MINUTES

GOVERNMENT AFFAIRS COMMITTEE

APRIL 22, 2020 (EARTH DAY)
9:00 AM – 10:30 AM EDT

GO-TO MEETING

Approved at GAC June 9, 2020 Meeting.

ATTENDANCE

MEMBERS PRESENT: Walid Chakroun, Chair
Terry Townsend, Vice Chair
Michael Bilderbeck
Chris Gray
Larry Fisher
Sheila Hayter
Bill McQuade
Ross Montgomery
Andy Manos
Matt Jesson
Ryan Williams
Louis van Belle
Kinga Porst Hydras
Rob Hoadley
Tim Ashby
Chad Smith
Andrea Phillips
Colin Laisure-Pool
Daryl Collerman
Stephen Gill
Eduardo Conghos
Sam Hui
Gian Modgil
Roger Jones
Dunstan Macauley
Mick Schwedler

MEMBERS ABSENT: None

Shaping Tomorrow's Built Environment Today

GUESTS PRESENT:	Eileen Jensen, Incoming GAC Member Steve Emmerich, Incoming GAC Member Meghan McNulty, Incoming GAC Member Nanette Lockwood, Incoming GAC Member Thomas Reyes, Incoming GAC Member Nate Heffner, Incoming GAC Member George Pantelidis, Incoming GAC Member
STAFF PRESENT:	Alice Yates Jeremy Pollack Emily Porcari Patricia Ryan

CALL TO ORDER, WELCOME AND ROLL CALL

Mr. Chakroun called the meeting to order at 9:01 a.m. EDT and welcomed the members. A quorum was present. Mr. Chakroun read the summary of the ASHRAE Code of Ethics.

> *In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, inclusiveness and respect for others, which exemplify our core values of excellence, commitment, integrity, collaboration, volunteerism and diversity, and we shall avoid all real or perceived conflicts of interests.*
> *(Code of Ethics:* https://www.ashrae.org/about/governance/code-of-ethics)
> *(Core Values:* https://www.ashrae.org/about/ashrae-s-core-values)

REVIEW OF AGENDA

Mr. Chakroun reviewed the agenda. Mr. Hoadley asked to add to the agenda a discussion of the impacts on the committee of COVID-19; Mr. Fisher asked to add to the agenda a discussion of the Global Training Center.

APPROVAL OF MINUTES FROM FEBRUARY 1, 2020 MEETING

MOTION: To approve the minutes of February 1, 2020 as written.

Motion made by Mr. Gill and seconded by Mr. Montgomery.

MOTION PASSED: APPROVED BY VOICE VOTE (CNV)

UPDATE ON ACTION ITEMS

Ms. Yates reported that all the action items are complete (see Attachment A).

SUBCOMMITTEE REPORTS AND MBO STATUS REPORTS

The GAC Subcommittee Chairs provided their reports, along with the status of MBOs assigned to each. MBO status updates can be found in Attachment B.

Executive Subcommittee

Mr. Chakroun reported that the ASHRAE Epidemic Task Force on COVID-19 has been meeting regularly, and to date has received 22 questions from government officials or agencies. Staff will be working with the RVCs to ensure a response is sent to the official that asked the question, and ensuring follow-up on each government inquiry. All of these communications are also being logged into FiscalNote. ASHRAE has also written a letter the World Health Organization, and another general letter to government officials that can be used for a variety of audiences; please use the general letter to help get the word out on the important work that ASHRAE is doing.

The Refrigeration Committee has reached out to GAC for a liaison, and we are working to identify a member for this role. The Executive Subcommittee will be meeting one more time before the final full committee meeting.

Policy and Programs Subcommittee

APPROVAL OF PPIBs

Mr. Gill reported that the subcommittee has been focusing on the PPIBs, and the subcommittee approved five PPIBs at their last meeting on April 8. Ms. Hayter revised the Resiliency PPIB to include a statement on cybersecurity; that addition was also agreed to by the subcommittee. GAC members noted the PPIBs are really helpful for communicating with government officials, as they provide the official ASHRAE position; it is imperative they are included in the GAC training, as they are often under-utilized resources.

MOTION: To approve the five PPIBs listed below en-bloc.

i. Climate Change and the Built Environment
ii. Environmental Tobacco Smoke
iii. STEM Education & Workforce
iv. Resiliency in the Built Environment
v. Utilizing Energy Metrics and Building Benchmarking to Improve Whole Building Energy Performance.

MOTION PASSED: APPROVED BY VOICE VOTE (CNV).

Member Mobilization Subcommittee

Mr. Smith reported that he has stood up an Ad-Hoc committee to focus on better defining Government Outreach Days, and established metrics and reporting mechanisms to better track their impact. This ad-hoc will give its final report at the last subcommittee meeting.

Even though the coronavirus has derailed multiple Government Outreach Days, significant progress was already made with respect to meeting GAC's goals; if the remaining events could be conducted virtually, the goals can be met. But even if virtual meetings aren't able to be planned, substantial progress was made.

Global Affairs Subcommittee

Mr. Conghos reported that the subcommittee has held two meetings since Orlando, and they are making progress on a number of fronts. The subcommittee also provided feedback to the Epidemic Task Force concerning questions that governments are asking about the coronavirus.

Rules Subcommittee

Mr. Townsend reported that no one has submitted any changes to him on the documents the subcommittee oversees.

Nominating Subcommittee

Ms. Hayter reported that the subcommittee has completed its work for the year.

REPORTS FROM COUNCIL LIAISONS

Technology Council

Mr. Bilderbeck reported that Technology Council approved the Position Document on Infectious Aerosols.

Members Council

Mr. Gray reported that Members Council is working prepared to support the chapters, especially as it spreads from the big cities; effective messaging of this support and ASHRAE's resources is critical.

Publishing and Education Council (Mr. Fisher)

Mr. Fisher provided a written report (See Attachment C) and highlighted that the April 21 webinar on UVGI by Bill Bahnfleth is attracting a lot of interest, and they already have about 900 registrants.

EX-O REPORT

Mr. Macauley reported that the ETF is doing incredible work, and they are working at such a rapid pace in getting content prepared, assembled and disseminated. Mr. Macauley also reported that the Annual Meeting will be held as a virtual conference, and details are forthcoming.

COMMUNICATIONS COORDINATOR REPORT

Mr. Jones reported that his quarterly communications report was completed, and submitted on Monday and distributed to the committee.

REPORTS FROM REGIONAL VICE CHAIRS
The RVCs provided reports, and highlights are documented below. Full year-end reports will be delivered at the final GAC meeting.

- Region I - Mr. Manos reported they conducted a meeting with a Long Island legislator and offered support and resources on COVID-19; Mr. Manos also noted that the new GAC Business cards are very helpful.

- Region II – Mr. Hoadley reported that due to the coronavirus, they lost 2 government outreach events, including the large flagship event in Ottawa. Hoadley has also passed along information on COVID-19 resources to the New Brunswick Department of Transportation and Infrastructure and the Health Authority.

- Region III – Ms. Porst Hydras reported that the Virginia Government Outreach Day is on hold, and they are thinking about holding it virtually.

- Region IV – Mr. Ashby reported that the February 11 Atlanta event was very successful and several contacts were made. Due to the coronavirus, outreach days in South Carolina and North Carolina were cancelled. The region has also sent out coronavirus resources to various government entities. Mr. Ashby is currently working in the state Emergency Operations Center: **Thank you, Tim!!**

- Region V – Mr. van Belle reported that their Western Michigan Government Outreach Day was held in a different format, where they met with their elected officials in a restaurant; it's important to continue to think creatively about how these events can be planned and carried out. Local meetings can also provide a more direct link with elected officials in a less formal setting. The region is also working on PDH requirements for Indiana, and meeting with members of the professional licensing association.

- Region VI – Mr. Jesson reported that the region has been very successful in conducting Government Outreach Days in Iowa, Minnesota, and Wisconsin. Iowa also used an

innovative approach and set up an exhibit at which government officials stopped by and exchanged information. Due to coronavirus, the Missouri outreach event was cancelled.

- Region VII – Mr. Williams reported that they are working to get out information on ASHRAE Standards that can help improve air quality.

- Region VIII – Mr. Smith reported that he met with a Senator's office virtually, which was a successful event. Work at the state level has been impactful as more elected officials have committed to help us craft the language and sponsor legislation on energy code adoption in next years legislative session.

- Region IX – Ms. Phillips reported that two of their outreach days were cancelled, and they are considering doing virtual outreach. She is also working to ensure chapters are submitting their outreach reports.

- Region X – Mr. Laisure-Pool reported that the Arizona outreach day was cancelled and although they tried to do an online meeting, it didn't work out. With respect to their CRC, he is going to do online training with his GAC Chairs.

- Region XI – Mr. Collerman reported that their Ottawa outreach event was cancelled, which is disappointing as several important meetings were arranged.

- Region XII – Mr. Conghos reported they are conducting many webinars on COVID-19 and the attendance has been high. The online webinars are attracting more attendees than in-person meetings or trainings; this is one of the few positive aspects of the coronavirus.

- Region XIII – Mr. Hui reported that they are working with the ETF to respond to questions on the coronavirus from Japan and Singapore chapters. The Region is also promoting various webinars. Attachment D provides examples of these webinars.

- Region XIV – Mr. Gill reported that they have also had to cancel events, but they have conducted a number of webinars, including one from London that was shared with other Associations. Mr. Gill also reported that **June 26 is World Refrigeration Day**, and we should be getting out the message on this day.

- Region at Large - Mr. Modgil reported that they have held a number of successful Government Outreach Days, including with the Ministry of Electronics, which Jeff Littleton also attended. RAL has distributed lots of information on COVID-19 resources, and are holding several webinars on the topic.

OTHER BUSINESS

Preview for GAC - SY2020-2021

Mr. Townsend, as the incoming GAC Chair, provided a preview of what he envisions the committee will accomplish in SY 2020-21. Mr. Townsend wants to:

- Work more quickly and get information at the "speed of business," and be more proactive
- Continue the mentorship program, which was started this year
- Invite incoming GAC subcommittee chairs to participate in the May 13 Executive Subcommittee planning meeting
- Encourage members to "do their homework" in advance of meetings, including the Executive Subcommittee planning meeting
- Continue to focus on Government Outreach Days, continue to broaden the focus to include local level outreach, including with code officials and building commissioners (and possibly conducting training for these groups), and shift to thinking about them as "Government Outreach Daily"
- Develop a network of government chiefs of staff for accelerated outreach efforts
- Work with his incoming Vice Chair Chad Smith to develop a "2030 vision" for the GAC

Impacts on Committee Resulting from COVID-19

Mr. Hoadley wants to provide better information about ASHRAE support of its chapters in conducting virtual outreach and best practices, along with tools for holding virtual meetings.

> **Action Item:** Ms. Yates will distribute information to the GAC RVCs on ASHRAE support for virtual meetings. DUE DATE: ASAP

Global Training Center

Mr. Fisher discussed that the Global Training Center (GTC), which was overseen by Steve Comstock, will be overseen by Pub-Ed after Steve's retirement. Mr. Fisher also indicated that the Board will be discussing the future of the GTC.

> **Action Item:** GAC members should send ideas to Ms. Yates on why the GTC is important to the GAC in terms of government outreach. Ms. Yates will then assemble these ideas and write a letter from the GAC to the GTC Oversight Committee and ExCom, as well as Members Council for informational purposes. DUE DATE: May 29

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NEXT COMMITTEE MEETING

Mr. Chakroun announced the next committee meeting will be the last of the year, and will be held as part of ASHRAE's Virtual Conference. GAC subcommittees will be meeting about two weeks prior to this final meeting.

ASHRAE VIRTUAL MEETING
Tuesday, June 9, 2020
8:00 a.m. – 12:00 p.m. EDT

ADJOURN

Mr. Chakroun adjourned the meeting at 11:01 a.m. (EDT).

Respectfully submitted,
Alice M. Yates, Staff Liaison

ACTION ITEMS

GOVERNMENT AFFAIRS COMMITTEE

Last Updated: March 6, 2020

#	Action	Assigned To	Due Date	Status	C/O
1	Compile lessons learned from GAC members regarding what has been helpful for engaging Chapter Chairs, and for getting members to serve in the GAC Chair positions.	Chad Smith (Member Mobilization)	Next Committee Meeting	This is an ongoing task, so it will be marked as complete.	C
2	Evaluate naming a GAC liaison to the YEA Committee.	Walid Chakroun	Next GAC meeting	This will be Walid's appointment to make for SY19-20. June 12, 2019 -Appointment letter sent to Sheila Hayter. June 13, 2019 – Hayter accepted.	C
3	Work with the Marketing Department to make revisions discussed at the October 30, 2019 GAC meeting to the draft GAC Business Card.	Alice Yates	Winter Meeting	Revisions made, and business cards will be distributed to GAC Members at the Winter Meeting.	C
4	Request that Technology Council through the staff liaison provide resources on coronavirus, which will be distributed to GAC members so that these can be provided to government officials worldwide.	Alice Yates	ASAP	Email was sent to the staff liaison on February 4. On February 28, a new webpage was published on the ASHRAE website with these resources, and shared with the GAC, with direction given to the RVCs to share with their chapters. ashrae.org/COVID19.	C
5	Investigate with Fiscal Note staff whether the Government Outreach Day form can be electronically linked to Fiscal Note.	Staff	April 22	The number of forms received hasn't been a bottleneck to reporting in Fiscal Note. The issue is that these forms are not being submitted; the MMSC Chair will be following up with	C

#	Action	Assigned To	Due Date	Status	C/O
				RVCs to press GAC Chapter Chairs to submit reports on their Government Outreach Days.	

GAC MBOS
SY2019 - 2020

Updated: 04-20-2020

MBO	Subcommittee Assigned	Status
1. Contact at least one government entity and collaborate with at least one aligned organization in each region to help in successful government outreach.	Member Mobilization and Global Affairs	All but 3 regions have conducted an event, or have one planned Will encourage RVCs to connect with aligned organizations in these meetings. GAC will emphasize developing relationships with these organizations, and not just meet with them. A chart has been created by GASC to identify potential allies by region.
2. Develop more efficient processes to enable sharing of resources and information with ASHRAE grassroots members to support the Public Policy Priorities and inform government officials in every region across the globe.	Member Mobilization	The GAC webpages have been revised and updated; the pages are now more consistent, concise and navigable, making it easier for ASHRAE members and government officials to identify the resources they need. In addition, the new software FiscalNote provides helpful code alerts to the RVCs; it's critical that the RVCs get this information out to the Chapters.
3. Identify areas for which ASHRAE can lead proactively in the future.	Policy & Programs	The following areas have been identified: • Resilience • Next generation refrigerants • Targeting jurisdictions that have 2030/2050 climate goals and other energy efficiency goals The PPSC has created PPIBs on Resiliency and Refrigerants.
4. Build bridges with intergovernmental organizations to introduce them to ASHRAE as the leading source for technical HVACR information.	Executive Subcommittee	GAC Chair met with UNEP in Washington, DC, and UNEP also attended the GAC Training and the full GAC meeting in Orlando. Staff has included a link to the UNEP Refrigerants webpage from the ASHRAE Government Affairs website. GAC has contacted the World Health Organization regarding COVID-19 resources.

MBO	Subcommittee Assigned	Status
5. Provide support to chapters outside North America utilizing both the Government Affairs Office in Washington and the Global Training Center in Dubai and the ASHRAE staff office in Europe.	Executive Subcommittee	Steve Comstock has been providing updates, and also sharing information with Stephen Gill, RVC for Region XIV. GAC will continue to strengthen the relationship with Brussels and the Dubai Training Center.
6. Develop and implement programs to promote awareness and use of Building EQ (in cooperation with the Building EQ Committee)	Member Mobilization	A flyer has been developed, along with a presentation. The Building EQ Committee has also made itself available to provide briefings for government officials.
7. Develop implementation plan for promoting ASHRAE standards for use in the residential market. For the international audience, promote the *customized* version of 90.2 to be used in different part of the world. Examples: Kuwait and Saudi Arabia.	Policy & Programs and Global Affairs	Walid Chakroun shared his experiences with the Subcommittee about his efforts in Saudi Arabia and Kuwait with 90.2 RAL GAC RVC Gian Modgil is conducting outreach in India including promoting a customize version of standards 90.2 and 188. Gian will report on additional materials that would be helpful for future outreach.
8. Expand Government Outreach Days/DOTH including development of new training materials to include documents, videos and case studies, and extend to Federal Congressional outreach. Work on model Outreach day including materials specifically targeting outside North America Chapters.	Member Mobilization and Global Affairs	Government Outreach days have been significantly expanded, and the GAC is on track to meet its goal of 45 outreach events, as long as scheduled and planned events move forward as virtual meetings. A new training videos is being developed, which will likely be completed in Sept. due to covid-related cancellations of outreach events. A presentation was developed in order to provide training for government outreach to ASHRAE chapters around the world. The GASC has discussed translating certain handouts into local languages. They have looked at the general ASHRAE factsheet. - The Factsheet has been translated into Spanish. - The Factsheet is being translated into French The GASC is tracking annual events and key themes to help with this MBO moving forward.

MBO	Subcommittee Assigned	Status
9. Develop tool to quickly respond to inquiries to better serve the ASHRAE Members.	Member Mobilization	GovAffairs@ashrae.org has been better profiled on the website and some inquiries recently have come in and have been responded to by staff. *Every page* on the Government Affairs website includes an easy "button" for members and visitors to "Share their views." The full GAC also approved a recommended modification to the Manual for Chapter Operations which should enable Chapters to engage more readily with government officials.

4-15-20 GAC Executive Committee Report from PEC liaison Larry Fisher

In reference to PEC Covid activities PEC sent me these items this morning:

- There are mostly free resources here COVID-19 resources page
- 250 registrants for the April 7 online 3-hour ALI course, Designing and Operating High-Performing Healthcare HVAC Systems (Dan Koenigshofer).
- At last count, almost 900 registrants for the April 21 free 1-hour ALI webinar, Reducing Infectious Disease Transmission with UVGI (Bill Bahnfleth)
- I can report that Steve Comstock is home safe in Atlanta after leaving just in time before travel ban to US. Also the GTC is aggressively customizing virtual training instruction for Europe, Middle East, and RAL. This will compose of archived topics (2-6 hour) followed by live instructor led Q&A. Will qualify for PDH's. There is still a high demand for education with often includes government agencies. A virtual training was held 2 weeks ago at $125 a person and had 44 participants from around the world. We had a very diverse group of attendees. Below is the breakdown.

Total # of registrants 44 Non-members 5 Members 39

UNITED ARAB EMIRATES	7
SAUDI ARABIA	5
UNITED STATES	5
MALAYSIA	4
LEBANON	2
INDONESIA	2
SPAIN	2
GREECE	2
OMAN	1
PORTUGAL	1
JAPAN	1
UNITED KINGDOM	1
ITALY	1
NETHERLANDS	1
BELGIUM	1
SOUTH AFRICA	1
BULGARIA	1
SRI LANKA	1
MYANMAR	1
MALTA	1
TURKEY	1
NEW ZEALAND	1
RUSSIA	1

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ASHRAE Hong Kong Chapter – Webinar

Planning and Preparing Health Care Facilities for COVID-19 Pandemic
規劃和準備針對 2019 冠狀病毒病大流行的醫療保健設施

Date	:	23 April 2020 (Thursday)
Time	:	7:00pm – 8:30pm
Venue	:	Zoom Meeting (Meeting ID will be provided for successful applicant)
Fee	:	Free of Charge

Highlights

COVID-19 is a crisis of unprecedented proportions for the whole world. Hong Kong and many other cities in the world are facing significant challenge in public health emergency. As the COVID-19 pandemic evolves, people are increasingly concerned whether and how the hospitals and health systems can cope with the surge of infection and demand. This webinar will examine the engineering principles and strategy for planning and preparing the health care facilities for the emergency management. Experience in different countries is reviewed and relevant guidelines for designing health care facilities are identified.

Learning Objectives

- Understand the engineering principles for health care facilities related to the COVID-19 pandemic
- Explain the strategy for planning and preparing health care facilities and hospitals
- Appreciate the key issues and factors for emergency management in health systems

Medium of instruction

Cantonese with English supplements

Speaker

Sam C. M. Hui, BEng(Hons); PhD; CEng; CEM; BEAP; BEMP; HBDP; MCIBSE; MHKIE; MASHRAE; MIESNA; LifeMAEE; Assoc AIA

Dr. Hui is the Regional Vice Chair – Government Affairs, ASHRAE Region XIII. He is also a Chartered Engineer (CEng) in building services engineering, a Certified Energy Manager (CEM), a Building Energy Assessment Professional (BEAP), a Building Energy Modeling Professional (BEMP), and a High-performance Building Design Professional (HBDP). He has extensive teaching experience in building services engineering and has over 29 years experience in the study of building energy efficiency and sustainable building technology.

Registration

Number of participants is limited and prior registration is required. For registration, please complete Registration Form in the following link: https://forms.gle/jS93Ku2FxFUWAVP69. The deadline of application is on 20 April 2020. Successful members will be notified by e-mail on or before 21 April 2020. If the applicants have not received the confirmation e-mail on or before 22 April 2020, their applications will be regarded as not successful.

For enquiry, please contact our Chapter Program Committee Chair, Mr. Taylor Chow via ashraehk@gmail.com.

ASHRAE Hong Kong Chapter

ASHRAE Hong Kong Chapter - Webinar:
23 Apr 2020 (Thu)

Planning and preparing health care facilities for the COVID-19 pandemic

規劃和準備針對2019冠狀病毒病大流行的醫療保健設施

Ir Dr. Sam C. M. Hui

Regional Vice Chair – Government Affairs, ASHRAE Region XIII

E-mail: sam.cmhui@gmail.com

http://ibse.hk/200423_ASHRAE-HKC_Webinar_SamHui.pdf

Apr 2020

Our appreciation for healthcare and frontline workers

感謝醫護及前線人員

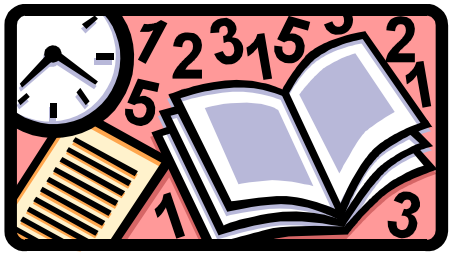
Work Together, Save Lives

Engineers support you in health care facilities

工程師在醫療保健設施中為您們提供支援

攜手合作
拯救生命

About the Speaker



- ***Ir Dr. Sam C. M. Hui*** *許俊民 博士 工程師*

  - PhD, BEng(Hons), CEng, CEM, BEAP, BEMP, HBDP, MASHRAE, MCIBSE, MHKIE, MIESNA, LifeMAEE, AssocAIA
    - CEng = Chartered Engineer
    - CEM = Certified Energy Manager
    - BEAP = Building Energy Assessment Professional
    - BEMP = Building Energy Modeling Professional
    - HBDP = High-performance Building Design Professional
    - LifeMAEE = Life Member, Association of Energy Engineers
    - AssocAIA = Associate Member, American Institute of Architects
  - ASHRAE Distinguished Lecturer (2009-2011)
  - President, ASHRAE Hong Kong Chapter (2006-2007)
  - 29 years teaching & research experience at HKU, CityU and THEi

ASHRAE Overview

Founded in 1894

57,000+
Volunteer Members

130+
countries

Celebrating 125 Years in 2020

7,400+
Student Members
10+
Regions
190+
Chapters
400+
Student Branches

www.ashrae.org

ASHRAE Certification Programs

Certification Program	Relevant Experience and Knowledge
Building Energy Assessment Professional (BEAP)	Building energy audit, building energy management, building services systems (design, installation, and/or management)
Building Energy Modeling Professional (BEMP)	Building energy simulation, energy modeling software, building energy analysis, building services systems (design and/or installation)
Commissioning Process Management Professional (CPMP)	Building testing and commissioning, facilities operations/management, construction, design, or consulting
Healthcare Facility Design Professional (HFDP)	Healthcare HVAC&R design, medical equipment & procedures, healthcare facilities operation & maintenance
High-Performance Building Design Professional (HBDP)	HVAC&R design, sustainability concepts, energy analysis, indoor environment, controls, energy and environmental performance, water conservation, commissioning, building operation & maintenance
Operations & Performance Management Professional (OPMP)	Facility operations/management, construction, design, or consulting, Facility life cycle, O&M program, building performance management, communications, environmental, health & safety

(Source: https://www.ashrae.org/professional-development/ashrae-certification)

ASHRAE Hong Kong Chapter – Webinar

Planning and preparing health care facilities for the COVID-19 pandemic

- **Learning Objectives:**
  - Understand the engineering principles for health care facilities related to the COVID-19 pandemic
  - Explain the strategy for planning and preparing health care facilities and hospitals
  - Appreciate the key issues and factors for emergency management in health systems

ASHRAE Hong Kong Chapter

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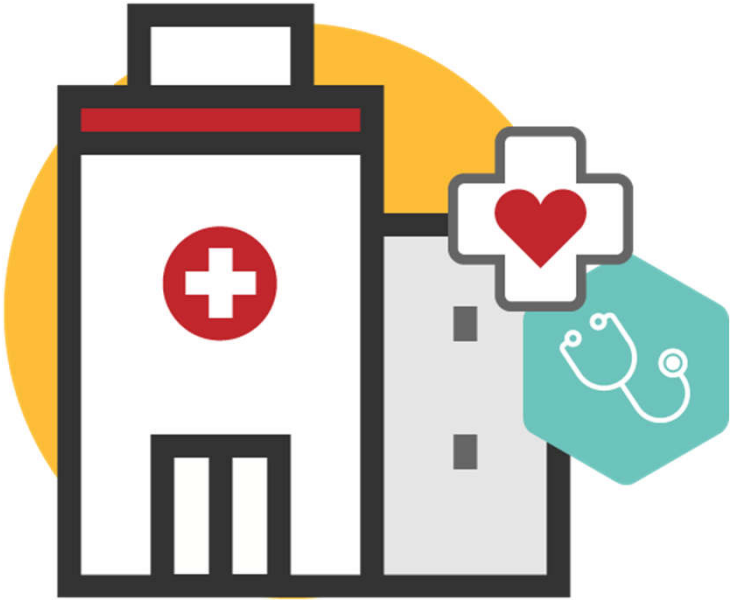
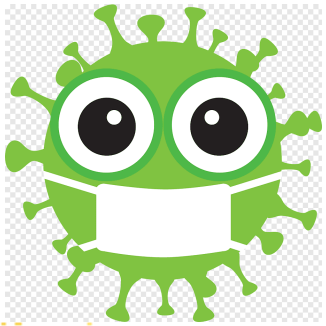
- Introduction
- Engineering principles
- Strategy for planning and preparedness
- Emergency management
- Conclusion

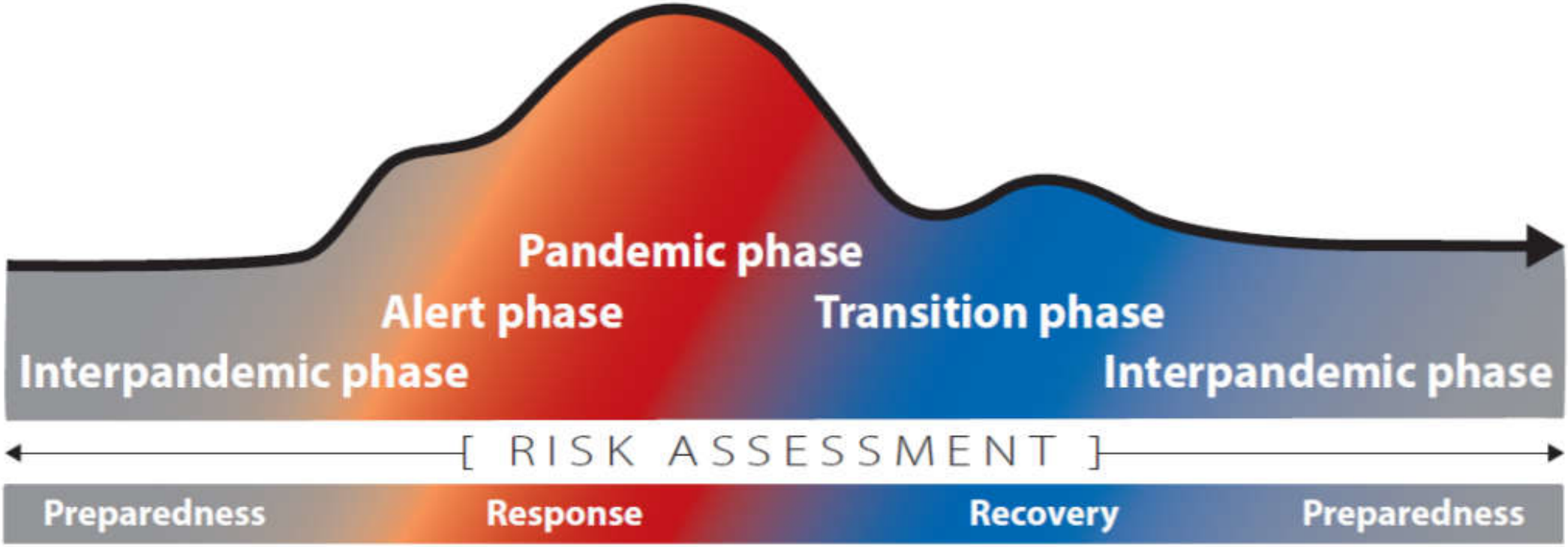


Introduction

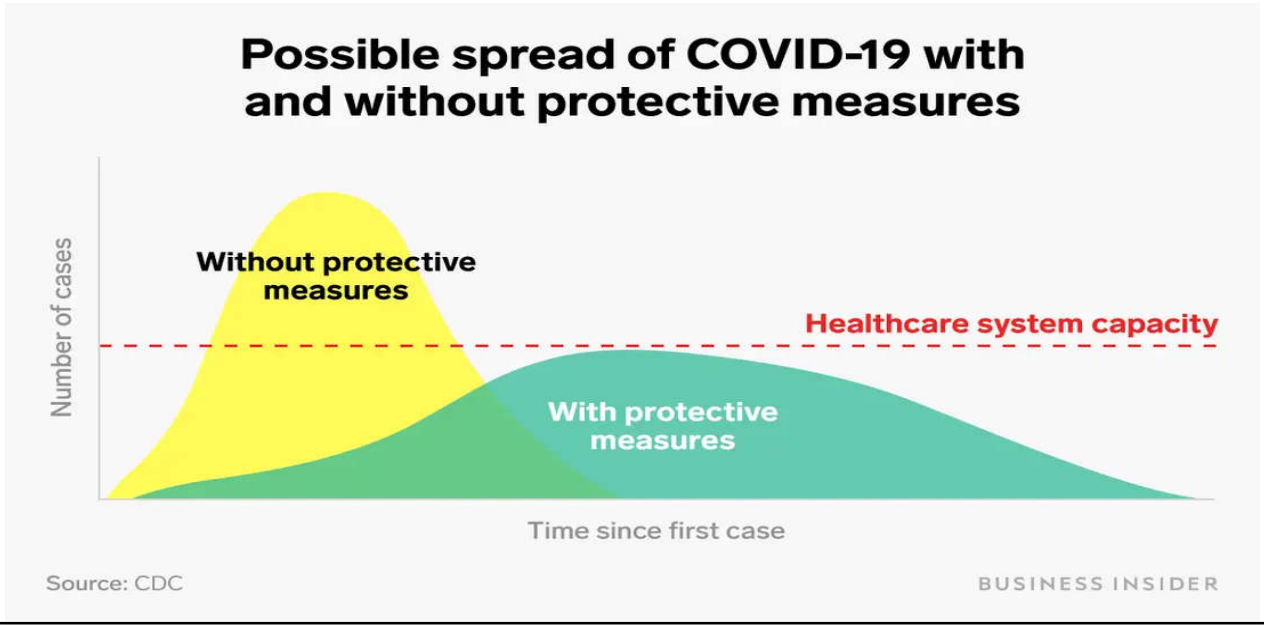


- COVID-19 pandemic 2019冠状病毒病大流行
  - Public health crisis, significant social & economic impacts/consequences
  - The healthcare system is being tested as the pandemic develops
  - Health care facilities are crucial for tackling the epidemic and protecting the health care workers & vulnerable populations
  - Serious questions around capacity & risk
    - Not enough hospital beds, medical devices & protection

The continuum of pandemic phases

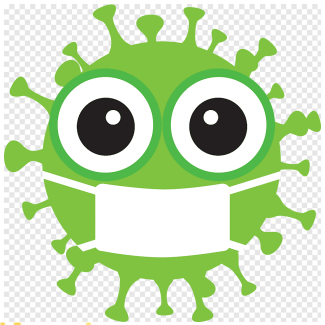


(Source: WHO's Pandemic Influenza Risk Management Guidance, https://www.who.int/influenza/preparedness/pandemic/influenza_risk_management/en/)



Flatten the curve of pandemics growth

Introduction

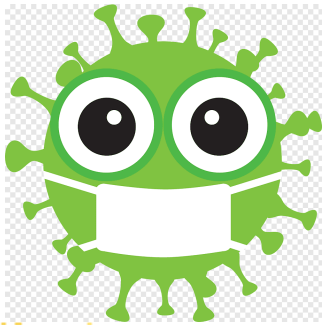


- Hospitals & healthcare systems 醫院和醫療系統
  - The healthcare systems in the world are trying to manage the COVID-19 pandemic
  - Health care facilities include hospital (acute care, psychiatric, rehabilitation), primary care outpatient facilities, ambulatory care facilities, small primary outpatient facilities, outpatient surgical facilities & assisted living facilities
  - Also nursing facilities, dental facilities & supporting facilities

- Ambulatory surgical centers
- Birth centers
- Blood banks
- Clinics and medical offices
- Diabetes education centers
- Dialysis Centers
- Hospice homes
- Hospitals
- Imaging & radiology centers
- Mental health & addiction treatment centers
- Nursing homes
- Orthopedic & other rehabilitation centers
- Telehealth
- Urgent care

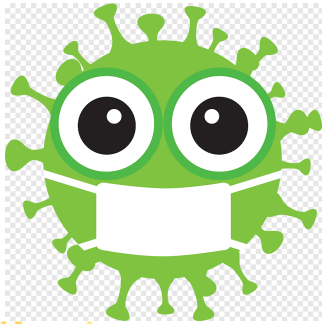
(Source: https://www.rasmussen.edu/degrees/health-sciences/blog/types-of-healthcare-facilities/)

Introduction



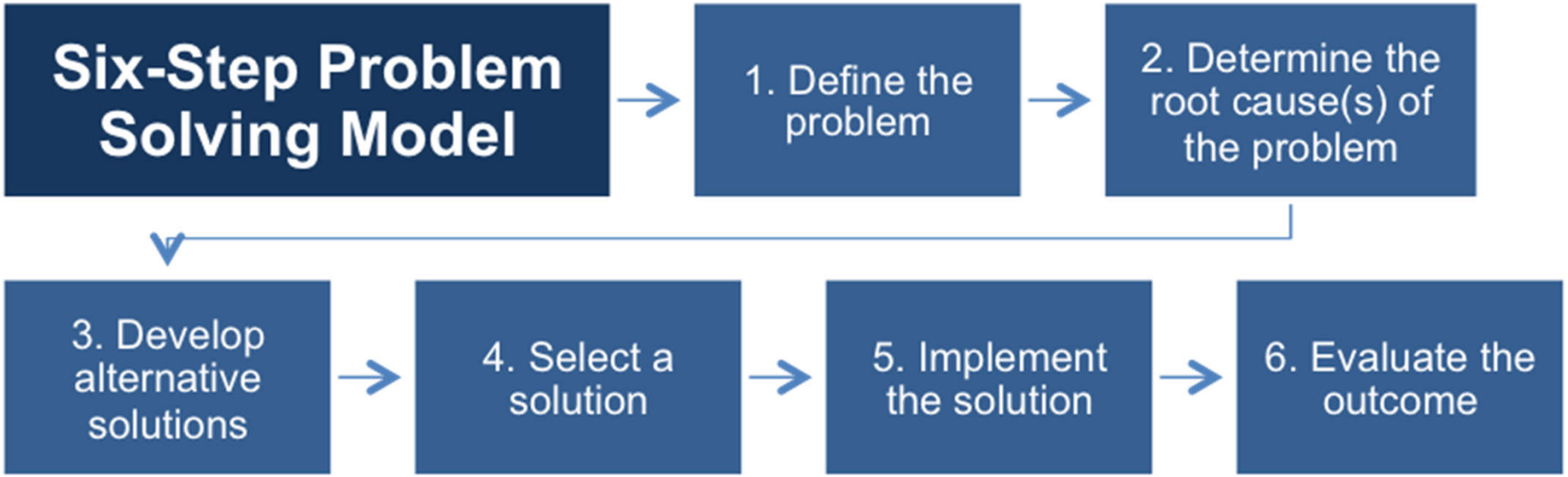
- Three main types of health care facilities:
  - 1. Hospital facilities 醫院設施
  - 2. Outpatient health care facilities 門診醫療設施
  - 3. Residential health care & support facilities 住院醫療和支援設施
- Hospitals are complex large-scale sociotechnical systems involving a large diversity of professions: hospital management, clinical management, equipment & buildings

Introduction

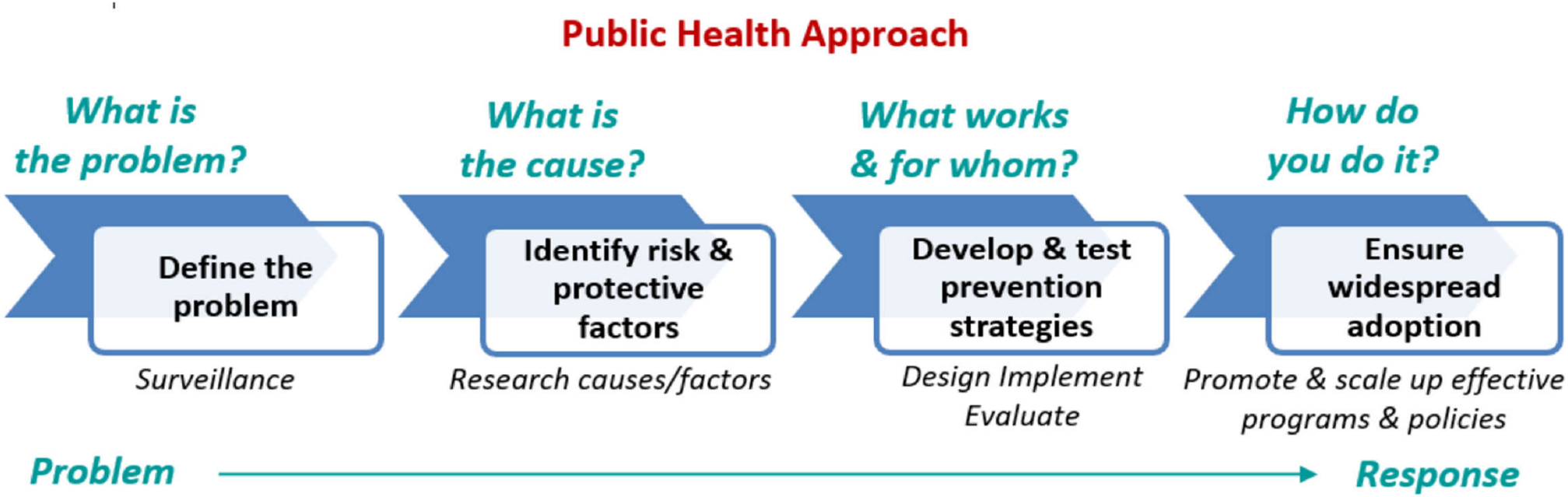


- Healthcare & hospital engineering 醫療保健和醫院工程
  - Fight against infection control in the health care facilities, with support from Architecture & Engineering
  - How to increase the capacity to absorb & effectively manage the surge of COVID-19 patients and maintain other health service
  - Apply engineering approach for problem solving

Engineering approach for problem solving for public health

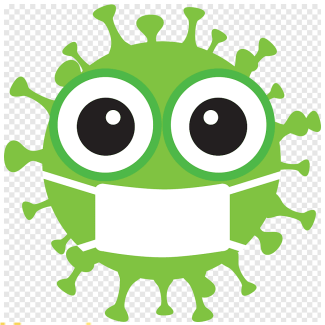


(Source: http://www.free-management-ebooks.com/news/six-step-problem-solving-model/)

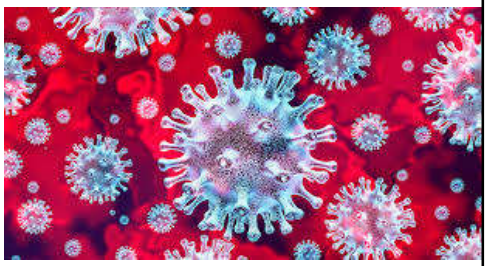


(Source: https://www.nasbla.org/advocacy/public-health)

Introduction

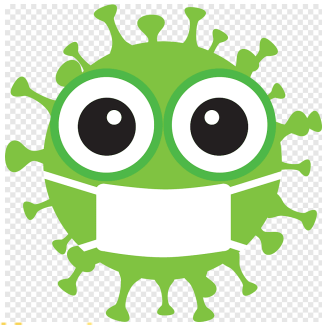


- Identify the key problems of COVID-19
  - Situations many have never encountered (unprecedented crisis)



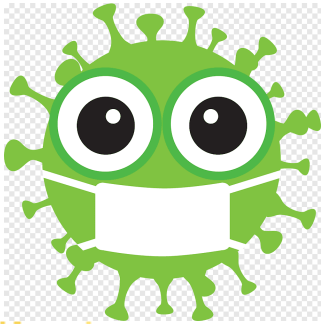
  - "*Invisible enemies*": difficult to trace the virus transmission source & infected persons (e.g. asymptomatic 無症狀的 & pre-symptomatic)
  - No available treatment or vaccination yet
  - Surge of infection & impact on health care service
    - Risk to vulnerable populations & healthcare workers

Introduction



- Engineering systems approach 工程系統方法
  - Use engineering knowledge to support the health care workers & the community
  - Establish & implement a systematic process
  - Main objective: safety of patients, health care workers & visitors
  - Help reduce the load & strain on the frontline health care workers & healthcare system
  - Support/Protect nurses & healthcare teams

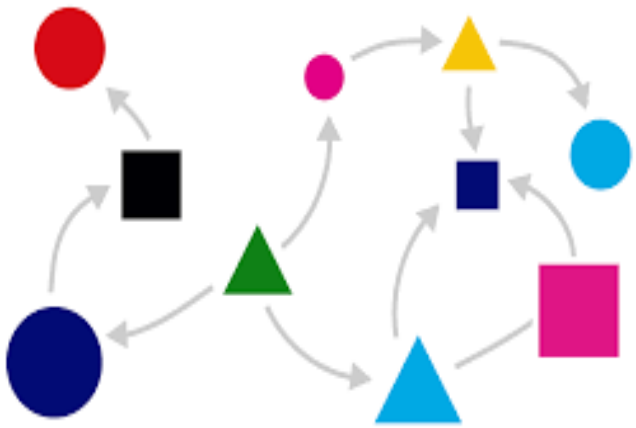
Introduction



- Criteria for measurement of performance:
  - Technical performance, including infection control, comfort, patient outcome
  - Safety, including fire prevention & control and minimizing falls & injuries for employees, visitors, and patients
  - Reliability & minimizing lost revenue
  - Minimizing maintenance costs
  - Minimizing energy costs
  - Adaptability

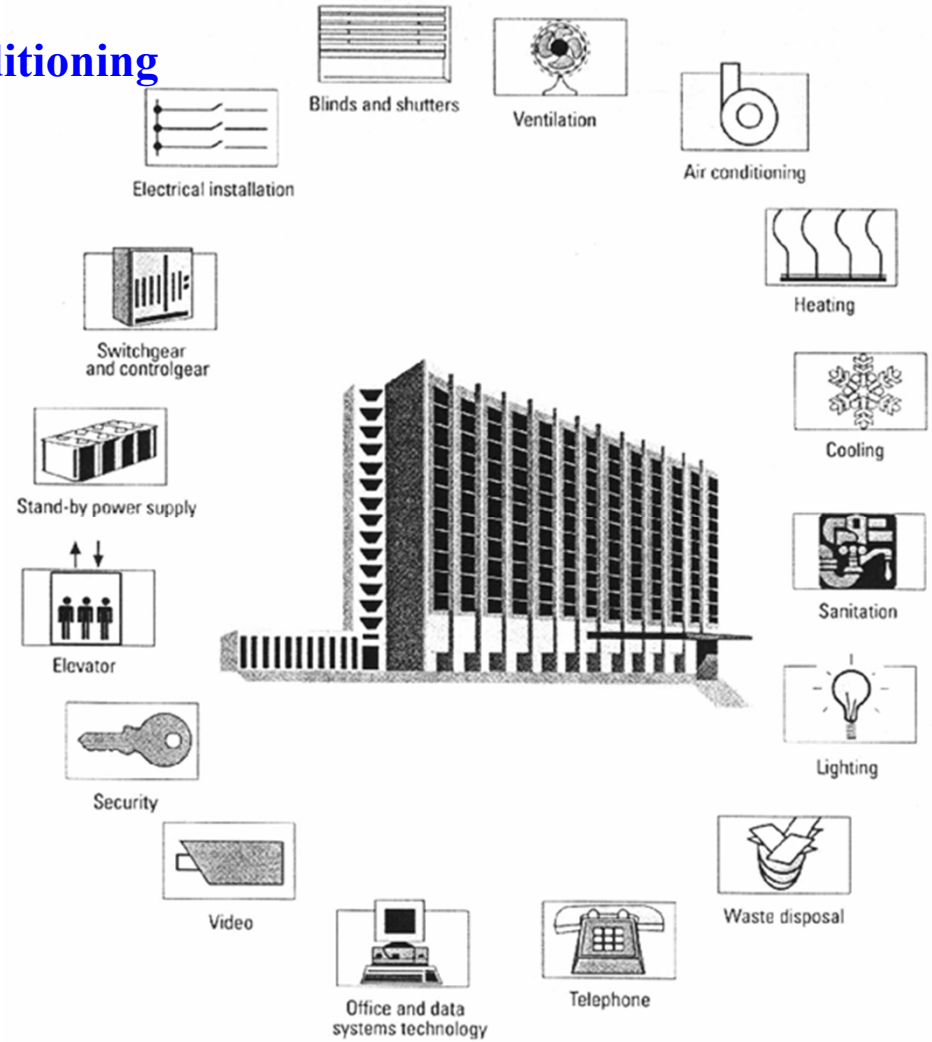
Engineering principles

- An Engineers' system philosophy
  - Systems thinking is applied to the analysis
  - Systems consist of sources and distribution
- Living entities that are:
  - Conceived (design)
  - Born (construction)
  - Assessed (commissioning Cx)
  - Nurtured (operation and maintenance O&M)



Engineering principles

- Typical engineering systems:
  - **HVAC - Heating, Ventilating and Air Conditioning**
  - IC - Instrumentation & Controls
  - BAS – Building Automation
  - F/G - Fuel Oil/Natural Gas
  - LS - Life Safety
  - G/V - Gas/Vacuum
  - P - Plumbing
  - SW - Special Water
  - NP - Normal Power
  - EP - Essential Power
  - LTG - Lighting
  - FAS - Fire Alarm
  - IT - Information Technology
  - FP - Fire Protection



Infection prevention and control (IPC) in health care facilities

PREVENT INFECTIONS SAVE LIVES IN HEALTH CARE

HANDLE ANTIBIOTICS WITH CARE

WHAT'S THE PROBLEM?

- **1 IN 10 PATIENTS** get an infection while receiving care
- **UP TO 20% OF AFRICAN WOMEN** get a wound infection after a caesarean section
- **UP TO 32% OF SURGICAL PATIENTS** get a post-op infection, up to 51% antibiotic resistant
- **50-70% OF INJECTIONS** given in some developing countries are unsafe
- **UP TO 90% OF HEALTH CARE WORKERS** do not clean their hands in some facilities
- **INFECTIONS** can lead to disability, **ANTIBIOTIC RESISTANCE**, increased hospital time and death
- **INFECTIONS CAUSE UP TO 56% OF DEATHS** among hospital-born babies

World Health Organization

PREVENT INFECTIONS SAVE LIVES IN HEALTH CARE

HANDLE ANTIBIOTICS WITH CARE

WHAT'S THE SOLUTION?

- **HAVE ACTIVE INFECTION PREVENTION AND CONTROL PROGRAMMES** and target antibiotic resistance
- **MONITOR INFECTIONS** and make action plans to reduce their frequency
- **USE CLEAN PRACTICES** and asepsis for interventions
- **NEVER RE-USE** needles and syringes
- **PRACTICE HAND HYGIENE** to prevent infections and reduce the spread of antibiotic resistance
- Only dispense antibiotics when **TRULY NEEDED** to **REDUCE THE RISK OF RESISTANCE**
- **HAVE ENOUGH STAFF**, a clean and hygienic environment and don't overcrowd health care facilities

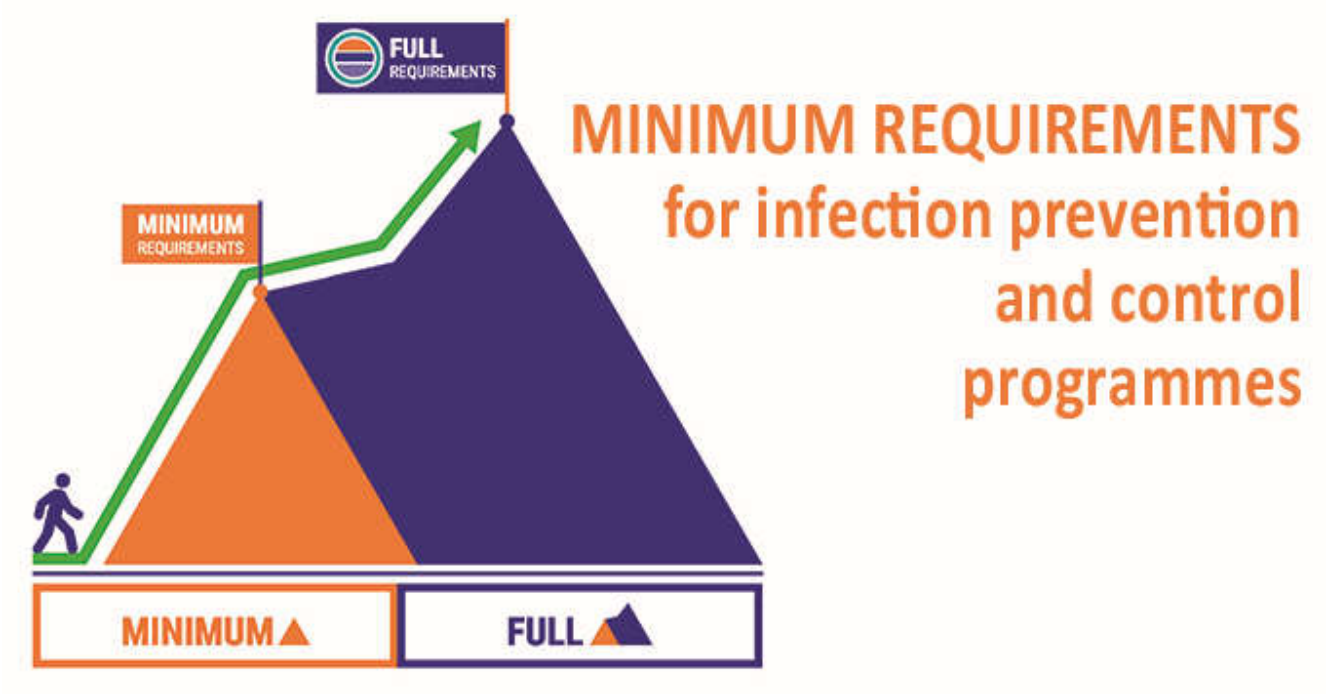
World Health Organization

(Source: WHO Infection prevention and control (IPC) https://www.who.int/infection-prevention/)

Core components of infection prevention and control (IPC) programmes

1. IPC programmes 2. IPC guidelines 3. IPC education & training 4. Health care-associated infection surveillance	5. Multimodal strategies 6. Monitoring, evaluation & feedback 7. Workload, staffing & bed occupancy 8. Built environment, materials & equipment for IPC

World Health Organization



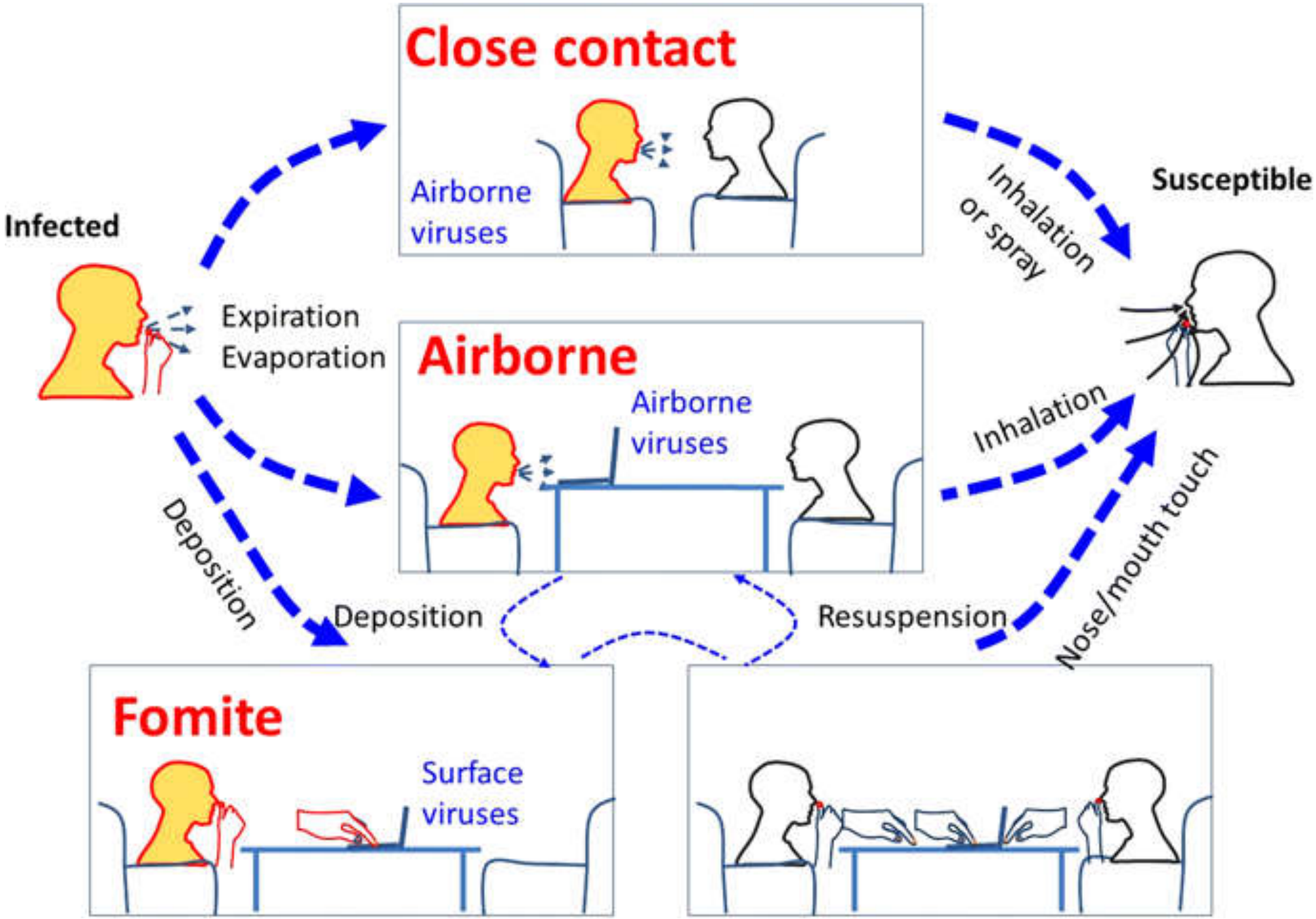
WHO Guidelines:

- Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level https://www.who.int/gpsc/ipc-components-guidelines/
- Minimum requirements for infection prevention and control (IPC) programmes https://www.who.int/infection-prevention/publications/min-req-IPC-manual/
- Improving infection prevention and control at the health facility https://apps.who.int/iris/handle/10665/279788

Engineering principles

- COVID-19 modes of transmission:
  - 1. Droplets sprayed by affected individuals
  - 2. Contact with patient respiratory secretions
  - 3. Contaminated surfaces & equipment
- Infection control risk assessment (ICRA)
  - Symptoms & viral shedding to the environment varied considerably
  - Many commonly used items, toilet facilities, and air samples had evidence of viral contamination

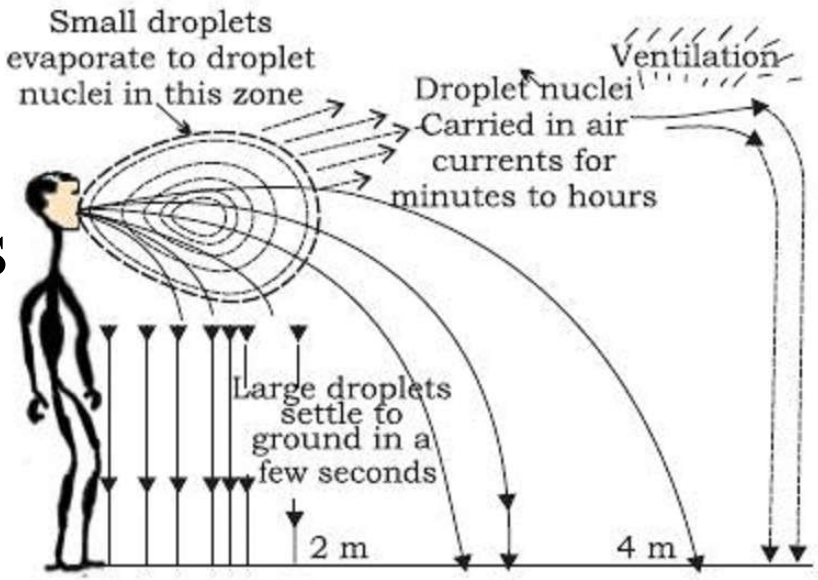
Possible transmission routes of respiratory infection



(Source: Recognition of aerosol transmission of infectious agents: a commentary https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-019-3707-y)

Engineering principles

- Airborne vs contact transmission
  - Disease spread through both direct (droplet & person-to-person) as well as indirect contact (contaminated objects & airborne transmission)
- Basic science
  - Airborne microorganisms
  - Perspective of particle physics
  - Airborne transmissibility
  - Transmission dynamics



Infection prevention & control using environmental/engineering controls

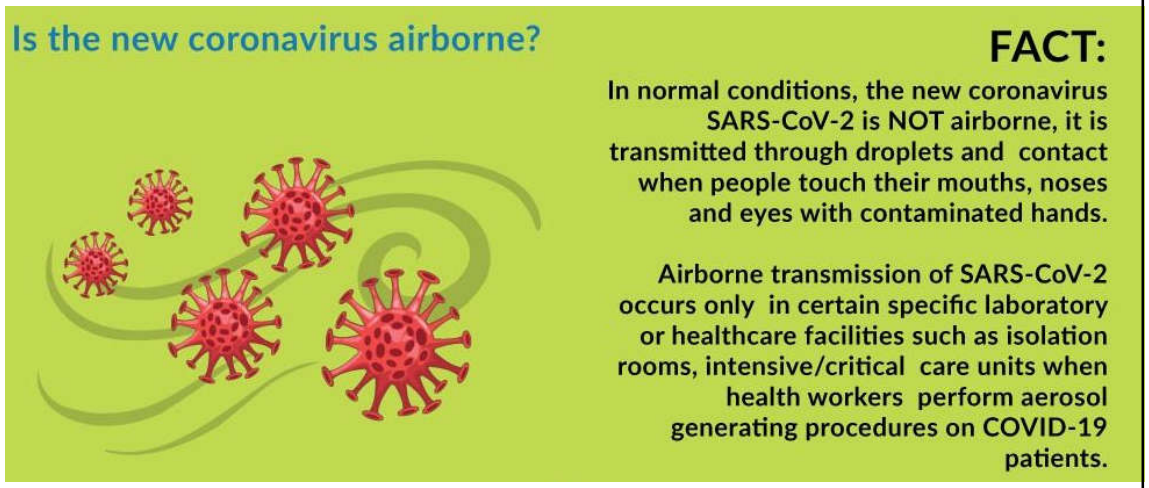
Design criteria:	**Control measures:**
- Infection sources	- Outdoor air ventilation
- Control measures	- Filtration
- Air quality	- Pressure differential
- Air movement	- Anterooms
- Temperature and humidity	- Contaminant source control
- Smoke control	- Temperature and humidity

- Fresh air, ventilation, and isolation are key factors in controlling the spread, all of which have connections to the built environment
- Main issues: filtration, air patterns, air changes, dilution, temperature, humidity, disinfection, and pressurization
- Design principle: "*Airflow from Clean to Less Clean*"

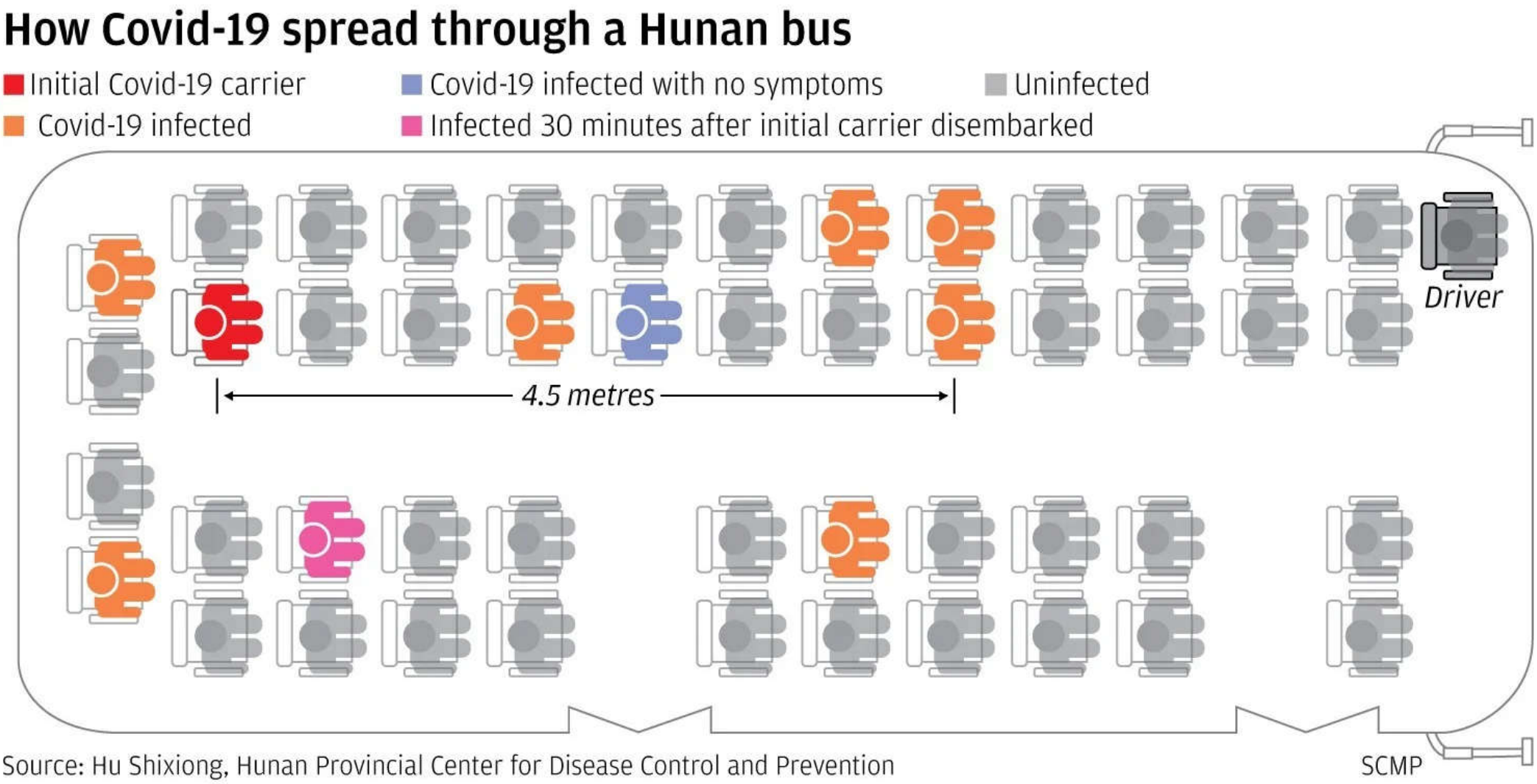
(Source: 2019 ASHRAE Handbook - HVAC Applications, Chapter 9 Health Care Facilities)

Engineering principles

- Prevention strategies for COVID-19:
  - Increase air changes
  - Outdoor air intakes
  - Exhaust air outlets
  - Air filters
  - Disinfection & decontamination
    - Using ultra-violet (UV) light, ionization & chemicals
  - COVID-19 can be transmitted through *aerosols* 氣溶膠
    - Movement & concentration of aerosols can be influenced by the HVAC system

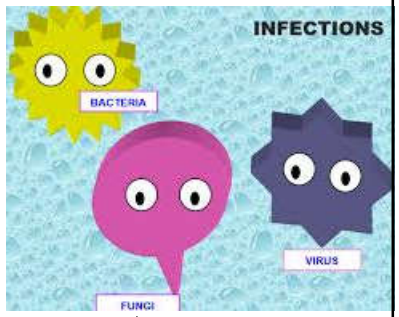


COVID-19 spread through a bus in Hunan, China



(Source: https://www.scmp.com/news/china/science/article/3074351/coronavirus-can-travel-twice-far-official-safe-distance-and-stay)

Engineering principles

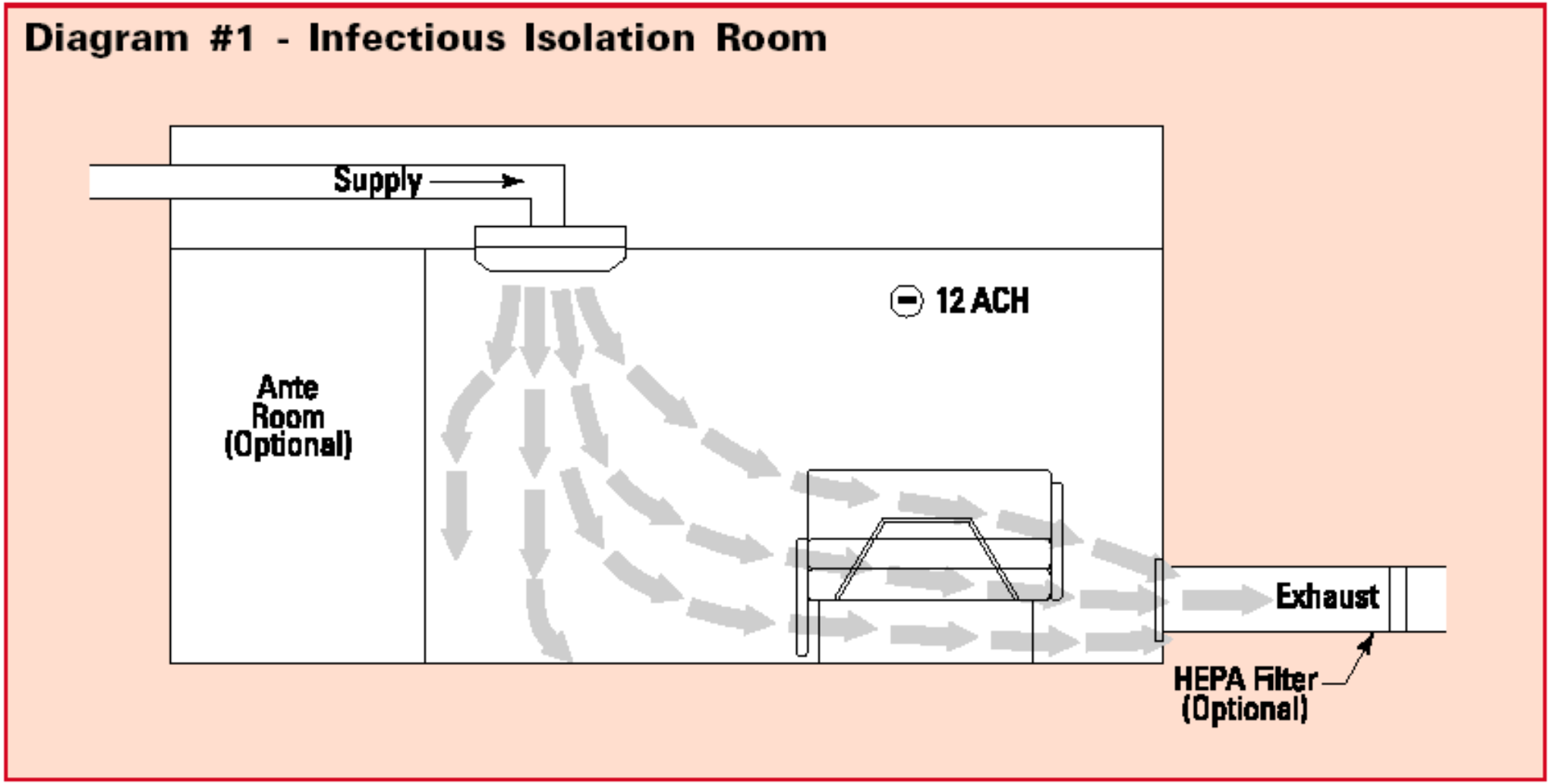


- Hospital-Associated Infections (HAI)
  - Nosocomial infections 醫療照顧相關感染
  - How to maintain clean & hygienic environment
    - Delimitation of the space in critical, semi-critical & non-critical area
    - Physical barriers erected between areas
    - Air contamination control & proper workflow
    - Correct choice of finishing materials
    - Design of isolation rooms, operating rooms, emergency depts & sterile processing

Engineering principles

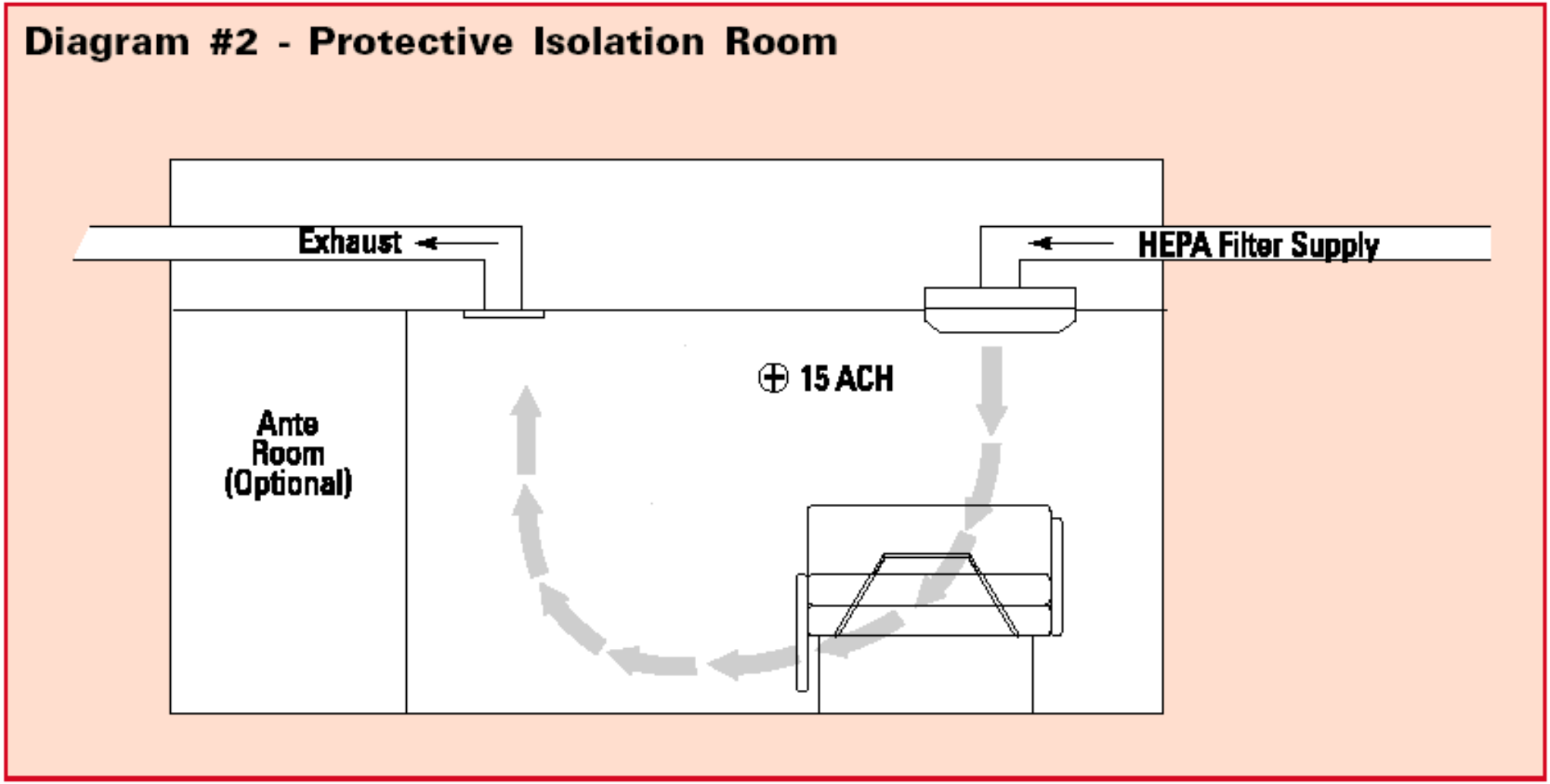
- Types of isolation rooms:
  - Airborne infection isolation (AII) room (for patients having an airborne communicable disease)
  - Protective environment (PE) room (for patients with weakened immune system)
  - Combined AII/PE (for patients suffering from a weakened immune system who also have an airborne communicable disease)
  - Contact isolation (for patients having a communicable disease that is not airborne)

Infectious isolation room



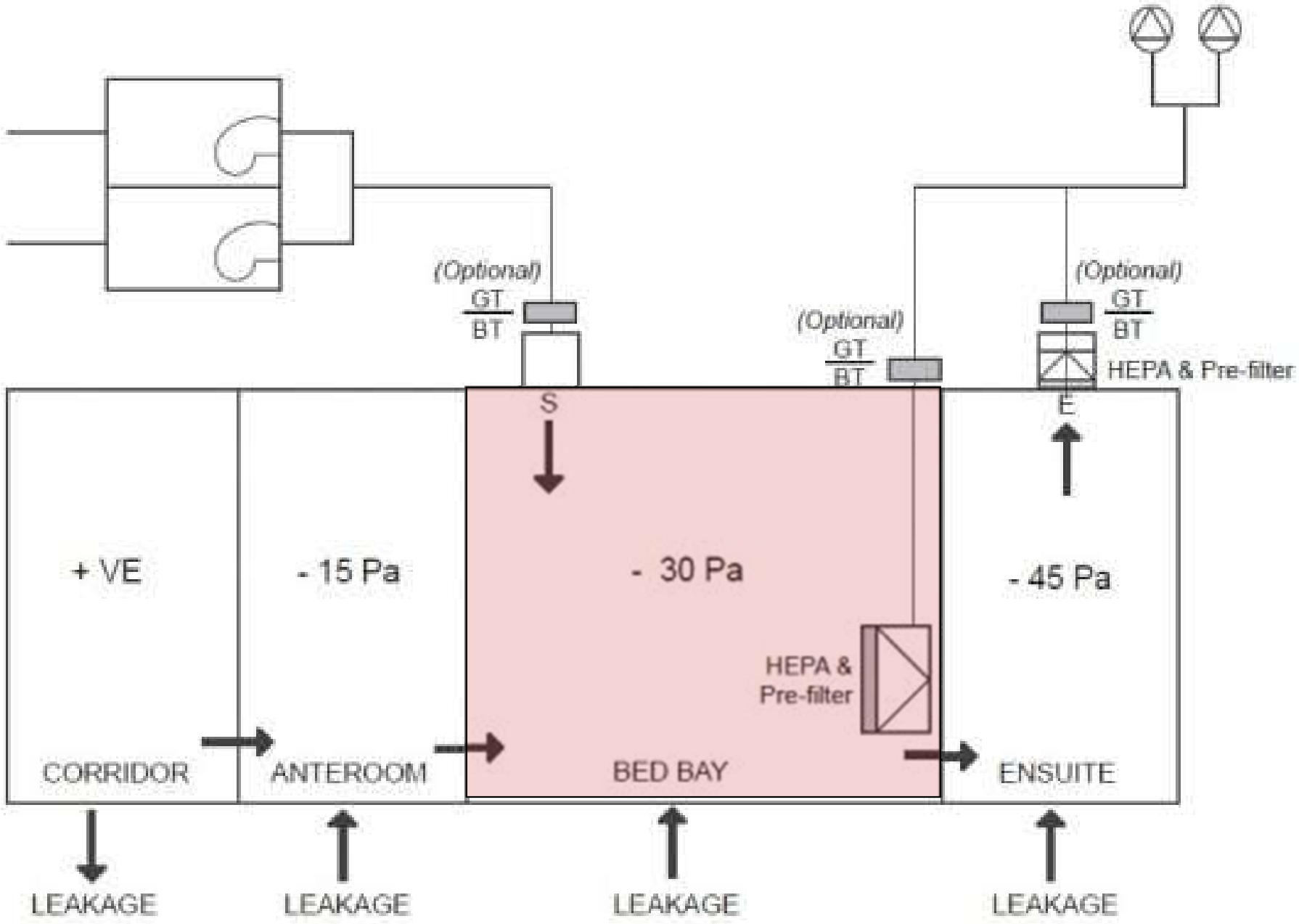
(Source: Source: http://www.price-hvac.com)

Protective isolation room



(Source: Source: http://www.price-hvac.com)

Schematic of isolation room with terminal mounted HEPA filters (pressure balanced)



(Source: Design Considerations for Hospital Class-N Isolation Rooms https://www.airepure.com.au/design-considerations-hospital-class-n-isolation-rooms/)

Engineering principles

- Two important concepts:
  - **Contamination control 污染控制**

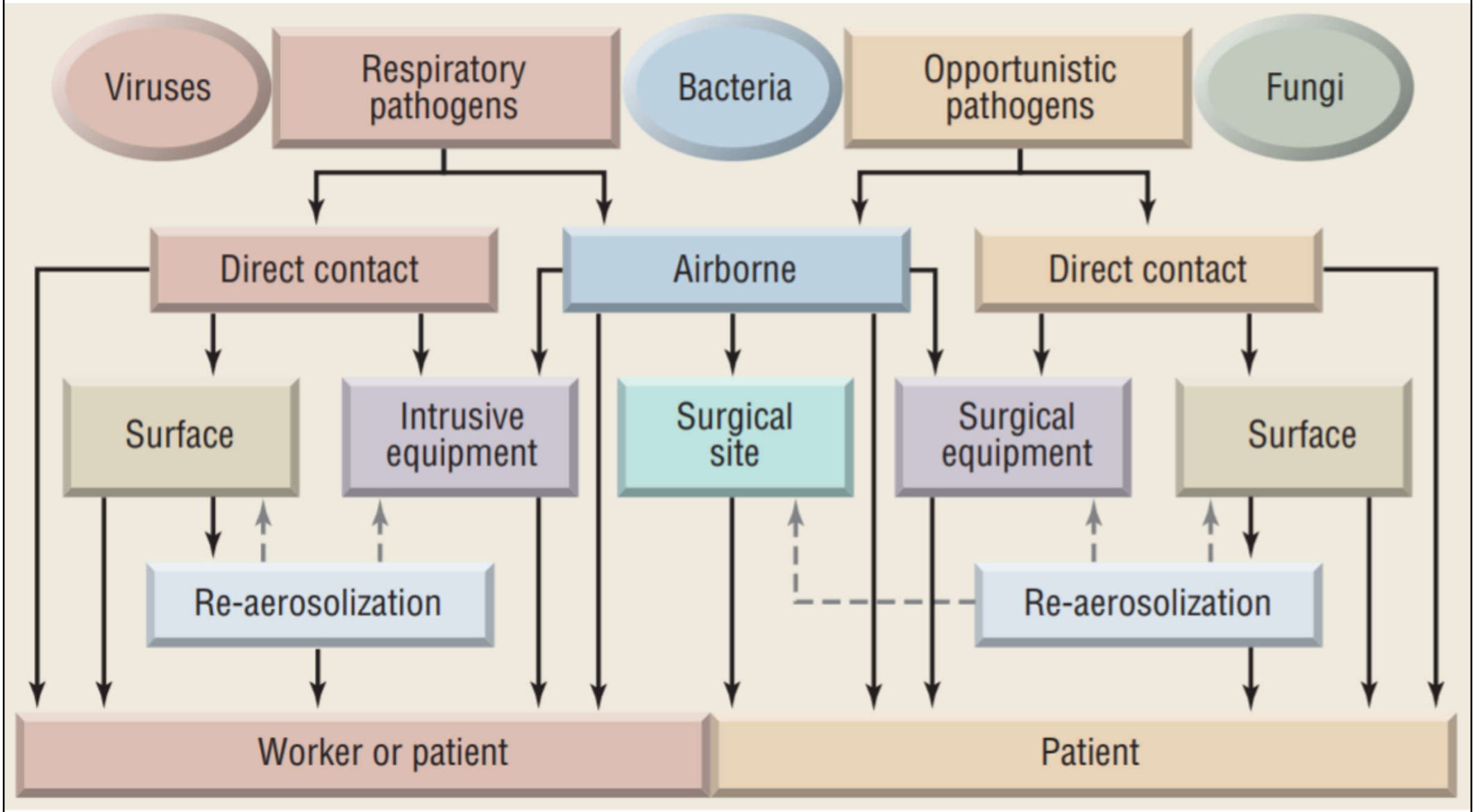
    HVAC is dominant

    - Control the existence, growth & proliferation of contamination in certain areas (e.g. cleanrooms)
    - Achieve asepsis (無菌的) environment -- being free from particulates, particularly bacteria, viruses & fungi
  - **Infection Control 感染控制**

    HVAC is secondary

    - Prevent the spread of infections in healthcare settings
    - Infection equation: the probability of getting an infection
    - *Infection = (Dose x Site x Virulence x Time)/(Level of host defense)*

Major aerobiological pathways of airborne nosocomial pathogens

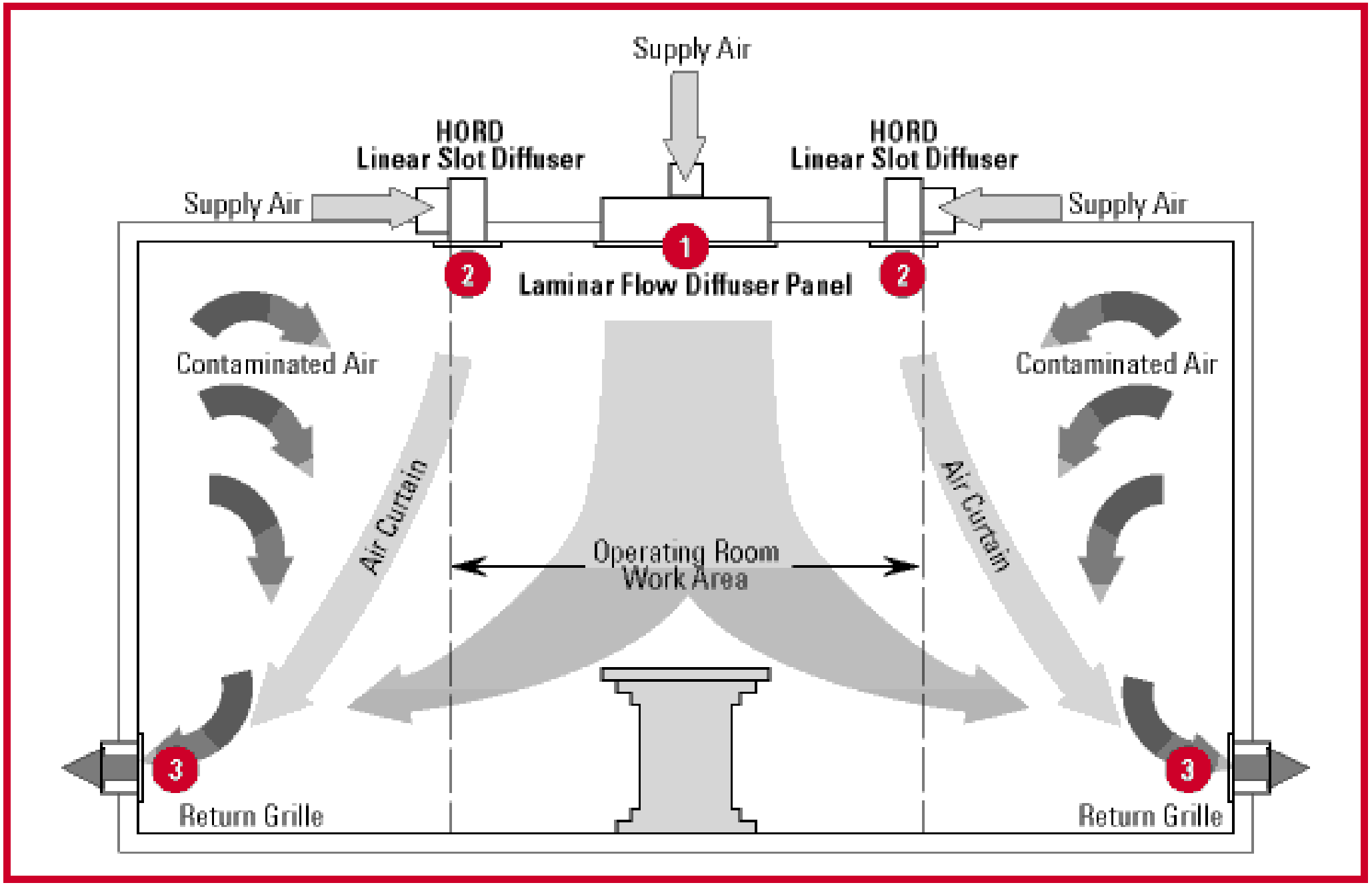


(Source: Kowalski, W., 2007. Air-treatment systems for controlling hospital-acquired infections, *HPAC*, 79 (1): 2-22)

Hospital operating theatre (typical design)

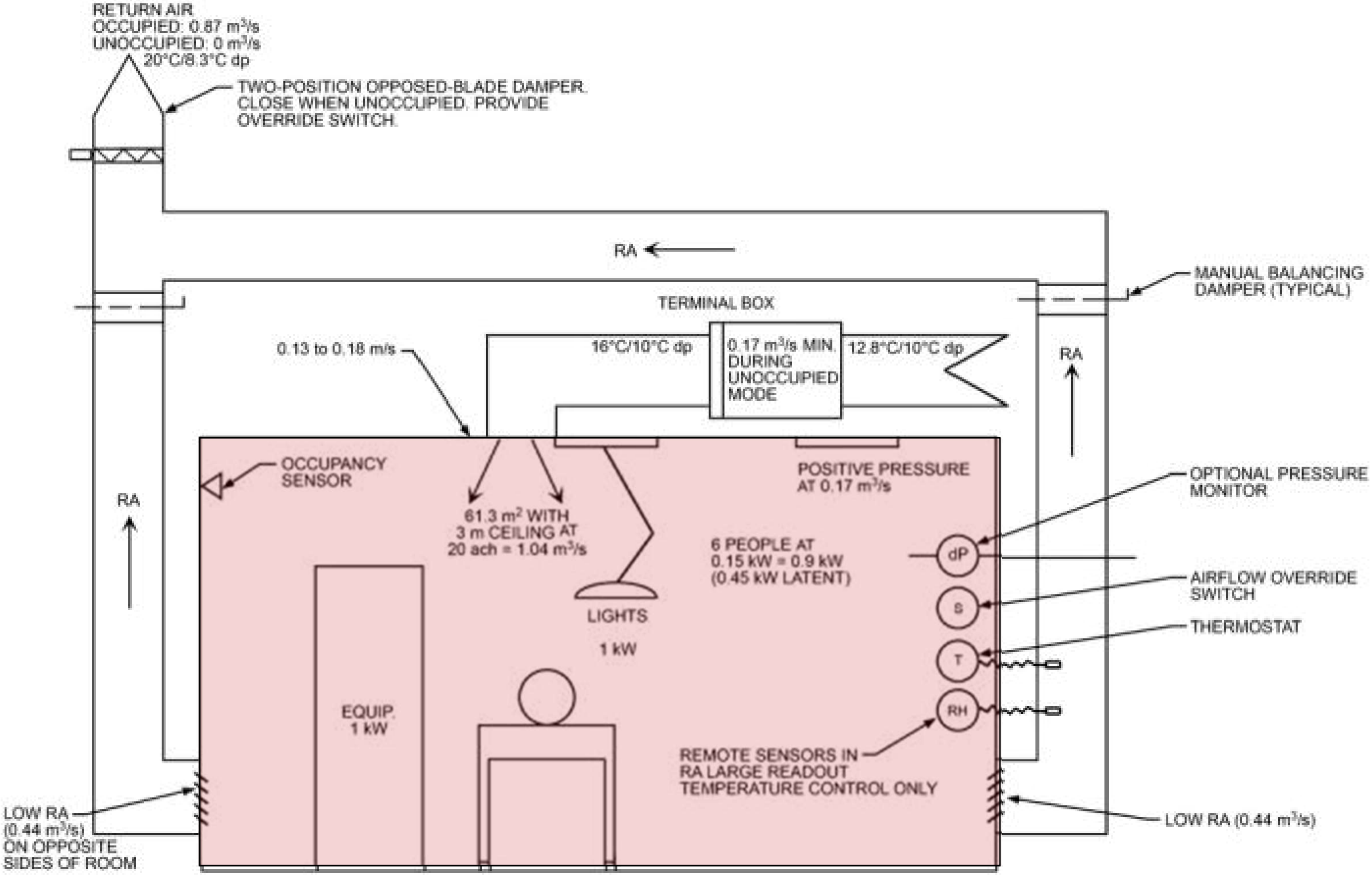
(Source: Source: http://www.price-hvac.com)

Hospital operating theatre (laminar flow with air curtains)



(Source: Source: http://www.price-hvac.com)

Operating room layout



(Source: ASHRAE, 2019. *ASHRAE Handbook 2019 HVAC Applications*, Chapter 9 Healthcare Facilities.)

Engineering principles

- HVAC systems can protect healthcare workers & enhance confidence by providing safe environment for their interactions with most contagious patients & reduce exposure when patients discharge contaminants during procedures
- For example, airborne infection isolation (AII) rooms require 12 air changes, negative relative pressure & air exhausted directly

(Reference: COVID 19 Guidance by Michael Sheerin https://www.bdcnetwork.com/tlccovid-19ventilationguidance)

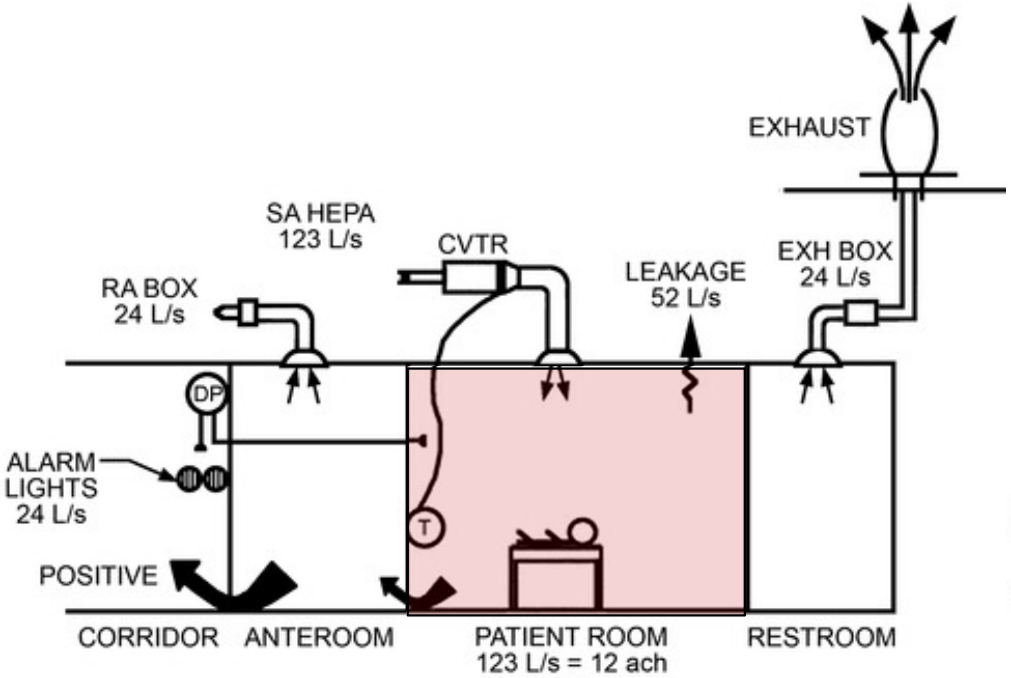
Engineering principles

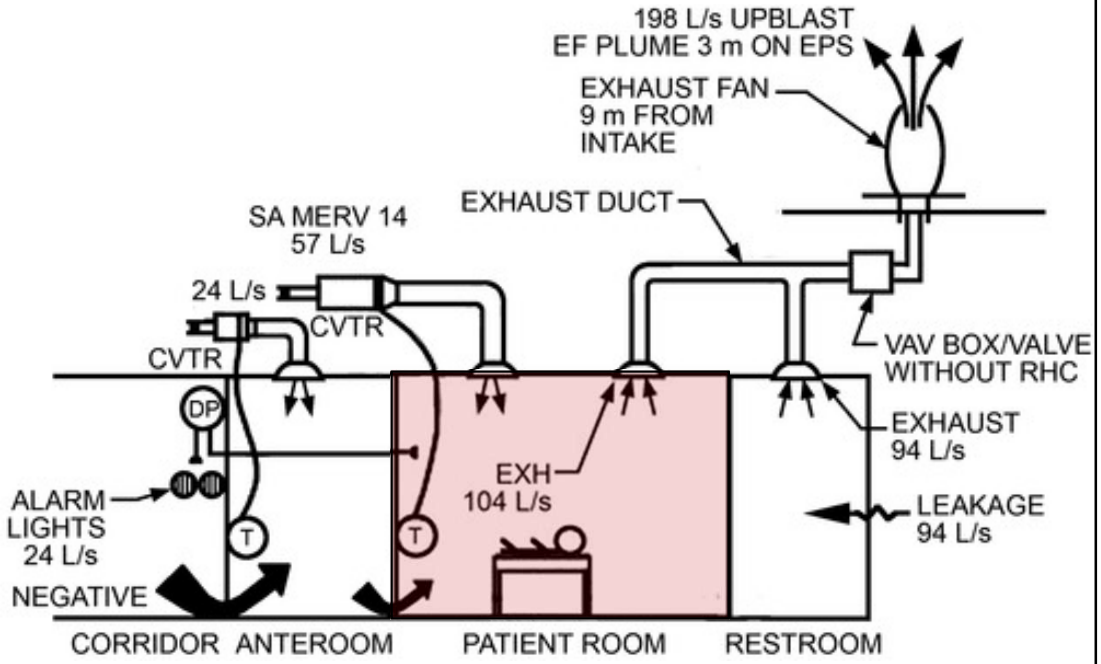
- Typical HVAC components:
  - Air terminals (e.g. ceiling diffuser)
  - Filtration system (e.g. MERV [minimum efficiency reporting value], and HEPA [High-efficiency particulate] air filters 高效濾網)
  - Exhaust system (for air discharge)
  - Monitoring device (for differential air pressure)
  - Ante room requirements (airlock lobby, with two doors)

Engineering principles

- ASHRAE/ASHE Standard 170 - Ventilation of Health Care Facilities
  - Ventilation system design requirements that provide environmental control for comfort, asepsis, and odour in health care facilities
    - Such as operating room (OR), patient care area, procedure room, protective environment (PE) room, airborne infection isolation (AII) room

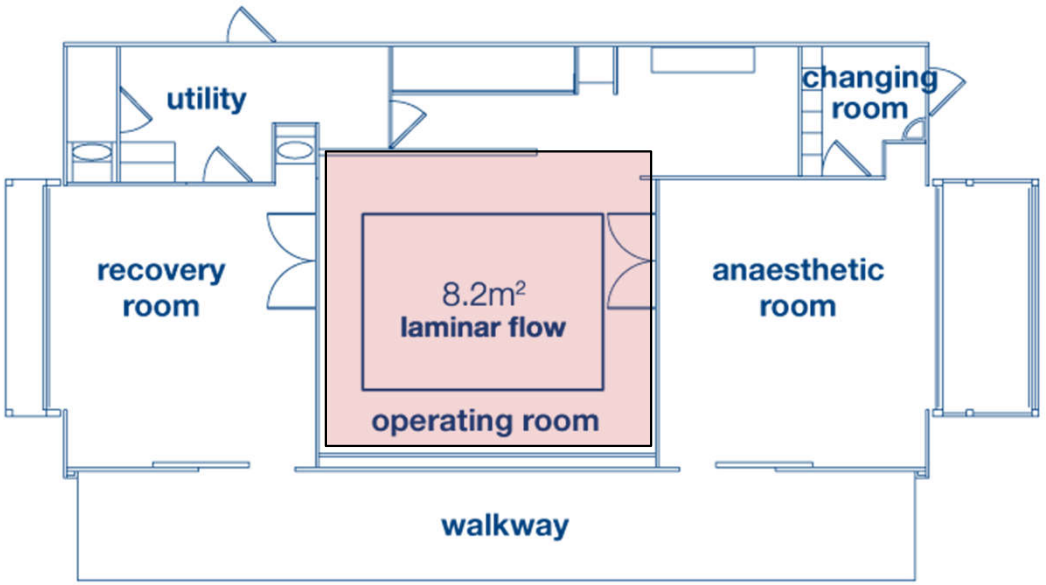
Operating room layout and arrangements





Protective environment room arrangement

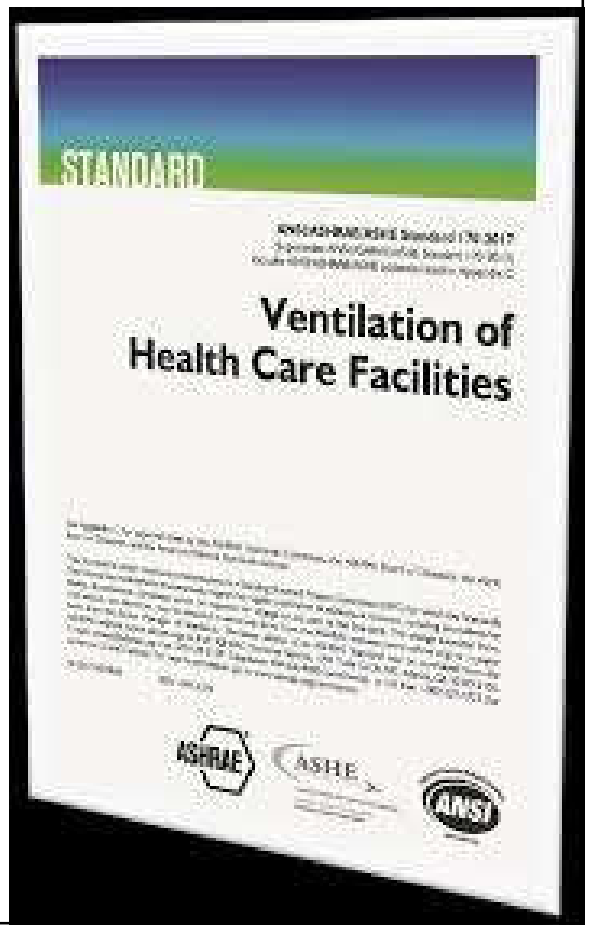
Airborne infection isolation room



(Source: ASHRAE, 2019. *ASHRAE Handbook 2019 HVAC Applications*, Chapter 9 Healthcare Facilities.)

Engineering principles

- Systems and equipment:
  - Utilities (electrical power, heating & cooling sources)
  - Air handling unit (AHU) design
  - Outdoor air intakes & exhaust discharges
  - Filtration
  - Heating & cooling systems
  - Humidifiers
  - Air distribution
  - Energy recovery systems
  - Insulation & duct lining



Engineering principles

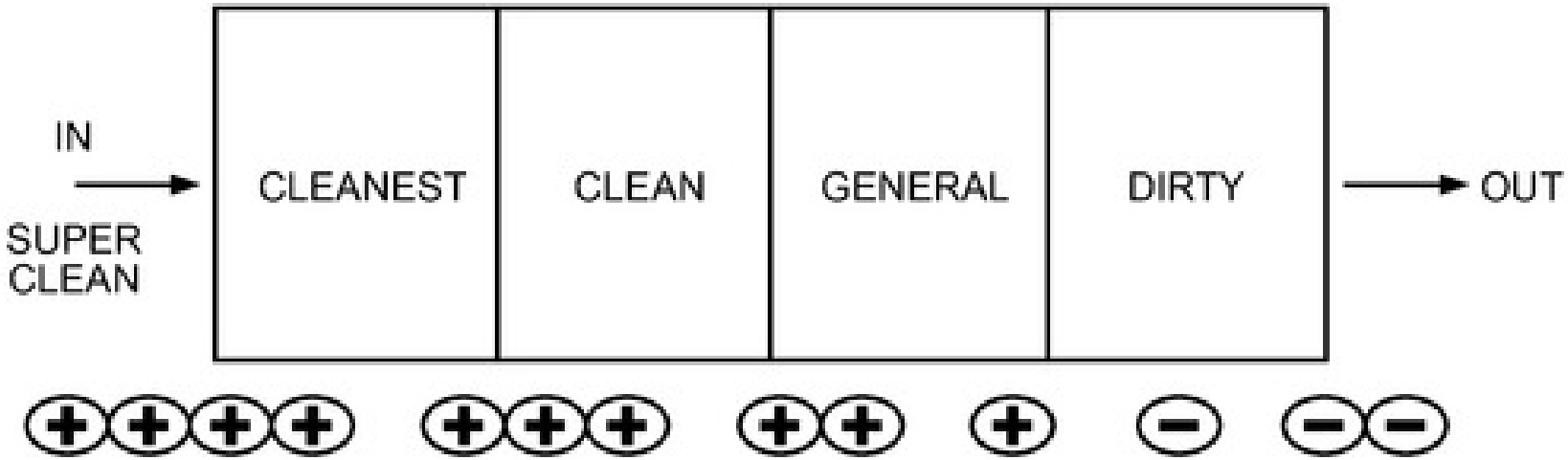
- Space ventilation (room specific requirements)
  - For hospital spaces, outpatient spaces & nursing home spaces
  - Controversial issues regarding HVAC & infection control e.g. air change rates & levels of filtration
  - How to pressurize to move air from clean to less clean areas
  - Maintain & control room pressurization
  - Maintain proper temperature & humidity

Table 1 Sample of ASHRAE *Standard* 170 Design Parameters

Function of Space	Pressure Relationship to Adjacent Areas	Minimum Outdoor ach*	Minimum Total ach*	All Room Air Exhausted Directly to Outdoors	Air Recirculated by Room Units	Design Relative Humidity,%	Design Temp. °C
Operating room	Positive	4	20	NR*	No	20 to 60	20 to 24
Emergency department public waiting area	Negative	2	12	Yes	NR*	max. 65	21 to 24
AII rooms	Negative	2	12	Yes	No	max. 60	21 to 24
Patient room	NR*	2	4	NR*	NR*	max. 60	21 to 24

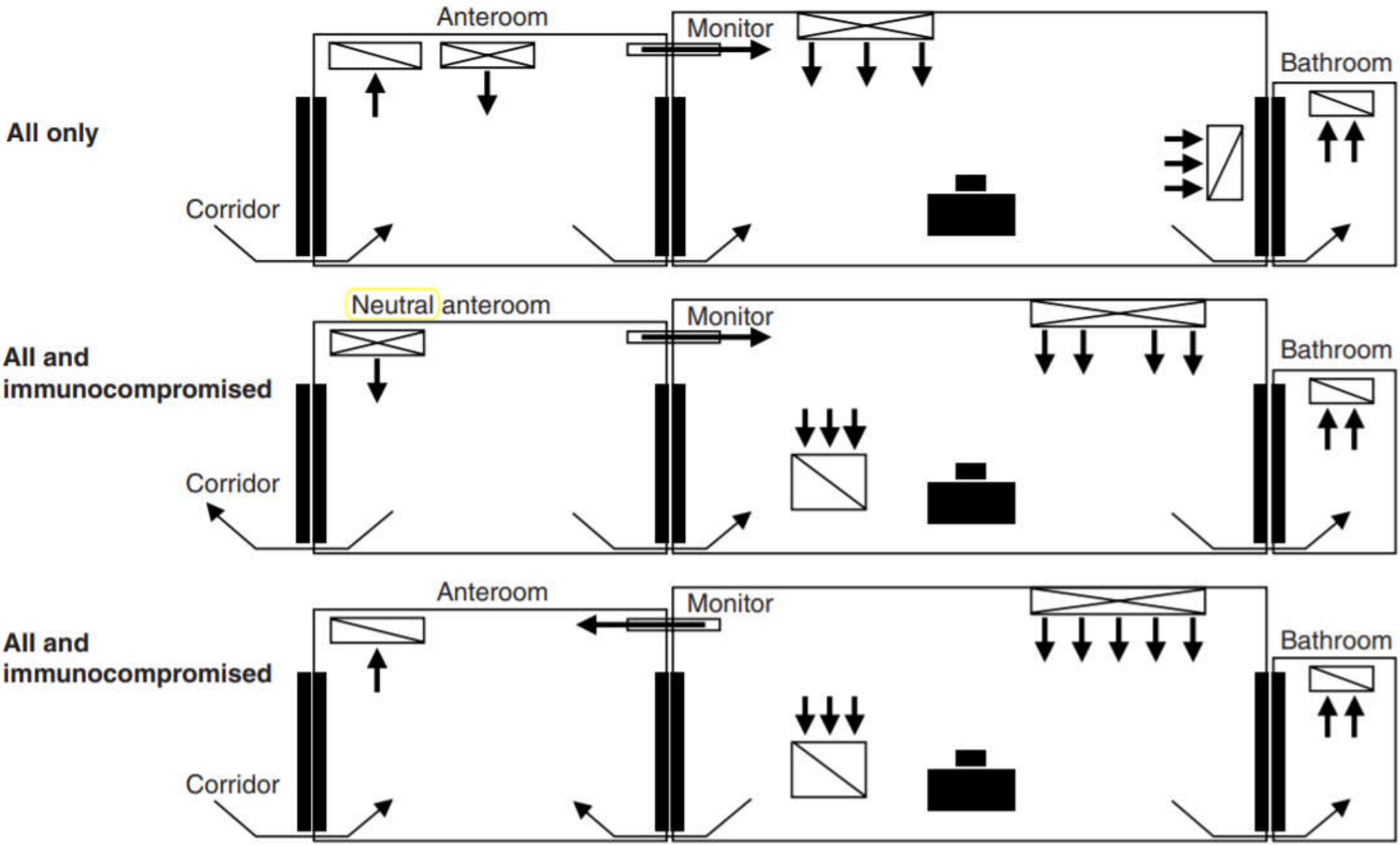
* ach = air changes per hour, NR = no requirement.

Controlling air movement through pressurization



(Source: ASHRAE, 2019. *ASHRAE Handbook 2019 HVAC Applications*, Chapter 9 Healthcare Facilities.)

Example of airborne infection isolation (AII) room with anteroom and neutral anteroom



(Source: CDC Guidelines for Environmental Infection Control in Health-Care Facilities http://www.cdc.gov/infectioncontrol/pdf/guidelines/environmental-guidelines-P.pdf)

Design standards for airborne infectious isolation rooms (AIIR)

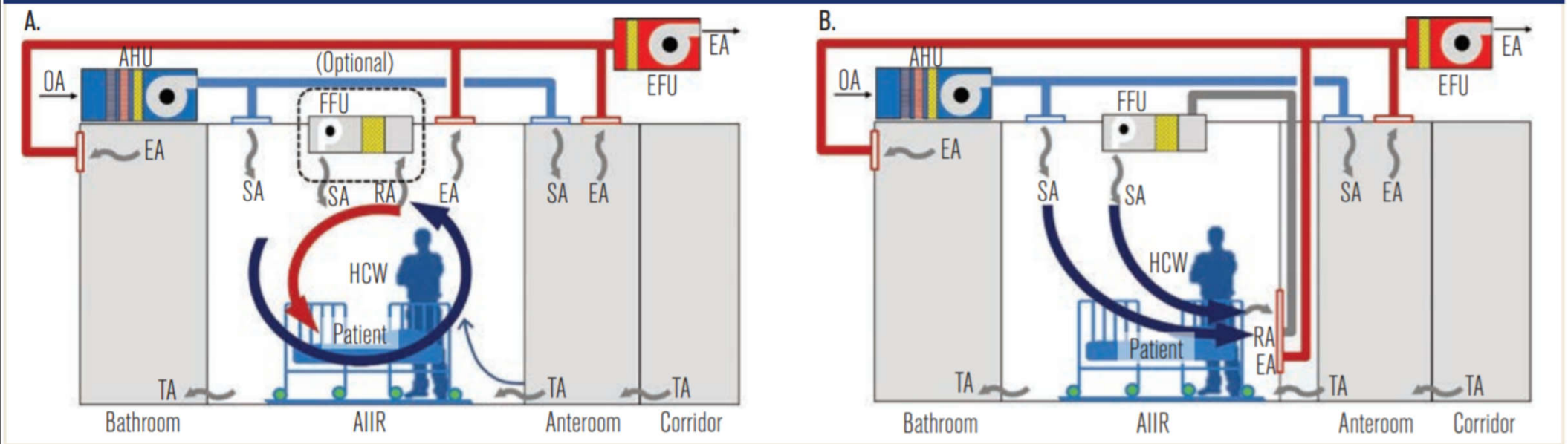
TABLE 1 Design standards for AIIR to prevent airborne contamination.[11]

	ORGANIZATION	AIR CHANGE RATE (ACH)		PRESSURE DIFFERENTIAL	RECIRCULATION	ANTEROOM
USA	Centers for Disease Control and Prevention	Existing	New/Remodeling	More than 2.5 Pa	Yes (w/HEPA Filter)	Recommend
		More than 6	More than 12			
Canada	Public Health Agency of Canada	Existing	New/Remodeling	–	Yes (w/HEPA Filter)	Recommend
		More than 6	More than 9			
UK	Department of Health	More than 10		More than 5 Pa	No	Recommend
Norway	Folkenhelseinstitutt	More than 12		More than 5 Pa	No	Mandatory
Australia	Department of Health And Human Services	Mandatory	Recommend	More than 15 Pa	No	Mandatory
		More than 12	More than 15			
Hong Kong	Infection Control Committee Department of Health	Existing	New/Remodeling	More than 2.5 Pa	Yes (w/HEPA Filter)	–
		More than 6	More than 12			
South Korea	Centers for Disease Control and Prevention	Mandatory	Recommend	More than 2.5 Pa	Yes (w/HEPA Filter)	Mandatory
		More than 6	More than 12			

(Source: Cho, J, Woo, K. and Kim, B.S., 2019. Improved ventilation system for removal of airborne contamination in airborne infectious isolation rooms, *ASHRAE Journal*, 61 (2): 8-21. https://images.magnetmail.net/images/clients/ASHRAE/attach/AJ_Newsletter/Cho_February_2019.pdf)

Ventilation strategies for airborne infectious isolation rooms (AIIR)

FIGURE 1 Ventilation strategies of the AIIR; (a) typical ventilation system and (b) improved ventilation system.



A. Typical ventilation system	**B. Improved ventilation system**
It may not efficiently reduce the pollutant concentrations of an infectious source at specific locations due to air mixing in the AIIR.	To have exhaust air (EA) grilles on the wall near the floor at the head of the bed, and to have supply air (SA) diffusers at the ceiling above the foot of the bed.

(Source: Cho, J, Woo, K. and Kim, B.S., 2019. Improved ventilation system for removal of airborne contamination in airborne infectious isolation rooms, *ASHRAE Journal*, 61 (2): 8-21. https://images.magnetmail.net/images/clients/ASHRAE/attach/AJ_Newsletter/Cho_February_2019.pdf)

Strategy for planning and preparedness

- Planning of health service & health facilities:
  - To better use the current facilities & develop new (emergency) facilities
  - Achieve reliable & effective health care delivery
    - Work with clinicians & medical professionals
    - Coordinate operations & identify needs/priorities
    - Define key areas & designated rooms
- Three critical issues to consider:
  - Healthcare system planning, infection control & emergency response

Strategy for planning and preparedness

- **COVID-19 Healthcare Planning Checklist**

  [From U.S. Department of Health and Human Services (HHS) Office of the Assistant Secretary for Preparedness and Response (ASPR)]

  - 1. Demand & operations planning
    - Implement more real-time tracking tools to continuously assess demand levels & better predict surges
  - 2. Talent management (human resources)
  - 3. Patient flow (operational procedures)
  - 4. Scheduling (logistics)

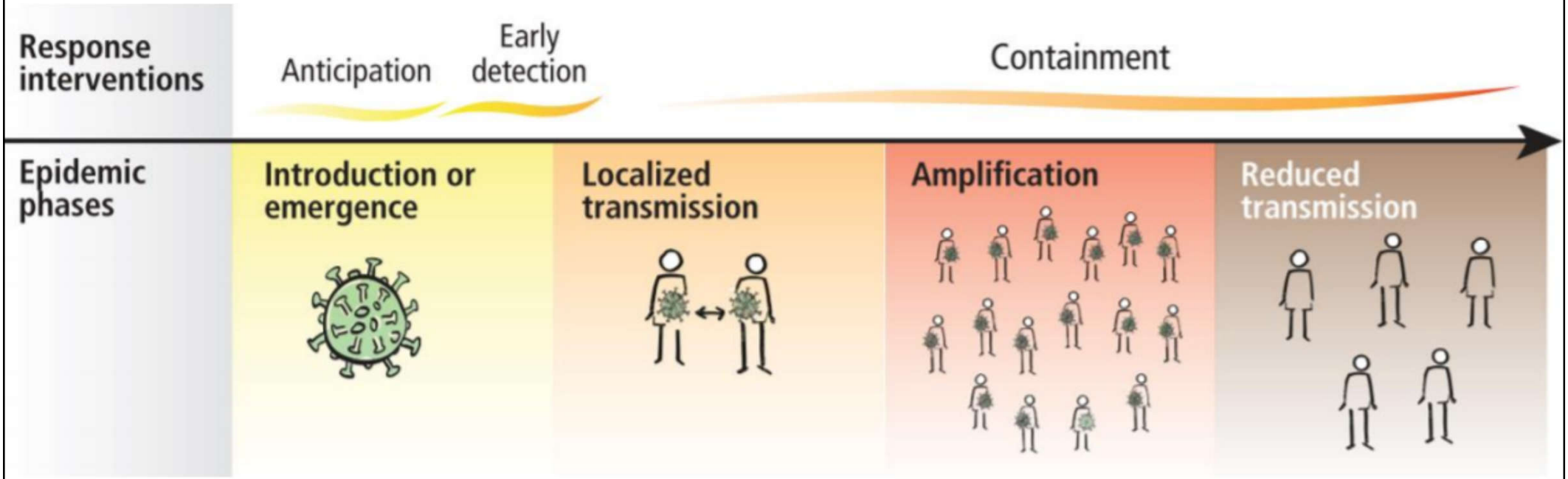
(Source: https://www.phe.gov/emergency/events/COVID19/Documents/COVID-19%20Healthcare%20Planning%20Checklist.pdf)

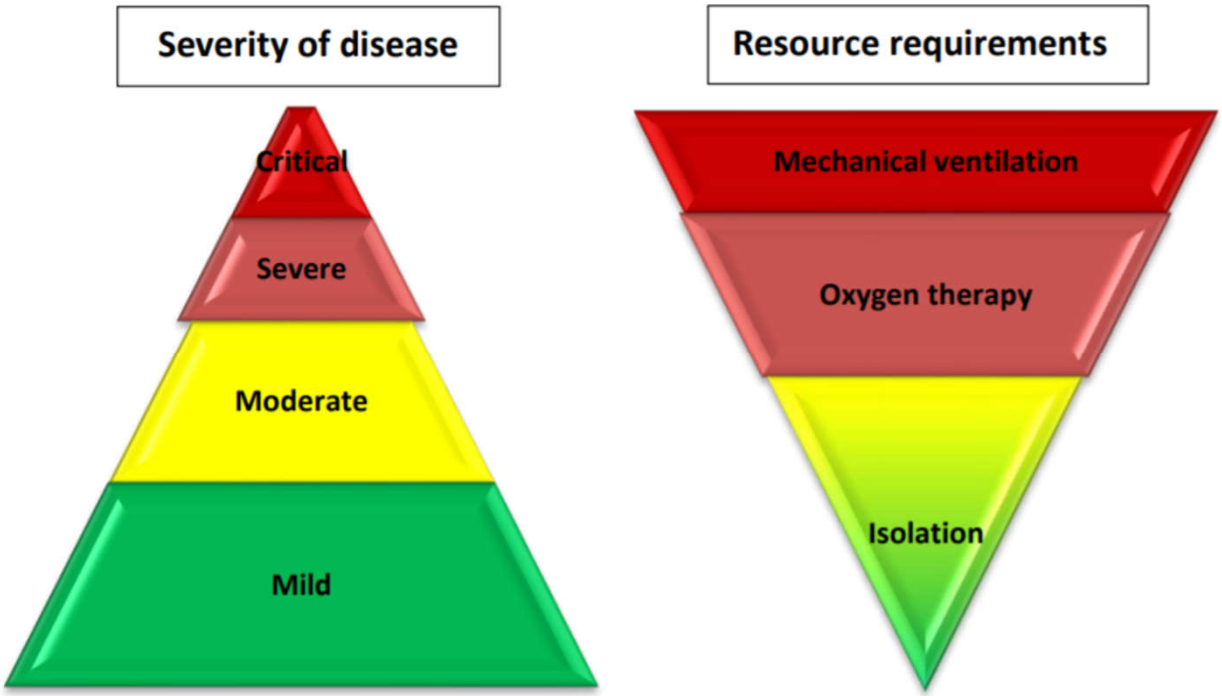
Strategy for planning and preparedness

- **WHO Operational considerations for case management of COVID-19 in health facility and community: Interim guidance, 19 March 2020**
  - 1. Key public health interventions regardless of transmission scenario
  - 2. Key action steps to be taken by transmission scenario to enable timely surge of clinical operations
- Public health objectives:
  - Prevent outbreaks, delay spread, slow & stop transmission
  - Provide optimized care for all patients, especially the seriously ill
  - Minimize the impact of the epidemic on health systems, social services & economic activity

(Source: WHO Operational considerations for case management of COVID-19 in health facility and community: Interim guidance, 19 March 2020 https://apps.who.int/iris/bitstream/handle/10665/331492/WHO-2019-nCoV-HCF_operations-2020.1-eng.pdf)

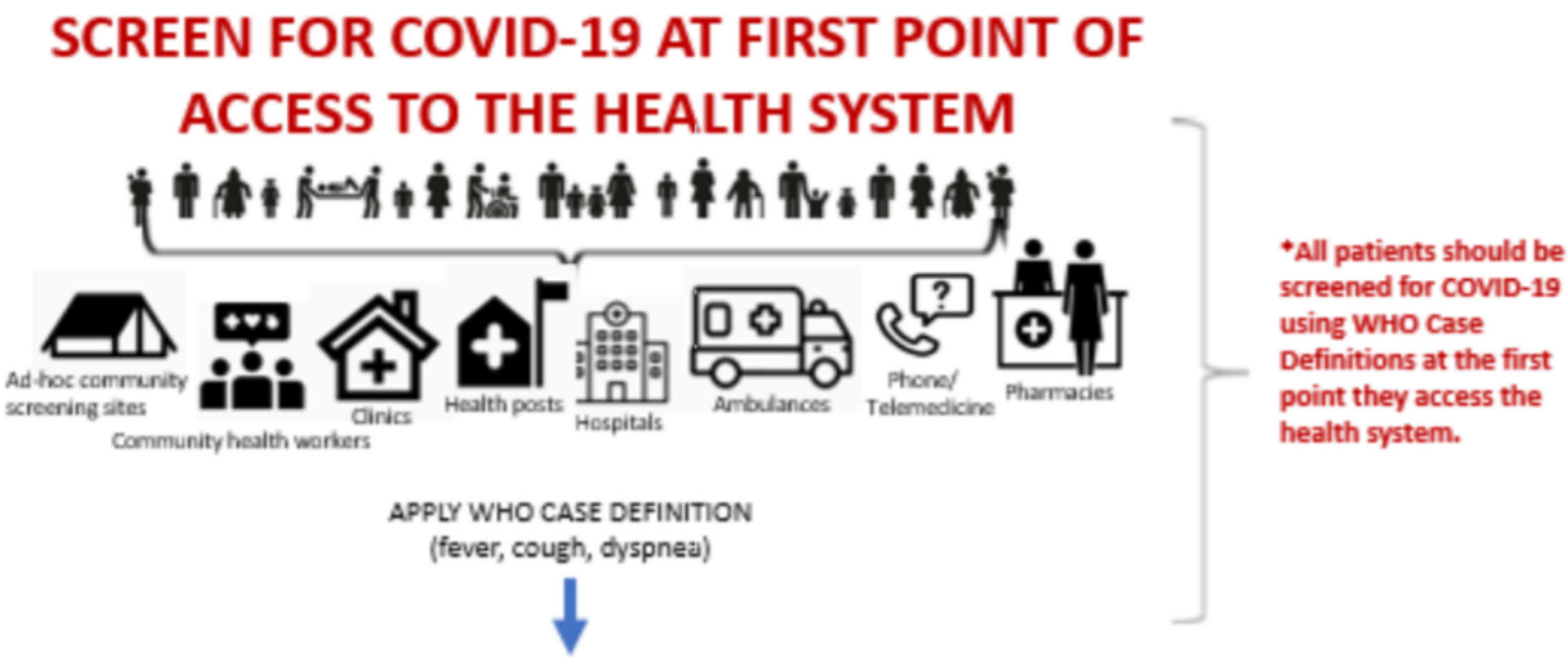
Case management of COVID-19 in health facility & community





(Source: WHO Operational considerations for case management of COVID-19 in health facility and community: Interim guidance, 19 March 2020 https://apps.who.int/iris/bitstream/handle/10665/331492/WHO-2019-nCoV-HCF_operations-2020.1-eng.pdf)

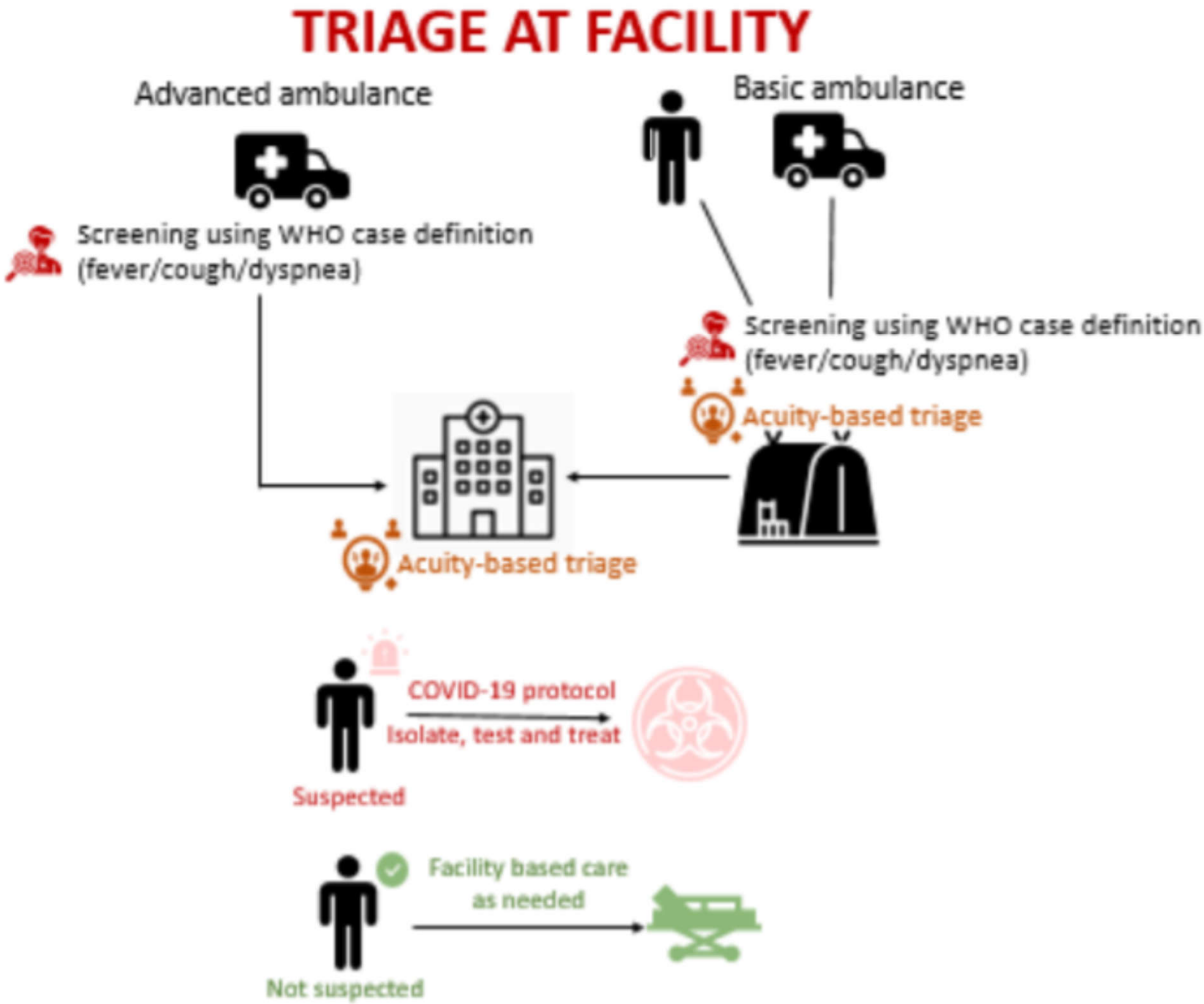
Screening for COVID-19 to the health system



Patients suspected to have COVID-19	Patients NOT suspected to have COVID-19
Refer to appropriate facility or testing site as per local protocol	Management as per local protocol (routine management or referral as per reorganization of service delivery)

(Source: WHO Operational considerations for case management of COVID-19 in health facility and community: Interim guidance, 19 March 2020 https://apps.who.int/iris/bitstream/handle/10665/331492/WHO-2019-nCoV-HCF_operations-2020.1-eng.pdf)

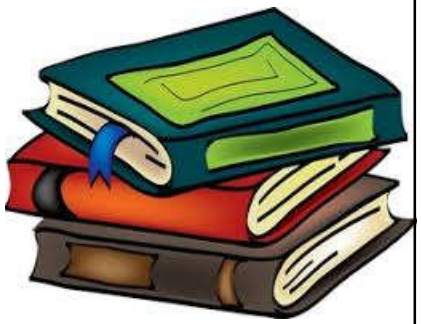
Triage (分流) for early recognition & source control



(Source: WHO Operational considerations for case management of COVID-19 in health facility and community: Interim guidance, 19 March 2020 https://apps.who.int/iris/bitstream/handle/10665/331492/WHO-2019-nCoV-HCF_operations-2020.1-eng.pdf)

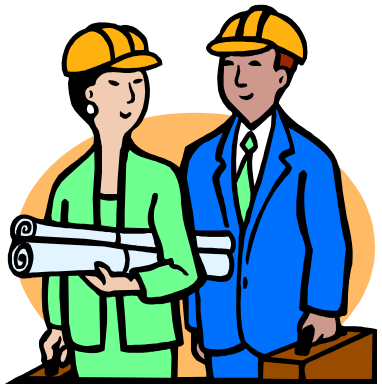
Strategy for planning and preparedness

- Health Facility Guidelines (selected ones):
  - Australasian Health Facility Guidelines (AusHFG) https://www.healthfacilityguidelines.com.au/
  - Facility Guidelines Institute (FGI), USA https://fgiguidelines.org/
  - International Health Facility Guidelines http://www.healthfacilityguidelines.com/
  - UK Dept. of Health (DH) Health Building Notes https://www.gov.uk/government/collections/health-building-notes-core-elements



Strategy for planning and preparedness

- Typical planning issues (new facilities):
  - Site selection & development
  - Masterplan development
  - Local design regulations
  - Land area measurement methodology & definitions
  - Floor area measurement methodology, definitions & diagrams
  - Parking & vehicular access



Strategy for planning and preparedness

- Major factors:
  - Hardware: Health care facilities, laboratories, supporting facilities
  - Software: Workforce (staff) - human resources & operational leaders
  - Supplies: Materials, equipment & devices
- Testing laboratories:
  - Capacity for COVID-19 large-scale testing
  - Off-site screening & testing stations (if needed)

Strategy for planning and preparedness

- Risk assessment & response
  - A multidisciplinary team (e.g., facility engineer, infection preventionist, risk manager, sterile processing manager or other designated personnel) should conduct a risk assessment

  - Include healthcare technology management (HTM) & sterilization professionals
  - Engage rapid response & case investigation teams
    - For quick reaction & contact tracing

  - Contingency planning & appropriate response

Useful COVID-19 resources for health care facilities

- ASHRAE COVID-19 (Coronavirus) Preparedness Resources http://ashrae.org/COVID19
- ASHRAE TC 9.6 Healthcare Facilities http://tc0906.ashraetcs.org/
- American College of Healthcare Executives (ACHE) COVID-19 Resource Center https://ache.org/COVID
- American Hospital Association (AHA) https://www.aha.org/2020-01-22-updates-and-resources-novel-coronavirus-2019-cov
- American Society of Health Care Engineering (ASHE) http://www.ashe.org/COVID19resources
- Association for the Health Care Environment (AHE) https://www.ahe.org/covid-19-resources-evs-professionals-2020
- CDC Resources for Clinics and Healthcare Facilities http://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/
- WHO Technical Guidance - Coronavirus disease (COVID-19) https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance

Strategy for planning and preparedness

- Practical issues to consider:
  - Understand the current facilities
    - Existing facility assessments (potential & limitations)
    - Prepare for emergency scenarios; hospitals must be able to react to a variety of circumstances
  - Additions, renovations & upgrades
    - Expand & renovate existing occupied hospitals (plan for noise problems & disruptions)
  - Converting buildings/sites on an ad hoc basis
    - For health care & quarantine facilities

Strategy for planning and preparedness

- **Pandemic Preparedness:**
  - How hospitals can adapt buildings to address worst-case scenarios https://www.bdcnetwork.com/blog/pandemic-preparedness-how-hospitals-can-adapt-buildings-address-worst-case-scenarios
    - 1. Including separate emergency entrances for contagious patients
    - 2. Transforming hospital lobbies - as well as other external spaces - for patient pre-screening
    - 3. Controlled separation between patients, visitors, and staff, based upon specific illnesses & their related level of contagion
    - 4. Providing the ability to convert existing hospital spaces - during a pandemic - into patient treatment spaces

Strategy for planning and preparedness

- Technology potential for COVID-19:
  - Telehealth or Telemedicine 遠程醫療
  - Artificial Intelligence (AI) 人工智能 (e.g. AI chatbot, fever detection cameras)
  - Robotics (e.g. for delivery, cleaning & disinfection)
  - Digital contact tracing (e.g. location-tracking apps)




Strategy for planning and preparedness

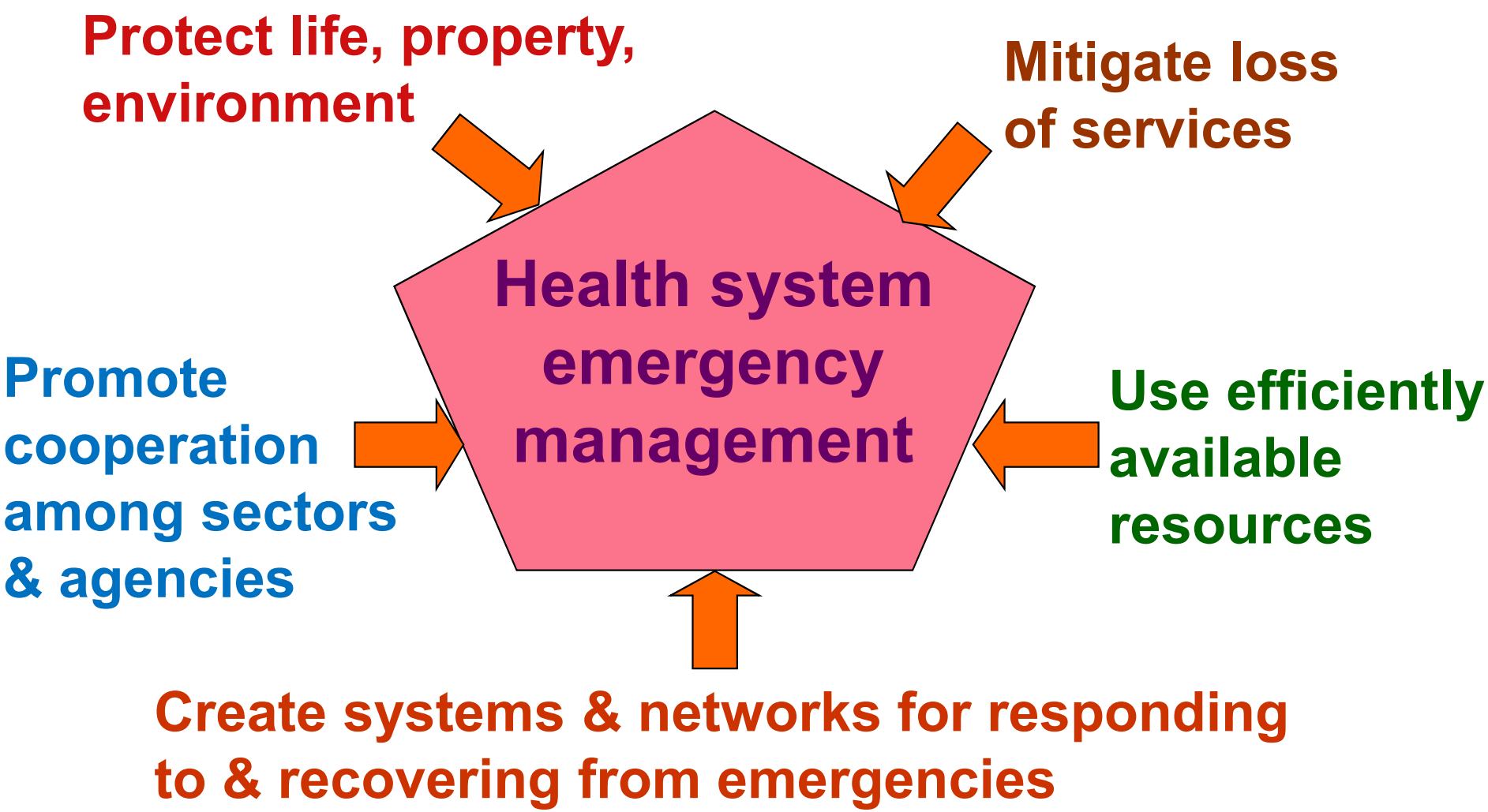
- Telehealth in the time of COVID-19 https://www.mobihealthnews.com/news/europe/telehealth-time-covid-19
  - For patients: self-isolated/home-isolated patients (self & distance monitoring), patients with mild cases (distance monitoring & treatment), patients after discharge (follow-ups)

  - For health workers: clinicians with mild symptoms can still work remotely with patients, retired clinicians, second opinion for severe cases, cross-border experience exchange, teleradiology, online trainings for health workers

Emergency management

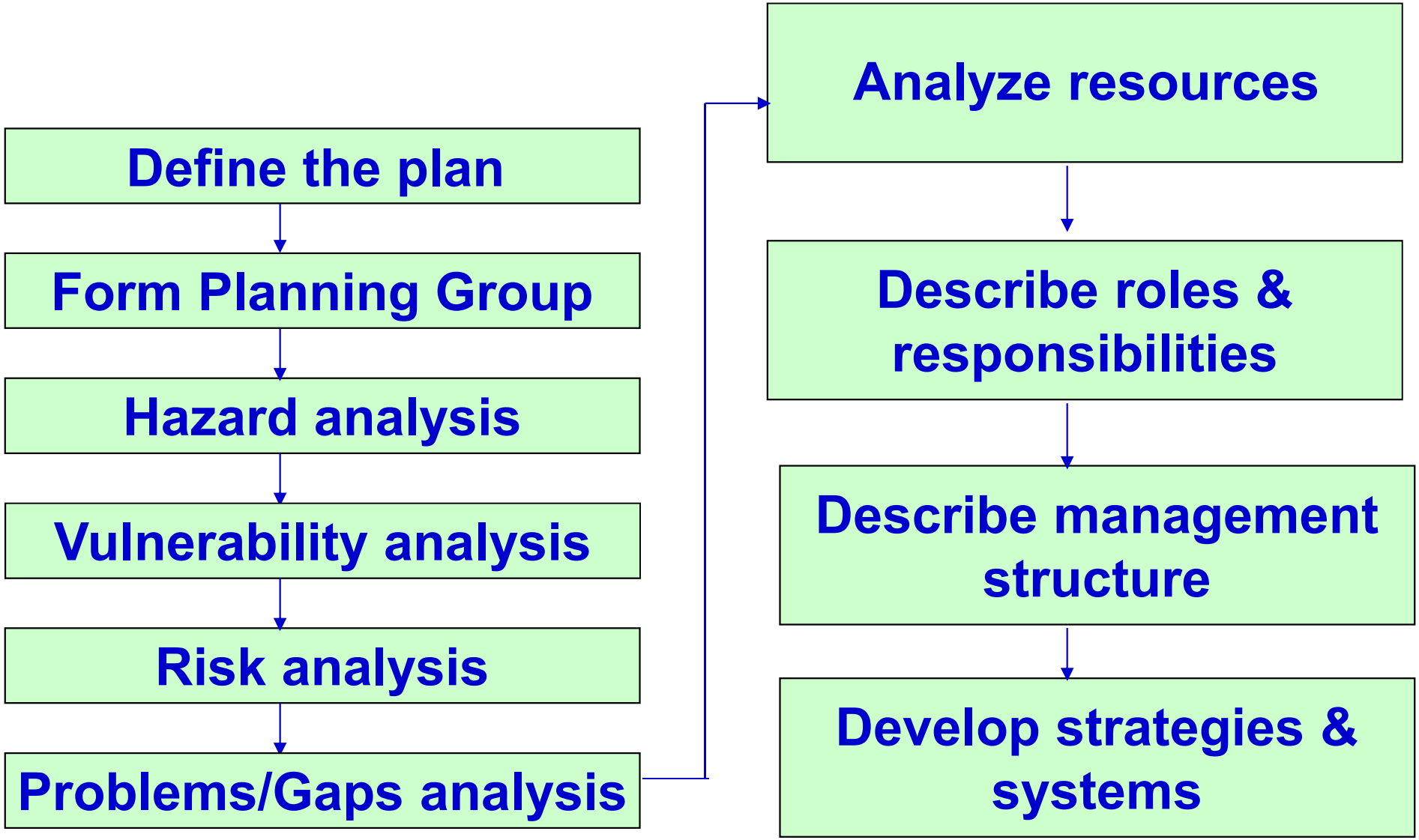
- **Pandemic risk management:**
  - Risk assessment and impacts on health system capacity & social institutions (e.g. elderly care)
  - Crisis management: require a rapid response
    - Shift from a containment to a mitigation approach
    - Community engagement & stringent social distancing
  - Protect the vulnerable populations, health care workers & first responders
  - Business continuity & provision of other essential healthcare services

Key concepts of health system emergency management



(References: Health emergency and disaster risk management https://www.who.int/hac/techguidance/preparedness/; Guidelines for Developing Hospital Emergency Management Plan http://asdma.gov.in/pdf/publication/undp/guidelines_hospital_emergency.pdf)

Emergency planning process



(References: Health emergency and disaster risk management https://www.who.int/hac/techguidance/preparedness/; Guidelines for Developing Hospital Emergency Management Plan http://asdma.gov.in/pdf/publication/undp/guidelines_hospital_emergency.pdf)

Emergency management

- **Principles and coordination:**
  - Four principles of emergency management: mitigation, preparedness, response & recovery
  - Coordination on health, education, travel & tourism, social protection, business, public works
  - Initial capacity assessment & risk analysis, including mapping of vulnerable populations
    - Such as elderly, disabled, pregnant women & children
  - Surge plans to manage increased demand for testing, screening, quarantine & treatment

Emergency management

- **Key components of hospital emergency response:**
  - 1. Command & control
  - 2. Communication
  - 3. Safety & security
  - 4. Triage
  - 5. Surge capacity
  - 6. Continuity of essential services
  - 7. Human resources
  - 8. Logistics & supply management
  - 9. Post-disaster recovery

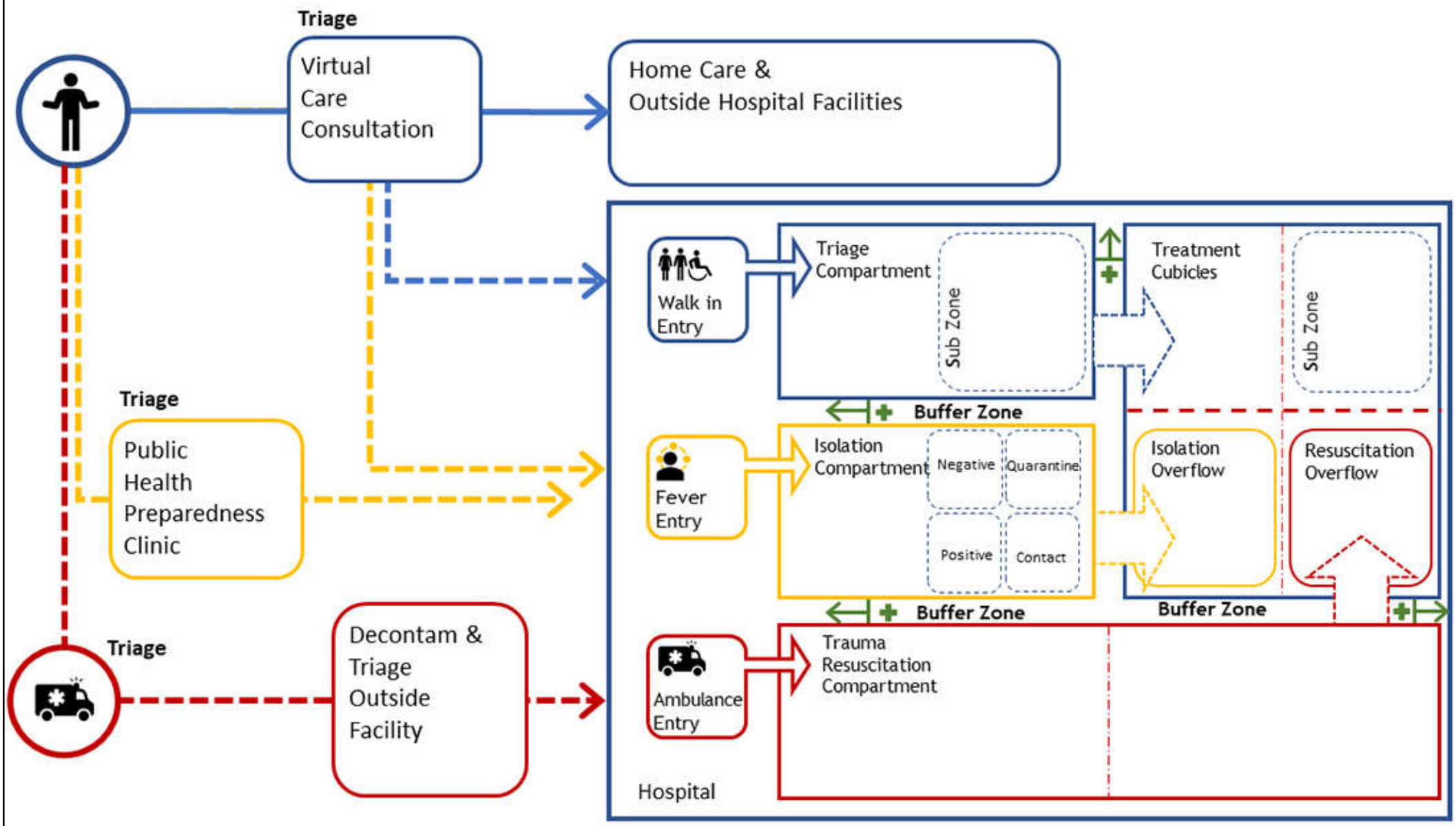
(Reference: Hospital emergency response checklist https://www.who.int/publications-detail/hospital-emergency-response-checklist)

Emergency management

- **Manage COVID-19 suspected cases:**
  - Hospitals have AII Rooms, e.g. 1-2 per patient floor or suite
    - These rooms would normally be used for suspected COVID patients, along with other infectious conditions e.g. Tuberculosis
    - As numbers increase, too few AII rooms may be available to house suspected COVID patients
  - The general course of growth from suspected cases to a high number of confirmed cases is commonly shorter than the time frame for treatment & release of "first in" patients, so it is important to recognize that committing AII rooms to patients limits future flexibility
  - Ensure hospital resilience to maintain critical functions

(Reference: COVID 19 Guidance by Michael Sheerin https://www.bdcnetwork.com/tlccovid-19ventilationguidance)

Segmenting hospital patient flows in the case of surge scenarios (an example from Singapore)



(Source: It's not if, but when: Designing healthcare spaces that support pandemic response https://www.bdcnetwork.com/blog/it%E2%80%99s-not-if-when-designing-healthcare-spaces-support-pandemic-response)

Emergency management

- **Pandemic response:**
  - Facilities could consider designating entire units to care for known or suspected COVID patients
    - Staffed with dedicated healthcare personnel to limit exposure risk
  - Clinicians have advocated against cohorting suspected & confirmed patients in the same unit/ward, to avoid the potential for conversion
  - Temporary patient segregation plan is required for safe segregation of suspected & confirmed patients
  - Set up testing & screening sites exclusively for identifying COVID-19 positive patients in a safe environment

Emergency management

- Clinical modes & operation in hospitals:
  - 1. Normal mode (use existing AII rooms)
  - 2. Small scale surge capacity mode (e.g. create additional dedicated AII or temporary patient observation/segregation rooms with HEPA & negative pressure)
  - 3. Large scale surge capacity mode – may be asked to establish dedicated ward(s)
  - [Remark: temporary patient observation/segregation areas are not true AII rooms]

(Reference: COVID 19 Guidance by Michael Sheerin https://www.bdcnetwork.com/tlccovid-19ventilationguidance)

Emergency management

- Emergency Department (ED)
  - Accident and Emergency (A&E) 急症室 - frontline first responder & transport of patients
  - Restrict access to ED & increase protection measures
  - Use of negative pressure ambulance (負壓救護車) or chambers
  - Evaluation & management of COVID patients
    - Persons Under Investigation (PUI) capable of self care are triaged outside the ED, either through screening stations set up in tent or temporary space, and advised to continue home care until results are available

(Reference: American College of Emergency Physicians (ACEP) https://www.acep.org/corona/COVID-19/)

Emergency management

- Outpatient & residential facilities 門診和住院設施
  - Precautions for COVID cases
    - Handling of suspected/confirmed case; patient placement/transfer
  - Staff sickness monitoring: checking staff (before every shift) & visitors for flu-like conditions, temperature & travel history
  - Managing visitors: restricting visitors to a resident room or halting visits altogether
  - Environmental cleaning, disinfection & decontamination
  - Special considerations for vulnerable populations (e.g. in nursing homes 療養院)

(Reference: Reducing the risk of transmission of COVID-19 in the hospital setting (Updated 17 April 2020) https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control/reducing-the-risk-of-transmission-of-covid-19-in-the-hospital-setting)

Emergency management

- How to increase capacity of facilities in emergencies
  - Hospital resilience & response to unexpected challenges
  - Design for adaptability, free up capacity at the main hospitals for extraordinary situations, in patient care spaces or temporary spaces when surges occur
  - Flexibility of transforming regular rooms into isolation units & expanding critical intensive care units (ICUs)
  - Modify hospitals, smaller facilities & spare spaces to meet the surge demand and to increase areas for medical screening, triage & other patient care
  - Relocate service to another location in a hospital network

Designing healthcare for surge capacity

1. Repurposing existing facilities (e.g. sports stadiums, convention centres, hotels, or student housing)
2. Rethinking the hospital (assess non-clinical spaces & spaces capable of performing multiple functions easily)
3. Putting support spaces to work (facilities that can be converted quickly in a matter of hours)
4. Reactivating former patient care spaces (reuse outdated patient care towers for administrative or other non-patient facing functions)
5. Modular outpatient thinking (for the compartmentalization required for infectious populations)
6. Investing in caregivers (require dedicated healthcare professionals & workforce)

(Source: https://www.gensler.com/research-insight/blog/designing-healthcare-for-surge-capacity)

Emergency management

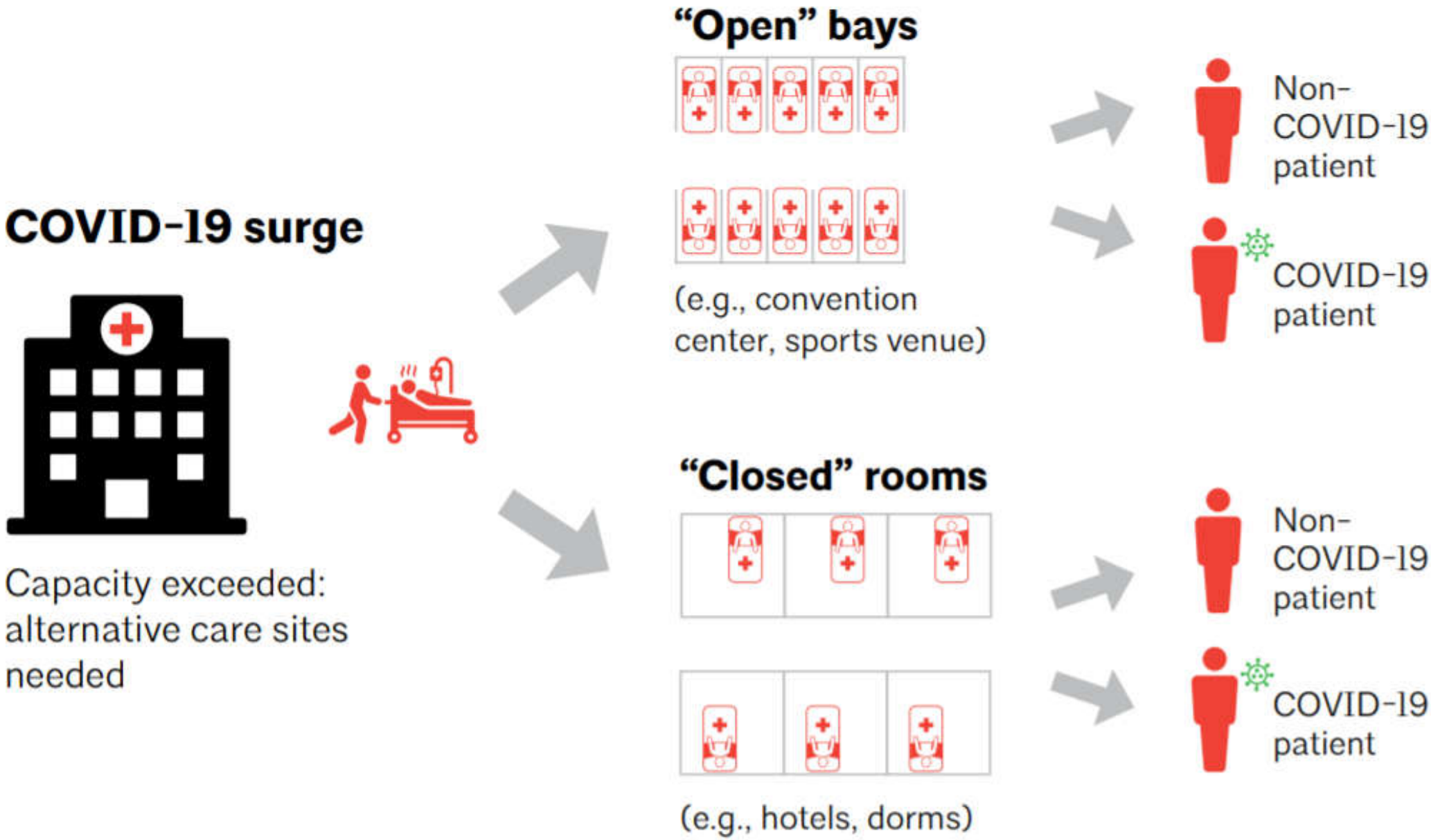
- **Alternative health care facilities**
  - In response to bed shortage & facility saturation
    - More flexibility to provide hospital services
    - Adapt other buildings or sites into health care facilities
  - Major issues to consider:
    - Fast assembled & efficient design (very tight timetable)
    - Pre-existing structures that can quickly be adapted (a structure with a robust mechanical system, significant plumbing capacity & an existing fire rating)
    - Proximity to adjacent medical services (to readily share resources, supplies & personnel)
    - Develop a systematic framework for conversion

(Reference: Alternative Healthcare Facilities: Architects Mobilize their Creativity in Fight against COVID-19 https://www.archdaily.com/937840/alternative-healthcare-facilities-architects-mobilize-their-creativity-in-fight-against-covid-19)

Emergency management

- Adaptive reuse of buildings in a pandemic scenario
  - Also known as ***Alternate Care Sites (ACS)***
  - Should consider both safety & functionality, not solely bed counts; usually provide the minimum requirements for patient & staff safety only
  - Create a strategy for the short term & long term
  - Adapt existing buildings for health care operations
    - 1. "Open" structures e.g. convention centres, stadium, enclosed sports venues
    - 2. "Room-based" structures e.g. hotels & dormitories, are also a consideration, particularly newer facilities that have ventilation & bathroom facilities for distinct separation of patients

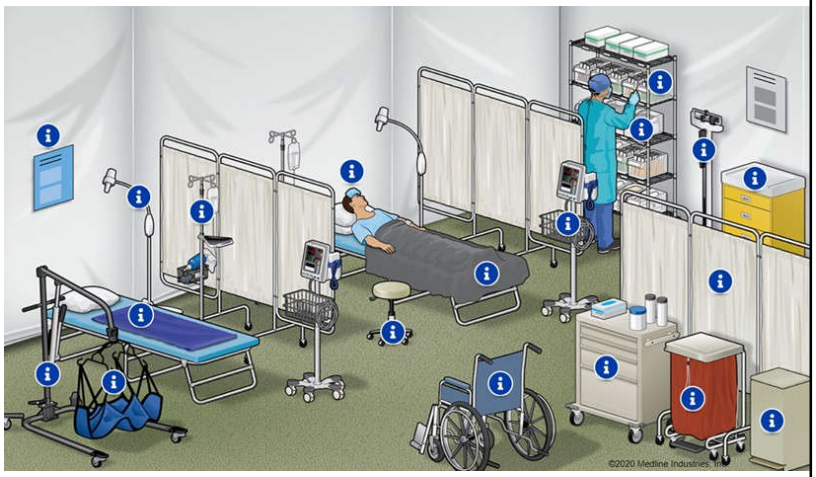
Alternate Care Sites (ACS) to cope with the surge



(Source: AIA COVID-19 Task Force 1: Health Impact Briefing #1, April 6, 2020. COVID-19 alternative care sites: Addressing capacity, safety, & risk challenges for our nation's hospitals during a public health pandemic response http://content.aia.org/sites/default/files/2020-04/KC20_AAH_C-19_Alt-Care-Sites-Whitepaper_sm_v03_FINAL.pdf)

Emergency management

- How to safely & effectively provide healthcare operations within a non-healthcare setting
  - Can use a hotel for patients needing less intensive care while using inpatient beds for COVID-19 patients
- Key factors:
  - Site selection, roadway access & security
  - Building size considerations
  - Building security
  - Clinical considerations
  - Physical configuration



(Reference: COVID-19 Alternate Care Site Resources https://asprtracie.hhs.gov/technical-resources/111/covid-19-alternate-care-site-resources/99)

Emergency management

- Alternate Care Sites (ACS) implementation process
  - 1. Identify potential sites (e.g. hotel, arena, closed hospital)
  - 2. Conduct site assessments
  - 3. Secure funding
  - 4. Secure property
  - 5. Convert site for healthcare use
  - 6. Secure wraparound services (food, transport, ambulance, waste, laundry & fencing)
  - 7. Staff, equipment & supplies
  - 8. Operate site (roles & responsibilities, flow, security, etc)
  - 9. Restore site

(Source: US Army Corps of Engineers (USACE) - Alternate Care Sites (ACS) https://www.usace.army.mil/Coronavirus/Alternate-Care-Sites/)

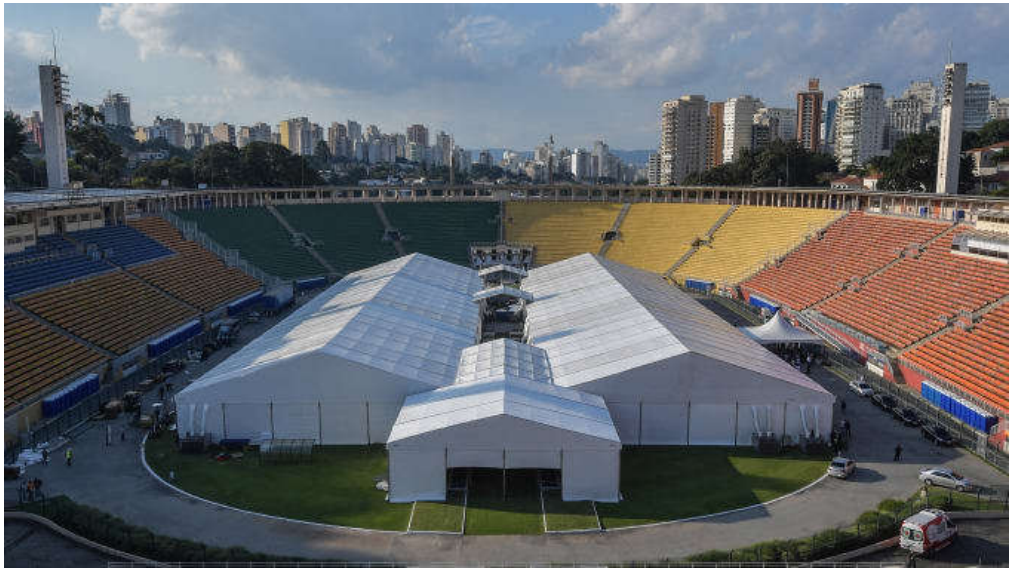
Emergency management

- **Emergency field hospitals for COVID-19**
  - Temporary field hospitals were set up for:
    - (a) COVID-19 patients with mild or no symptoms
    - (b) Patients who need treatment & intensive care
  - Have different characteristics & functions, depending on purpose, budget & location
  - Prefabricated modules can be used to speed up, e.g.
    - https://www.alibaba.com/showroom/modular-hospital.html
    - https://www.medifa.com/notfall-intensivstation/?lang=en
    - https://hga.com/staat-mod

Emergency management

- Examples of temporary hospitals:
  - Makeshift & field hospitals
    - Huoshenshan Hospital (火神山醫院), Leishenshan Hospital (雷神山醫院) in Wuhan
    - Fangcang shelter hospitals (方艙醫院) in China
    - The new NHS Nightingale Hospitals in UK
    - Field hospitals in Brazil, Italy, Russia, Spain & USA
  - Hospital ships or floating hospitals
    - US Navy hospital ships USNS Comfort & Mercy

Examples of field hospitals set up to treat COVID-19 patients



Brazil: Pacaembu stadium in Sao Paulo

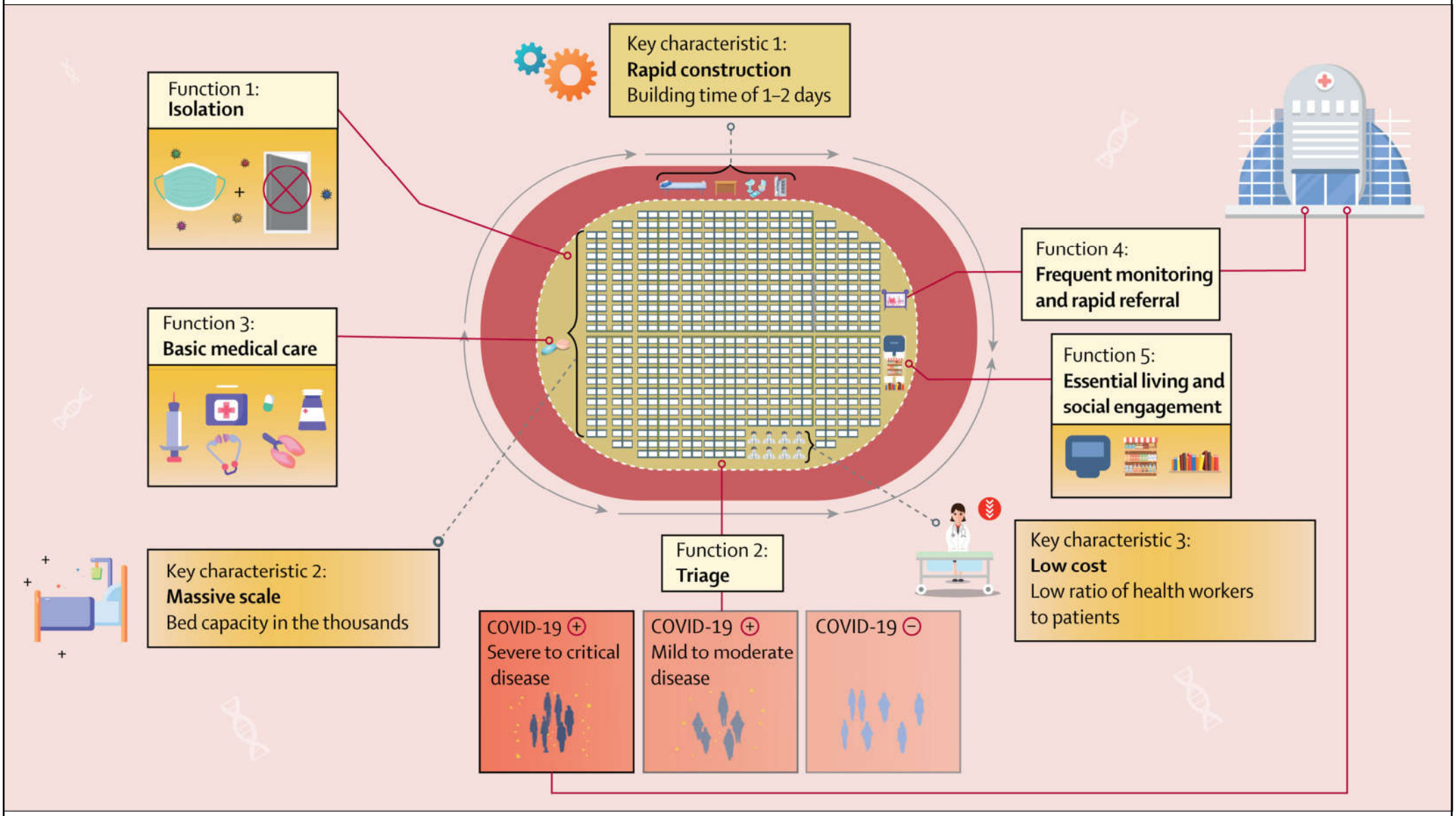
China: A sports stadium in Wuhan

USA: Jacob K. Javits Center in New York City

Spain: Fira Barcelona Montjuic centre in Barcelona

(Source: https://www.cnbc.com/2020/04/03/photos-of-field-hospitals-set-up-around-the-world-to-treat-coronavirus-patients.html)

Key characteristics and essential functions of Fangcang shelter hospitals (方艙醫院)

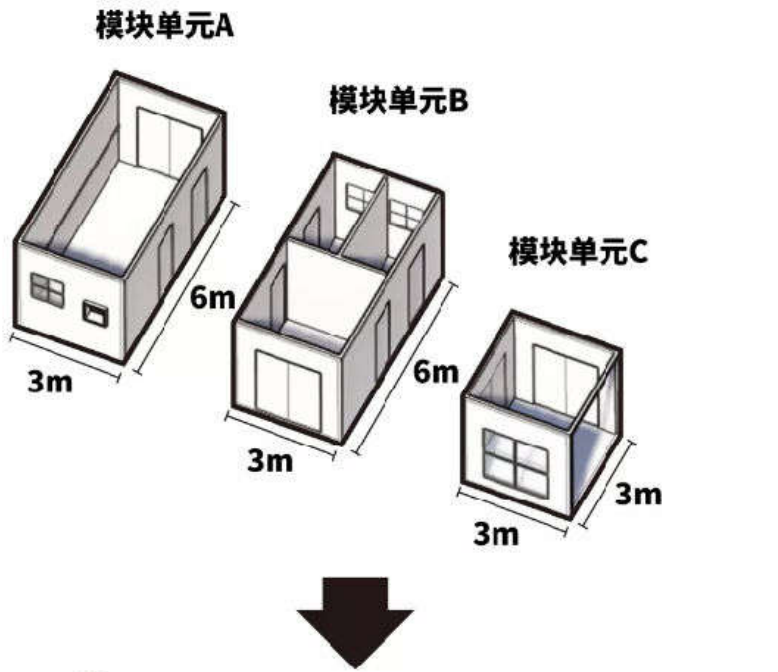


(Source: Chen, S. et al., 2020. Fangcang shelter hospitals: a novel concept for responding to public health emergencies, *Health Policy*, 395 (10232): 1305-1314. https://doi.org/10.1016/S0140-6736(20)30744-3)

Huoshenshan Hospital in Wuhan 武漢火神山醫院

图 1：火神山医院每个护理单元有 50 床，每 4 个单元为 1 个医疗区

数据来源：网易新闻，中信建筑设计院



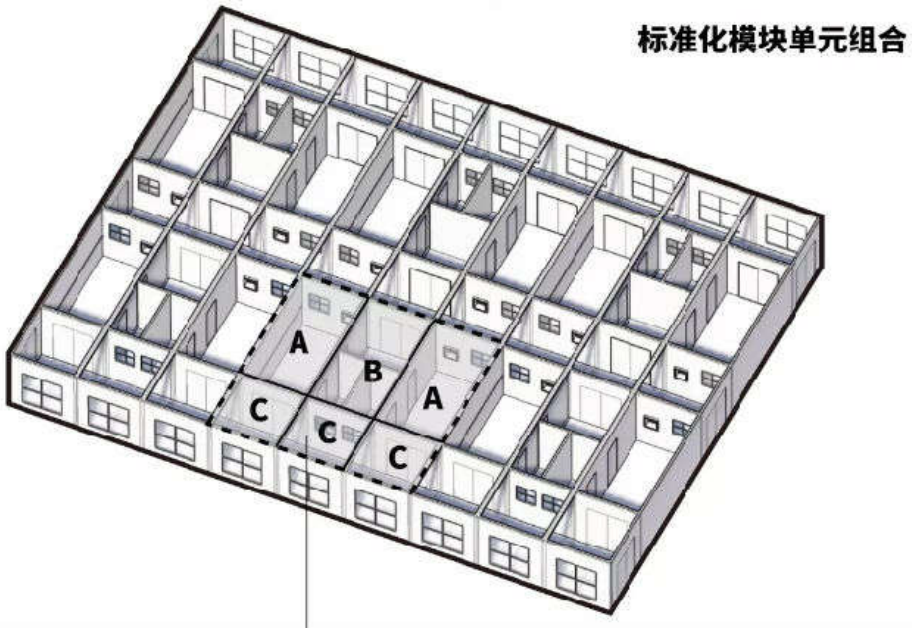


图 2：火神山医院平面图呈现 L 型

数据来源：网易新闻

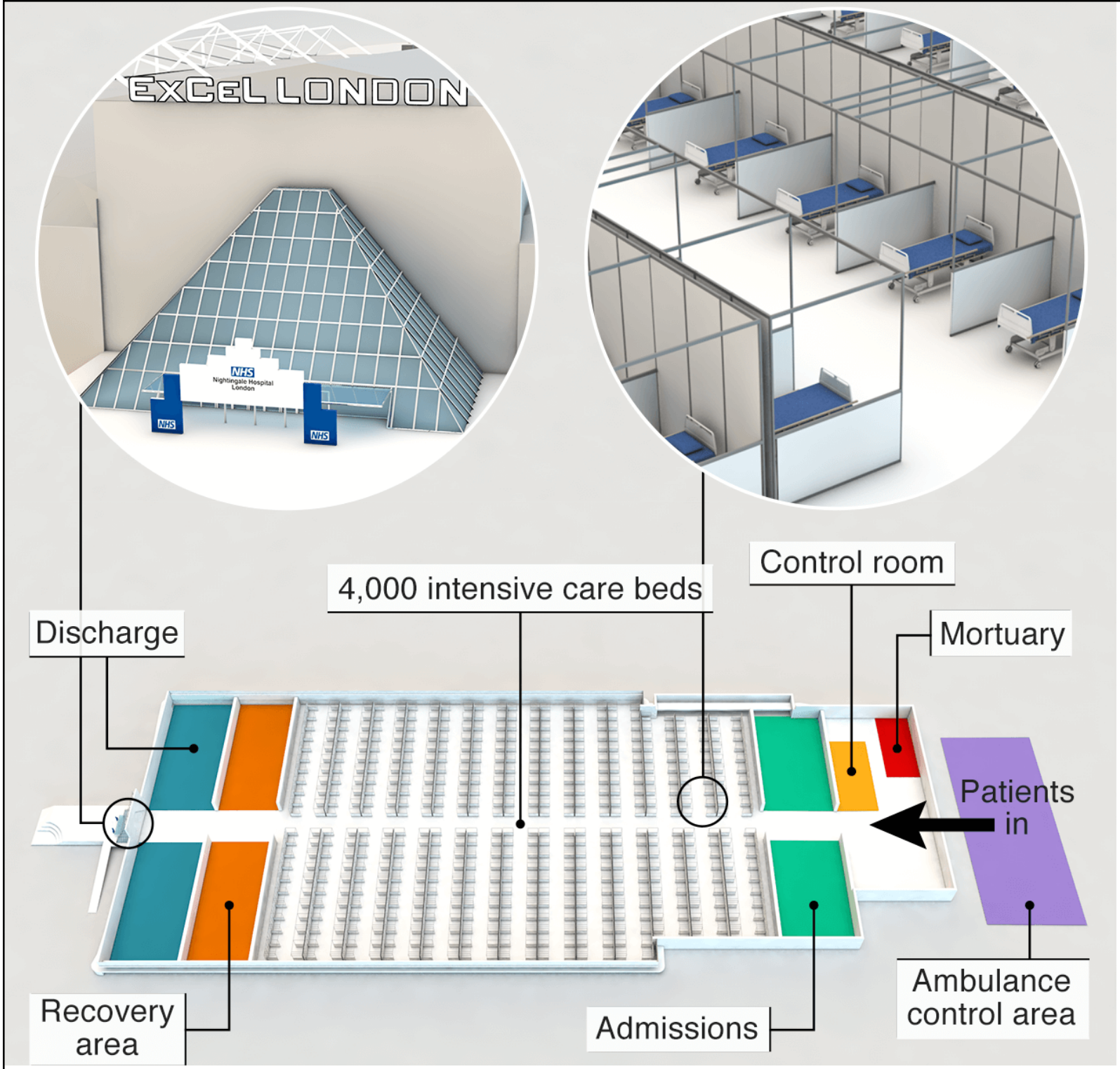
图 3：火神山医院病房效果图

数据来源：网易新闻

(Source: 从火神山、雷神山医院看装配式钢结构的应用_证券公司研报 http://www.precast.com.cn/index.php/subject_detail-id-14514.html；火神山房屋结构是啥样的？ http://www.precast.com.cn/index.php/subject_detail-id-14565.html)

Building the New NHS Nightingale Hospital in East London's ExCeL exhibition centre in just nine days

(Source: How NHS Nightingale was built in just nine days https://www.bbc.com/news/health-52125059)



The temporary NHS Nightingale hospital has space for 4,000 intensive care beds

(Source: How NHS Nightingale was built in just nine days https://www.bbc.com/news/health-52125059)

Emergency management

- Converting hotels into hospitals or quarantine sites
  - In pandemic, hospitals are overflowing; hotels are empty
  - Which hotels & for what medical needs? Four scenarios:
    - 1. To quarantine suspected or asymptomatic patients
    - 2. Non-COVID-19 positive patients in recovery who don't require life-support equipment (relocate them to free up hospital beds)
    - 3. Non-COVID-19 positive patients in recovery that require specialized & powered equipment
    - 4. COVID-19 positive patients in treatment
  - Key considerations: cleanable surfaces, mechanical & electrical systems, nurse-call devices & handwash sinks

(References: https://www.bdcnetwork.com/covid-19-innovation-setting-parameters-hotel-hospital-conversions; https://www.bdcnetwork.com/cities-scramble-hospital-beds-treat-covid-19-patients-leo-daly-offers-hotel-hospital-solution)

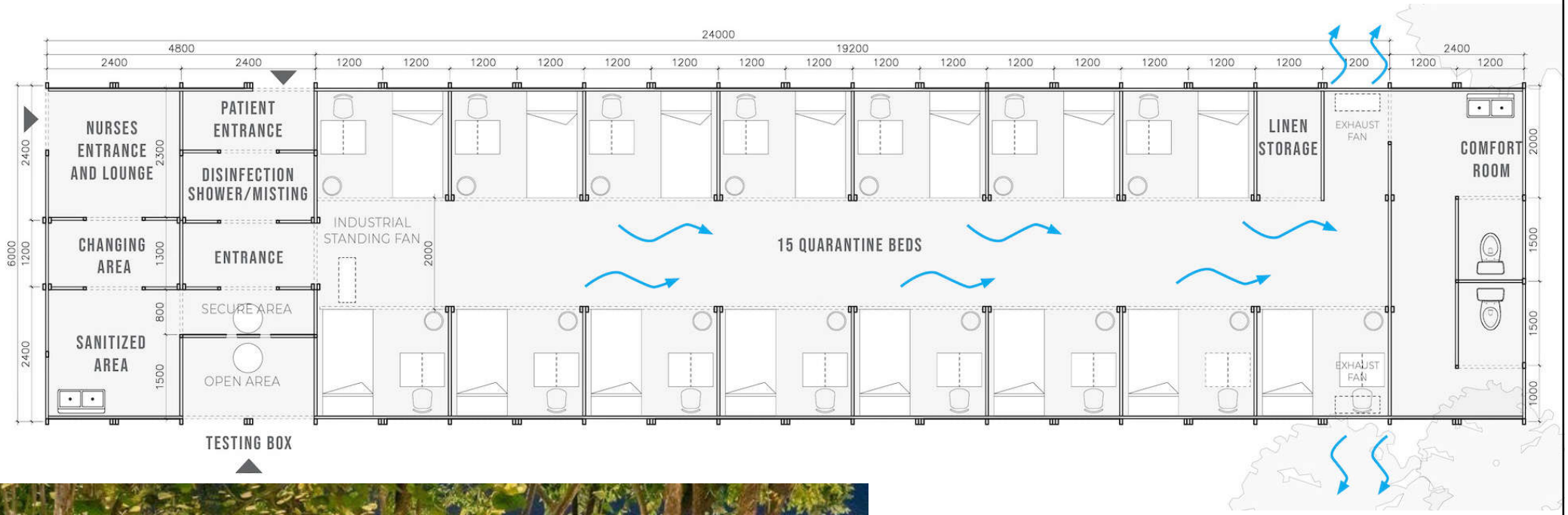
Emergency management

- **Quarantine facilities 檢疫設施**
  - Healthcare & quarantine needs increase from the pandemic
  - Also housing clinical staff to treating low-acuity patients
  - Emergency quarantine facility - unoccupied/acquired buildings, temporary shelters/pavilions, hotels/dorms
    - Key factors: Speed, readily available, location & scalability
  - Examples:
    - Hong Kong: Recreation centre, holiday village, training camp, newly built public housing, modular units, hotel
    - Philippines: Temporary structures built on site https://www.wtadesignstudio.com/eqf/

Quarantine camp set up at Lei Yue Mun Park and Holiday Village

(Source: https://www.scmp.com/news/hong-kong/health-environment/article/3052522/coronavirus-new-hong-kong-quarantine-camps-cost)

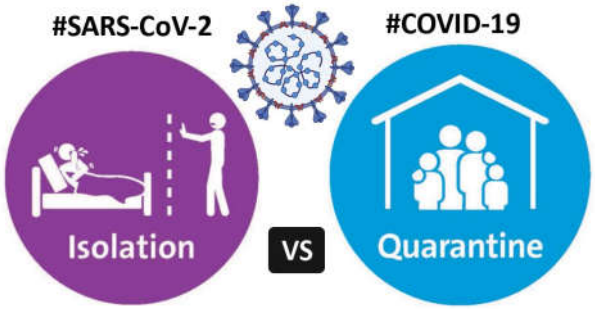
Temporary/Emergency quarantine facilities (Manila, Philippines)



(Source: https://www.architecturalrecord.com/articles/14553-manila-based-architecture-firm-designs-temporary-quarantine-facilities; https://www.wtadesignstudio.com/eqf/)

Emergency management

- Quarantine vs Isolation: 檢疫 vs 隔離
  - **Quarantine** is the restriction of activities or separation of persons (in a non-health care facility) who are not ill, but who might have been exposed to infection, with the objective of monitoring symptoms & early detection of cases, for preventing transmission of diseases
    - Usually quarantined in their homes or community-based facilities
  - **Isolation**, different from quarantine, is the separation of ill or infected persons from others, so as to prevent the spread of infection or contamination
    - Using isolation rooms or facilities



Mobile quarantine facility: The crew of Apollo 11 in quarantine after returning to Earth, visited by Richard Nixon.

(Source: https://en.wikipedia.org/wiki/Mobile_quarantine_facility)

Emergency management

- Guidelines for quarantine facilities:
  - Evaluation of potential sites
  - Risk assessment
  - Securing entry & exit points
  - Human resource arrangement
  - Coordination, monitoring & supervision
  - Logistic management, cleaning & supplies
  - Social support and recreation

(Source: Guidelines for Quarantine Facilities COVID-19 - NCDC, India https://ncdc.gov.in/WriteReadData/l892s/9054265331158454612 0.pdf; Guidelines: Establishing Quarantine Facility https://www.nih.org.pk/wp-content/uploads/2020/03/20200325-Guidelines-for-Quarentine-Facility-Establishment-0301-1.pdf)

Conclusion

- COVID-19 crisis will not end soon ☹ ☹ ☹
  - Successful pandemic response requires close coordination between the health system & the greater community
- Engineering support is crucial for tackling the public health emergency
  - To leverage problem-solving skills to optimize safety & mitigate risk in health care facilities
  - Engineers could help in master planning, risk assessment, troubleshooting & solving technical problems
- We should learn from the mistakes made before (e.g. SARS 2003)

THANK YOU 謝謝 !!

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