. (2018 June). Disinfection in the Hospital Environment. Guide to Infection control in the Hospital. Retrieved from https://isid.org/wp-content/uploads/2018/06/ISID_Infection_Guide_Chapter10.pdf

Greiner, A. L., Angelo, K. M., McCollum, A. M., Mirkovic, K., Arthur, R., & Angulo, F. J. (2015). Addressing contact tracing challenges—critical to halting Ebola virus disease transmission. International Journal of Infectious Diseases, 41, 53-55.

Guide to CAP Accreditation. (2018). College of American Pathologists. Retrieved from https://documents.cap.org/documents/2018-guide-to-accreditation.pdf

Hamer, D. (2020, March 27th). Teleconference with Eden Strategy Institute.

Healthcare Denmark. (2018, March 1st). Denmark – a telehealth nation. Retrieved from https://www.healthcaredenmark.dk/media/r2rptq5a/telehealth-v1.pdf

Hermesauto. (2020, April 6). Pilot's 'soft skills' useful as SG Clean Ambassador. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/pilots-soft-skills-useful-as-sg-clean-ambassador

Herrick M. (2017, February 1st). Planning and maintain hospital air isolation rooms. Health Facilities Management Magazine. Retrieved from https://www.hfmmagazine.com/articles/2671-planning-and-maintaining-hospital-air-isolation-rooms.

Hermesauto. (2020, May 27). Covid-19 patients will be discharged even if they test positive after 14 days, says Malaysia's health chief. Retrieved May 28, 2020, from https://www.straitstimes.com/asia/se-asia/covid-19-patients-will-be-discharged-even-if-they-test-positive-after-14-days-says

Hester, W. P. (2020, March 20). UVA Health Independently Develops New COVID-19 Tests. Retrieved from https://news.virginia.edu/content/uva-health-independently-develops-new-covid-19-tests

Hopkins, C. (2020, March 23). "We are desperate": Trump's inaction has created a crisis with protective medical gear. Retrieved from https://www.vox.com/2020/3/22/21189896/coronavirus-in-us-masks-n95-respirator-doctors-nurses-shortage-ppe

How Strata is Pioneering a Rolling Forecast in Healthcare. (2013, October 29). Retrieved from https://www.stratadecision.com/article/pioneering-a-rolling-forecast/

Hurst, D., Sharpe, S., & Yeager, V. A. (2017). Administrative Preparedness Strategies: Expediting Procurement and Contracting Cycle Times During an Emergency. Public Health Reports, 132(3), 294–297. doi: 10.1177/0033354917698131

Imaging Technology News . (2020, March 23). Deployment of Health IT in China's Fight Against the COVID-19 Epidemic. Retrieved from https://www.itnonline.com/article/deployment-health-it-china's-fight-against-covid-19-epidemic?fbclid=IwAR1ThYia76lN4TBlSmdAT2TrSPraROPsZ9_u7GEsyozKquEa_dzCBZNCSG8

Infection prevention and control – Hand hygiene tools and resources. World Health Organization. Retrieved at https://www.who.int/infection-prevention/tools/hand-hygiene/en/

Isakov, A., Miles, W., Gibbs, S., Lowe, J., Jamison, A., & Swansiger, R. (2015). Transport and management of patients with confirmed or suspected Ebola virus disease. Annals of emergency medicine, 66(3), 297-305. Retrieved from https://web.mhanet.com/SQI/Emergency%20Preparedness/Infectious%20Diseases/Transport%20and%20Management%20of%20Patients%20with%20Confirmed%20or%20Suspected%20EVD.PDF.

Isinnova. (2020, March 26). Easy – Covid19 ENG. Retrieved from https://www.isinnova.it/easy-covid19-eng/

Iskander, J., Rose, D. A., & Ghiya, N. D. (2017). Science in emergency response at CDC: structure and functions. American Journal of Public Health, 107(S2), S122-S125. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5594391/pdf/AJPH.2017.303951.pdf

ISO 15189:2012. (2014, August 1). Retrieved from https://www.iso.org/standard/56115.html

Japsen, B. (2020, April 15). Abbott Labs Has Shipped 566,000 Rapid COVID-19 Tests To All 50 U.S. States. Retrieved from https://www.forbes.com/sites/brucejapsen/2020/04/14/abbott-labs-has-shipped-566000-rapid-covid-19-tests-to-all-50-us-states/#2c8656f33205

JCI Accreditation Standards for Hospitals, 7th Edition. (2019). Joint Commission International. Retrieved from https://store.jointcommissioninternational.org/assets/3/7/proposed_jci_7th_edition_standards.pdf

Johns Hopkins Center for Health Security . (2020). Ventilator Stockpiling and Availability in the US F. Johns Hopkins Center for Health Security. Retrieved from http://www.centerforhealthsecurity.org/resources/COVID-19/200214-VentilatorAvailability-factsheet.pdf

Johns Hopkins Medicine. (2014, November 17th). Ebola Patient Transport Drill – Johns Hopkins Medicine and Lifeline. Retrieved from https://www.youtube.com/watch?v=RRdxNzLXvhQ.

Kaplan, L. M., & McGuckin, M. (1986). Increasing handwashing compliance with more accessible sinks. Infection Control & Hospital Epidemiology, 7(8), 408-410. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/3638277

Khalik, S. (2020, February 3). Wuhan virus: $100 a day for those quarantined; severe penalties for people who flout quarantine orders. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/health/100-a-day-for-those-quarantined-severe-penalties-for-people-who-flout-quarantine

Khalik, S. (2020, March 24). Coronavirus: 49 patients moved to private hospitals to free up capacity at public facilities. Retrieved from https://www.straitstimes.com/singapore/49-patients-moved-to-private-hospitals-to-free-up-capacity-at-public-facilities

Khalik, S., & Goh, T. (2020, February 3). Wuhan virus: Each Singapore household to get 4 free masks for contingencies. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/health/each-spore-household-to-get-4-free-masks-for-contingencies

King, D., Vlaev, I., Everett-Thomas, R., Fitzpatrick, M., Darzi, A., & Birnbach, D. J. (2016). "Priming" hand hygiene compliance in clinical environments. Health Psychology, 35(1), 96. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/26214075

Kit, T. S. (2020, March 21). Singapore launches TraceTogether mobile app to boost COVID-19 contact tracing efforts. Retrieved from https://www.channelnewsasia.com/news/singapore/covid19-trace-together-mobile-app-contact-tracing-coronavirus-12560616

Knaus, C. (2020, March 16). Australian health department says supply of key component in coronavirus testing under strain. Retrieved from https://www.theguardian.com/world/2020/mar/16/australian-doctors-warn-coronavirus-testing-compromised-by-failure-to-stockpile-key-chemical-reagent

Kok, X., Sim, D.(2020, March 25th). Singapore's eight-step plan to combat the coronavirus. (2020, March 25). South China Morning Post. Retrieved from https://www.scmp.com/week-asia/health-environment/article/3076926/singapore-way-eight-steps-fight-coronavirus-thousands

Korosec, K. (2020, March 22). Ford, GM, Tesla given the 'go ahead' to produce ventilators, Trump says. Retrieved from https://techcrunch.com/2020/03/22/ford-gm-tesla-given-the-go-ahead-to-produce-ventilators-trump-says/

Kottasova, I. (2020, March 20th). Thousands of medical students are being fast-tracked into doctors to help fight the coronavirus. CNN. Retrieved from https://edition.cnn.com/2020/03/19/europe/medical-students-coronavirus-intl/index.html

Lauks, J., Mramor, B., Baumgartl, K., Maier, H., Nickel, C. H., & Bingisser, R. (2016). Medical team evaluation: effect on emergency department waiting time and length of stay. PloS one, 11(4). Retrieved from https://pdfs.semanticscholar.org/f97d/15e5c8954433e328d1de2fcec086f0d25cd0.pdf

Law, E., & Choon, C. M. (2020, April 6). How China, South Korea and Taiwan are using tech to curb coronavirus outbreak. Retrieved from https://www.straitstimes.com/asia/east-asia/how-china-s-korea-and-taiwan-are-using-tech-to-curb-outbreak

Lee, G. (2020). South Korea approves first four COVID-19 test kits under urgent-use license. Retrieved from https://www.bioworld.com/articles/433783-south-korea-approves-first-four-covid-19-test-kits-under-urgent-use-license

Lewiss, R. E. (2020, April 18). I'm an emergency medicine doctor: Here's how we're using ultrasound in innovative ways to combat COVID-19. Fast Company. Retrieved from https://www.fastcompany.com/90492442/im-an-emergency-medicine-doctor-heres-how-were-using-ultrasound-in-innovative-ways-to-combat-covid-19

Leventhal, R. (2020, March 19th). HIPAA and COVID-19: Restrictions Loosened, But Experts Preach Caution. Healthcare Innovation. Retrieved from https://www.hcinnovationgroup.com/covid-19/article/21130404/hipaa-and-covid19-restrictions-loosened-but-experts-preach-caution

Lim, J. (2020, March 8). Singapore's stockpile of masks replenished from many sources. The Straits Times. Retrieved from https://www.straitstimes.com/singapore/health/singapores-stockpile-of-masks-replenished-from-many-sources

Liverpool Hospital. Clinical Guidelines: Receiving a Patient into ICU . Liverpool Hospital, Feb. 2014. Retrieved from www.aci.health.nsw.gov.au/__data/assets/pdf_file/0008/306449/liverpoolReceiving_a_patient_to_ICU.pdf.

Livingston, E. (2020, March 28). Sourcing Personal Protective Equipment During the COVID-19 Pandemic. Retrieved from https://jamanetwork.com/journals/jama/fullarticle/2764031

Malhotra, Sameer, et al. "Workflow Modeling in Critical Care: Piecing Together Your Own Puzzle." Journal of Biomedical Informatics, vol. 40, no. 2, Apr. 2007, pp. 81–92. Science Direct. Retrieved from https://www.sciencedirect.com/science/article/pii/S1532046406000633.

Mathews, A. W., & Evans, M. (2020, April 1). Hospitals, Doctors Feel Financial Squeeze as Coronavirus Sweeps U.S. Retrieved from https://www.wsj.com/articles/hospitals-doctors-feel-financial-squeeze-as-coronavirus-sweeps-u-s-11585768706

Maunder, R. G., Leszcz, M., Savage, D., Adam, M. A, et al (2008). Applying the Lessons of SARS to Pandemic Influenza. Canadian Journal of Public Health, 99(6), 486–488. doi: 10.1007/bf03403782

McCluskey, P. D. (2020, March 31). Boston Medical Center furloughs 10 percent of its workforce as part of cutbacks across the health care industry - The Boston Globe. Retrieved from https://www.bostonglobe.com/2020/03/31/business/boston-medical-center-furloughs-10-percent-its-workforce/

McInturff, S. L., Make, B. J., Robart, P., & Saposnick, A. B. (1999). AARC Clinical Practice Guideline, Suctioning of the Patient in the Home. Respiratory Care, 44(1), 99–104. Retrieved from http://www.rcjournal.com/cpgs/sotpithcpg.html

McKinsey & Co. (2010). How sourcing excellence can lower hospital costs. Retrieved from https://healthcare.mckinsey.com/sites/default/files/779148_How_Sourcing_Excellence_Can_Lower_Hospital_Costs_Health_International_10.pdf

Mills, S., & Bryden, D. (2010). A practical approach to teaching medical ethics. Journal of Medical Ethics, 36(1), 50-54. Retrieved April 2, 2020, from www.jstor.org/stable/20696716

Ministry of Health, Singapore. (2020, April 1). Clarifications on Misinformation Regarding COVID-19. Retrieved from https://www.moh.gov.sg/covid-19/clarifications

Minnesota Department of Health – Office of Emergency Preparedness. Airbone Infectious Disease Management – Methods for Temporary Negative Pressure Isolation. Retrieved from https://www.health.state.mn.us/communities/ep/surge/infectious/airbornenegative.pdf.

Minnesota Department of Health – Office of Emergency Preparedness. Airbone Infectious Disease Management – Methods for Temporary Negative Pressure Isolation. Retrieved from https://www.health.state.mn.us/communities/ep/surge/infectious/airbornenegative.pdf.

Missouri Department of Health and Senior Services. Pandemic Influenza Business Planning Toolkit. Retrieved from https://health.mo.gov/emergencies/panflu/pdf/panflubusinesstoolkit.pdf

Modern Healthcare. (2020). Labs face challenges creating diagnosis testing for COVID-19. Retrieved from https://www.modernhealthcare.com/technology/labs-face-challenges-creating-diagnosis-testing-covid-19

MOH pandemic readiness and response plan for influenza and other acute respiratory diseases (Revised April 2014). Ministry of Health. Retrieved from https://www.moh.gov.sg/docs/librariesprovider5/diseases-updates/interim-pandemic-plan-public-ver-_april-2014.pdf

Mollura, D. J., Palmore, T. N., Folio, L. R., & Bluemke, D. A. (2015). Radiology preparedness in Ebola virus disease: guidelines and challenges for disinfection of medical imaging equipment for the protection of staff and patients. Radiology, 275(2), 538-544.

Monto, A. (2020, March 31). Teleconference with Eden Strategy Institute.

Moore, S. (2020, March 28). Coronavirus Myths, Rumors and Misinformation: Johns Hopkins Medicine. Retrieved from https://www.hopkinsmedicine.org/coronavirus/coronavirus-myths-rumors-misinformation.html

Mounk, Y. (2020, March 11). The Extraordinary Decisions Facing Italian Doctors. The Atlantic. Retrieved from https://www.theatlantic.com/ideas/archive/2020/03/who-gets-hospital-bed/607807/

Mount Sinai Hospital. Procedures for transportation of patients in vre/mrsa precautions. Retrieved from https://eportal.mountsinai.ca/Microbiology/protocols/pdf/k2biv.pdf.

Mount Sinai Hospital. Procedures for transportation of patients in vre/mrsa precautions. Retrieved from https://eportal.mountsinai.ca/Microbiology/protocols/pdf/k2biv.pdf.

Naming the coronavirus disease (COVID-19) and the virus that causes it. World Health Organization (WHO). Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it

Nardelli, A., & Ashton, E. (2020, March 27). Everyone In Iceland Can Get Tested For The Coronavirus. Here's How The Results Could Help All Of Us. Retrieved from https://www.buzzfeed.com/albertonardelli/coronavirus-testing-iceland

Nates, Joseph L, et al. “ICU Admission, Discharge, and Triage Guidelines: A Framework to Enhance Clinical Operations, Development of Institutional Policies, and Further Research.” Critical Care Medicine, vol. 44, no. 8, Aug. 2016, pp. 1553–1602. Critical Care Medicine , doi:10.1097/CCM.0000000000001856.

National Health Services, National Services Scotland. (2015). Transmission Based Precautions Literature Review: Patient Placement (Isolation/Cohorting). Retrieved from https://hpspubsrepo.blob.core.windows.net/hps-website/nss/1725/documents/1_tbp-lr-isolation-and-cohorting-v1.0.pdf.

Newsroom, N. B. C. (2020, March 21). URGENT: UVA Health accepting donations of to combat COVID-19. Retrieved from https://www.nbc12.com/2020/03/21/urgent-uva-health-accepting-donations-combat-covid-/

Occupational Safety Group . (n.d.). Six Tips to Help you Build a Positive Safety Culture. Retrieved from https://osg.ca/six-tips-to-help-you-build-a-positive-safety-culture-in-your-workplace/

Paladino, L., Silverberg, M., Charchaflieh, J. G., Eason, J. K., et al. (2008). Increasing Ventilator Surge Capacity in Disasters: Ventilation of Four Adult-Human-Sized Sheep on a Single Ventilator With a Modified Circuit. Resucitation , 77(1). Retrieved from https://pubmed.ncbi.nlm.nih.gov/18164798/

Palmer B., Clark L. (2016). Recommended practices for filtration for airborne infections containment rooms in health care facilities. National Air Filtration Association. Retrieved from https://www.nafahq.org/wp-content/uploads/Airborne-Infections-Containment-Rooms-in-Health-Care-Facilities-Secured.pdf.

Papagiotas, S. S., Frank, M., Bruce, S., & Posid, J. M. (2012). From SARS to 2009 H1N1 influenza: the evolution of a public health incident management system at CDC. Public Health Reports, 127(3), 267-274. Retrieved from https://journals.sagepub.com/doi/abs/10.1177/003335491212700306

Patient Safety Network . (n.d.). Culture of Safety. Retrieved from https://psnet.ahrq.gov/primer/culture-safety

Paul G. (2020, January 28th). ZTE and China Telecom enabled the first remote diagnosis of coronavirus via a 5G telehealth system. Business Insider. Retrieved from https://www.businessinsider.com/zte-china-telecom-build-5g-telehealth-system-for-coronavirus-2020-1?IR=T.

Perry, T. (2020, April 2). Canadian doctor's brilliant 'evil genius' hack transforms 1 ventilator into 9. Retrieved from https://www.upworthy.com/canadian-doctors-brilliant-evil-genius-hack-turns-one-ventilator-into-nine?fbclid=IwAR0GfNRT6I8b2Wk4ULTfjYmNJYpJuwiZO1JGxXtQfS8yijwpD0ZcE0829TY

Peters, A. (2020, March 26). How we can redesign cities to fight future pandemics. Retrieved from https://www.fastcompany.com/90479665/how-we-can-redesign-cities-to-fight-future-pandemics?fbclid=IwAR0Nff_KMc6uHg92zxCadNStA0CUyyIODYtJ98FjDbgzqGYHEDptHI3fsxU

Phòng chống COVID-19 tại Hà Nội: 6 bệnh viện mũi nhọn chuẩn bị 1.000 giường bệnh. (2020, March 12). Retrieved from https://baotainguyenmoitruong.vn/phong-chong-covid-19-tai-ha-noi-6-benh-vien-mui-nhon-chuan-bi-1-000-giuong-benh-300231.html

Prin, M., & Wunsch , H. (2014). The Role of Stepdown Beds in Hospital Care. American Journal of Respiratory and Critical Care Medicine, 190(11). Retrieved from https://www.atsjournals.org/doi/full/10.1164/rccm.201406-1117PP

Proctor, N. (2020, March 18th). Advocates say to remove barriers to fixing ventilators, other covid-19-related medical equipment. US PIRG. Retrieved from https://uspirg.org/news/usp/advocates-say-remove-barriers-fixing-ventilators-other-covid-19-related-medical-equipment

Rasoal, D., Skovdahl, K., Gifford, M., & Kihlgren, A. (2017, December). Clinical ethics support for healthcare personnel: an integrative literature review. In Hec Forum (Vol. 29, No. 4, pp. 313-346). Springer Netherlands. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5688194/

Reuters. (2020, March 21). Vietnam calls up medical students, retired doctors in coronavirus fight. Retrieved from https://finance.yahoo.com/news/vietnam-calls-medical-students-retired-111531660.html

Rose , L., Schultz, M. J., Cardwell, C. R., Jouvet, P., McAuley, D. F., & Blackwood, B. (2014, June 10). Do ventilators that manage the reduction of ventilator support (weaning) reduce the duration of weaning compared to strategies managed by clinicians? Retrieved from https://www.cochrane.org/CD009235/EMERG_do-ventilators-manage-reduction-ventilator-support-weaning-reduce-duration-weaning-compared

Royal Government of Bhutan (2011). National Influenza Pandemic Preparedness Plan. Retrieved from https://info.undp.org/docs/pdc/Documents/BTN/00060314_FINAL%20NIPPP.pdf

RT. (2019, December 10). Ventilator Weaning: Its About Technology and Teamwork. Retrieved from https://www.rtmagazine.com/department-management/clinical/ventilator-weaning-technology-teamwork/

Scott, D. (2020, March 17). US hospitals are struggling to respond to the Covid-19 pandemic. Retrieved from https://www.vox.com/policy-and-politics/2020/3/17/21183263/coronavirus-us-hospitals-elective-surgeries-icu-masks

Sen, N. J. (2020, March 22). The Big Read: Singapore has been buttressing its food security for decades. Now, people realise why. Channel News Asia. Retrieved from https://www.channelnewsasia.com/news/singapore/covid19-coronavirus-singapore-food-security-stockpile-national-12563280

Siegel, J. D., Rhinehart, E., Jackson, M., & Chiarello, L. (2007). 2007 Guideline for isolation precautions preventing transmission of infectious agents in healthcare settings. Retrieved from https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf

Şimşek, E. M., İzdeş, S., Parpucu, Ü. M., Ulus, F., Cırık, M. Ö., & Ünver, S. (2019). How Effective are Intensive Care Unit Beds Used in Our Region? Turkish Journal of Anaesthesiology and Reanimation, 47(6), 485–491. doi: 10.5152/TJAR.2019.65289

Sin, Y. (2020, May 14). All foreign workers in dorms to be tested for Covid-19. Retrieved from https://www.straitstimes.com/singapore/all-foreign-workers-in-dorms-to-be-tested-for-covid-19

Singapore Budget 2020. Retrieved from https://www.gov.sg/features/budget2020

Singapore Expo being prepared to house COVID-19 patients who have recovered but may still be infectious: Gan Kim Yong. (2020, April 5). Retrieved from https://www.channelnewsasia.com/news/singapore/covid19-singapore-expo-community-care-facility-12611318

Singapore General Hospital. Retrieved from https://www.sgh.com.sg/patient-care/visiting-specialist/emergency-care-singapore-general-hospital

Sinnenberg, L., Buttenheim, A. M., Padrez, K., Mancheno, C., Ungar, L., & Merchant, R. M. (2017). Twitter as a tool for health research: a systematic review. American journal of public health, 107(1), e1-e8.

South China Morning Post . (2020, March 29). Why so few Covid-19 infections in Singapore's health workers? Retrieved from https://www.scmp.com/week-asia/health-environment/article/3077345/coronavirus-why-so-few-infections-singapores-health?fbclid=IwAR2uj7Root94TOOU0ivdOU10PBr4jpLY_f-05SwLTxwd7GqqR41KQO2vtXY

Srivastava, R. (2020, March 9). The message to doctors has always been clear: if you get sick, do it on your own time | Ranjana Srivastava. Retrieved from https://www.theguardian.com/commentisfree/2020/mar/09/the-message-to-doctors-has-always-been-clear-if-you-get-sick-do-it-on-your-own-time?CMP=share_btn_fb&fbclid=IwAR22DN3IMqHSK4c21twewfIQNKpyaWtaoqg2l1Y9zgYnIO6uLnVHbgwcn64

Standards for Emergency Department Deign and Specification for Ireland 2007. Irish Association for Emergency Medicine. Retrieved from http://www.iaem.ie/wp-content/uploads/2013/02/iaem_standards_for_ed_design__specification_for_ireland_300907.pdf.

Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). World Health Organization (WHO). Retrieved from https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)

Steffens, M. S., Dunn, A. G., Wiley, K. E., & Leask, J. (2019). How organisations promoting vaccination respond to misinformation on social media: a qualitative investigation. BMC public health, 19(1), 1-12.

Stricter safe distancing measures to prevent further spread of Covid-19 cases. Ministry of Health. Retrieved from https://www.moh.gov.sg/news-highlights/details/stricter-safe-distancing-measures-to-prevent-further-spread-of-covid-19-cases

Sun, K., Chen, J., & Viboud, C. (2020). Early epidemiological analysis of the coronavirus disease 2019 outbreak based on crowdsourced data: a population-level observational study. The Lancet Digital Health.

Taylor, D. (March 25th 2020). Covid-19: call for fast-track registration of refugee doctors in UK. The Guardian. Retrieved from https://www.theguardian.com/world/2020/mar/25/covid-19-call-for-fast-track-registration-of-refugee-doctors-in-uk

The Economist (2020, March 5th). Millions of Chinese, cooped up and anxious, turn to online doctors. Retrieved from https://www.economist.com/business/2020/03/05/millions-of-chinese-cooped-up-and-anxious-turn-to-online-doctors

The London Economic. (2020, March 22). 4,500 retired doctors and nurses sign up to rejoin NHS in just 48 hours. Retrieved from https://www.thelondoneconomic.com/news/4500-retired-doctors-and-nurses-sign-up-to-rejoin-nhs-in-just-48-hours/22/03/?fbclid=IwAR1pD9UCAOB8xg_CYAkgT7JvbvuJ7J3La_oylDNysKJyCvNnmVguf2FEZM8

Thomasy, H., Schulson, M., & Schulson, M. (2020, April 1). In the Race to Crack Covid-19, Scientists Bypass Peer Review. Retrieved from https://undark.org/2020/04/01/scientific-publishing-covid-19/

Ting, C. Y. (2020, February 12). Coronavirus: Singapore Government to foot bills of infected patients at public hospitals, except outpatient expenses. Retrieved from https://www.straitstimes.com/singapore/health/coronavirus-government-to-foot-bills-of-infected-patients-at-public-hospitals

Tzu Chi Foundation (2020, March 4th). Hualien Tzu Chi Hospital Sets up External Negative Pressure Specimen Collection. Retrieved from http://tw.tzuchi.org/en/index.php?option=com_content&view=article&id=1491%3Ahualien-tzu-chi-hospital-sets-up-external-negative-pressure-specimen-collection-&catid=125%3Aepidemic-prevention-for-covid-19&Itemid=369&lang=en

University of Iowa Health Care. (2017) Independent Comparative Study Conducted by University of Iowa Hospitals & Clinics on our TURBO-UV. Retrieved from https://www.mrsa-uv.com/uploads/8/9/7/2/8972491/turbo_uv_report_mh-f.pdf

U.S. Food and Drug Administration (2020). Emergency Use Authorization. Retrieved from https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization

Usdin, S. (2020). WHO reports China making 1.6M COVID-19 diagnostic kits per week, describes therapy and vaccine R&D priorities. Retrieved from https://www.biocentury.com/article/304545/who-china-makes-and-deploys-1-6-million-covid-19-tests-week-the-u-s-is-just-starting-to-ramp-up-capacity

Vashist, S. K. (2020). In Vitro Diagnostic Assays for COVID-19: Recent Advances and Emerging Trends. Retrieved from https://www.mdpi.com/2075-4418/10/4/202

Visitor Restrictions Due to Coronavirus. UCSF Health. Retrieved from https://www.ucsfhealth.org/for-visitors/visitor-restrictions-due-to-coronavirus

Voytko, L. (2020, April 1st). Overwhelmed NYC hospitals reportedly implementing "Do Not Resuscitate" policies for coronavirus patients. Forbes. Retrieved from https://www.forbes.com/sites/lisettevoytko/2020/04/01/overwhelmed-nyc-hospitals-reportedly-implementing-do-not-resuscitate-policies-for-coronavirus-patients/#7157510b3146

Wang, H., Wang, S., & Yu, K. (2020). COVID-19 infection epidemic: the medical management strategies in Heilongjiang Province, China. Retrieved from https://ccforum.biomedcentral.com/articles/10.1186/s13054-020-2832-8

Watson, I., & Jeong, S. (2020, March 3). South Korea pioneers coronavirus drive-through testing station. Retrieved from https://edition.cnn.com/2020/03/02/asia/coronavirus-drive-through-south-korea-hnk-intl/index.html

Wei, T. T. (2020, April 3). Coronavirus: Singapore Govt will no longer discourage wearing of masks, to give reusable masks to all households. Retrieved from https://www.straitstimes.com/singapore/health/coronavirus-govt-will-no-longer-discourage-wearing-of-masks-to-give-reusable-masks

Weston, M., Macupe, B., & Kiewit, L. (2020, April 1). How to tackle Covid-19 in informal settlements. Retrieved from https://mg.co.za/article/2020-03-27-how-to-tackle-covid-19-in-informal-settlements/?utm_medium=Social&utm_source=Facebook&fbclid=IwAR3Nmfvk3q1DrwOfW8SkWLtI4fsFcbzhZFpNKkAvq1S1L8Edk_6LCL6a-io#Echobox=1585508598

Weston, M., Macupe, B., & Kiewit, L. (2020, April 1). How to tackle Covid-19 in informal settlements. Retrieved from https://mg.co.za/article/2020-03-27-how-to-tackle-covid-19-in-informal-settlements/?utm_medium=Social&utm_source=Facebook&fbclid=IwAR3Nmfvk3q1DrwOfW8SkWLtI4fsFcbzhZFpNKkAvq1S1L8Edk_6LCL6a-io#Echobox=1585508598

WHO. (2014). Hospital Preparedness for Epidemics . Geneva, Switzerland : WHO. Retrieved from https://apps.who.int/iris/rest/bitstreams/674837/retrieve.

WHO Director-General's opening remarks at the media briefing on COVID-19. World Health Organization (WHO). (Press release). 11 March 2020. Retrieved from https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

WHO. (2011). Hospital emergency response checklist . WHO Publication . Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf

WHO. (2011). Hospital emergency response checklist. Retrieved from https://www.who.int/docs/default-source/documents/publications/hospital-emergency-response-checklist.pdf

WHO. (2014). Hospital Preparedness for Epidemics . Geneva, Switzerland : WHO. Retrieved from https://apps.who.int/iris/rest/bitstreams/674837/

Wolfe, C. M., Hamblion, E. L., Schulte, J., Williams, P., Koryon, A., Enders, J., ... & Laney, A. S. (2017). Ebola virus disease contact tracing activities, lessons learned and best practices during the Duport Road outbreak in Monrovia, Liberia, November 2015. PLoS neglected tropical diseases, 11(6), e0005597.

Wong, J., Goh, Q. Y., Tan, Z., & Sui, A. L. (2020, March 11). Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. Retrieved from https://link.springer.com/article/10.1007/s12630-020-01620-9

Wood, D. (2014, March 3rd). 10 Best Practices for Addressing Ethical Issues and Moral Distress. AMN Healthcare Research and Insights. Retrieved from https://www.amnhealthcare.com/latest-healthcare-news/10-Best-Practices-Addressing-Ethical-Issues-Moral-Distress/

World Health Organisation (2008). Outbreak Communication Planning Guide. Retrieved from https://www.who.int/ihr/elibrary/WHOOutbreakCommsPlanngGuide.pdf

World Health Organisation (2020, April 8). Advice on the use of point-of-care immunodiagnostic tests for COVID-19. Retrieved from https://www.who.int/news-room/commentaries/detail/advice-on-the-use-of-point-of-care-immunodiagnostic-tests-for-covid-19

World Health Organisation (2020). Coronavirus disease (COVID-19) technical guidance: Laboratory testing for 2019-nCoV in humans. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/laboratory-guidance

World Health Organisation (2020). The First Few X (FFX) Cases and contact investigation protocol for 2019-novel coronavirus (2019-nCoV) infection. Retrieved from https://www.who.int/docs/default-source/coronaviruse/20200129-generic-ffx-protocol-2019-ncov.pdf?sfvrsn=595eb313_2&download=true

World Health Organisation. (2020, Jan 27). “GREAT NEWS! The editors of major scientific journals have agreed to share any papers about the new #coronavirus (2019-nCoV) with WHO before publication, with authors’ consent. This is important to inform our assessment of the situation, our guidance to countries and actions.” Retrieved from https://twitter.com/WHO/status/1221475167869833217

World Health Organisation. (2020, March 20). “Risk communications should work with influencers in the community such as community leaders, religious leaders, women leaders & local health workers to promote #COVID19 safe practices like hand washing, respiratory hygiene & social distancing”. Retrieved from https://twitter.com/WHO/status/1241012632557150211

World Health Organisation. (2020). WHO Health Alert, Whatsapp Chat. Retrieved from https://api.whatsapp.com/send?phone=41225017596&text=hi&source=&data=

World Health Organization. (2020, February 27). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19) . Interim Guidance. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf

Yap, J. et al. (2020). COVID-19 Science Report: Diagnostics. ScholarBank@NUS Repository. doi:10.25540/e3y2-aqye

Yee, Y. W. (2020, May 11). Coronavirus: SafeEntry applications surge ahead of reopening of businesses. Retrieved from https://www.straitstimes.com/tech/safeentry-applications-surge-ahead-of-reopening-of-businesses

Zhejiang University School of Medicine. (2020). Handbook of COVID-19 Prevention and Treatment .

Zheng, Z. (2020, April 4th). NParks develops nifty real-time map showing crowd levels at most green spaces in S'pore. (n.d.). Retrieved from https://mothership.sg/2020/04/nparks-map-parks-crowd-level/

Zimmerman, B., Reason, P., Rykert, L., Gitterman, L., Christian, J., & Gardam, M. (2013). Front-line ownership: generating a cure mindset for patient safety. Healthc Pap, 13(1), 6-22. Retrieved from https://pdfs.semanticscholar.org/a30f/63a5c4166ee3bbafd322e344e318fc15c501.pdf?_ga=2.44008805.1900567441.1585215661-1409620267.1585215661

Zimmerman, B. (2016, December 7th). A culture of support: 4 ways to improve hand hygiene compliance. Beckers Hospital Review. Retrieved from https://www.beckershospitalreview.com/quality/a-culture-of-support-4-ways-to-improve-hand-hygiene-compliance.html

To learn more about our work, please visit edenstrategyinstitute.com or contact us at query@edenstrategyinstitute.com.