Hospital Isolation Facilities

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Background

- SARS outbreak in Hong Kong and among other countries in early 2003.
- Healthcare workers also infected after caring SARS patients.
- Huge social and economic impact.
- Public concerns on inadequate and inefficient patient isolation.
- Growing concerns on resurgent of SARS in winter of 2003.
- Necessary to promptly establish effective and efficient isolation facilities in public healthcare sector.

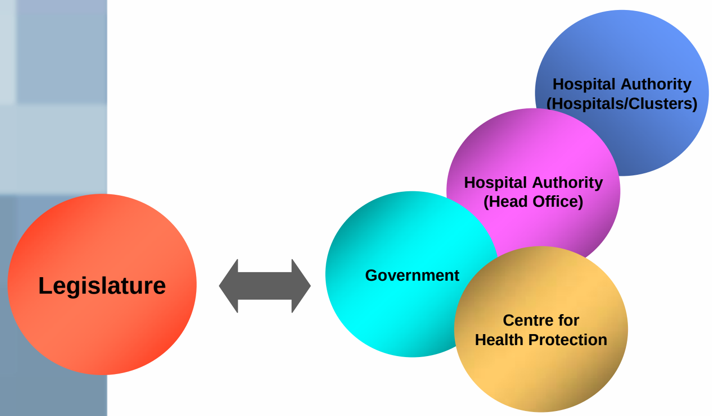
Immediate Questions

- How many of these isolation facilities are required?
- Where to build them? New building or existing renovation?
- What is the design standard?
- Can we build them to cater for likely 2003 winter resurgent of SARS (in less then six months time)?

Immediate Questions

- Policy issues
- Operation issues
- Technical issues

Policy & Operation Consideration



Policy & Operation Consideration

- Establish Community Alert System
- Set up Territory-wide Command Hierarchy.
- Decide isolation beds quantity requirement.
- Assign patients cohort across public hospitals with operation plan.
- Approve construction of isolation facilities in existing public hospitals.
- Lay down isolation facilities functional specifications.

Cascade to Operation and Technical Consideration

Isolation Facilities Functional Specifications

- Creation of negative pressure gradient with air flowing from “clean” zones (e.g. ward corridors) to “dirty” zones (e.g. patient rooms);
- Provision of 100% fresh air supply at no less than 12 air changes per hour;
- Installation of low level exhaust for better air flow pattern;
- Installation of high efficiency particulate air (HEPA) filter for filtering out droplets and aerosols;

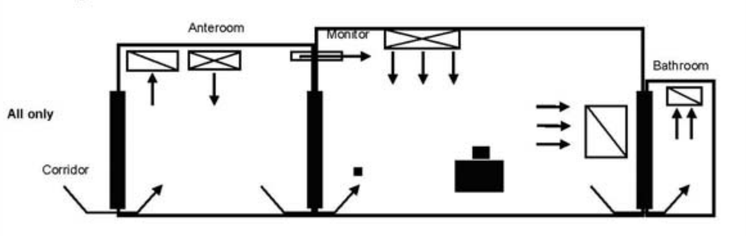
Cascade to Operation and Technical Consideration

Isolation Facilities Functional Specifications

- Air-tight construction for patient rooms to prevent cross contamination;
- Addition of doors to close off existing open cubicles;
- Provision of en-suite toilet / shower facilities in ward cubicles where existing building structure and building services installations permit; and
- Provision of infection control facilities for hospital staff such as gowning / de-gowning areas, changing rooms, shower facilities and clinical wash-hand basins.

Cascade to Operation and Technical Consideration

Isolation Facilities Functional Specifications



- The top diagram indicates air flow patterns when patient with only airborne infectious disease occupies room. Middle and bottom diagrams indicate recommended air flow patterns when room is occupied by immunocompromised patient with airborne infectious disease. Stacked black boxes represent patient beds. Long open boxes with cross-hatches represent supply air. Open boxes with single, diagonal slashes represent air exhaust registers. Arrows indicate directions of air flow.
- All isolation room with anteroom engineering features include
  - pressure differential of 2.5 Pa (0.01-in. water gauge) measured at the door between patient room and anteroom;
  - air flow volume differential >125-cfm. depending on anteroom air flow direction (pressurized versus depressurized);

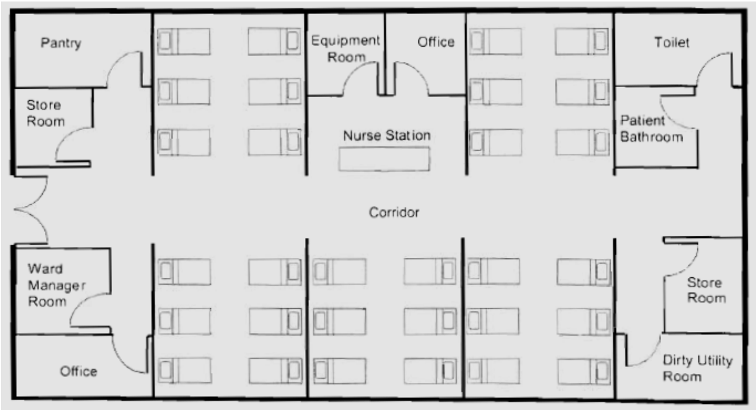
Source: CDC Guideline

Cascade to Operation and Technical Consideration

Operation & Technical Consideration

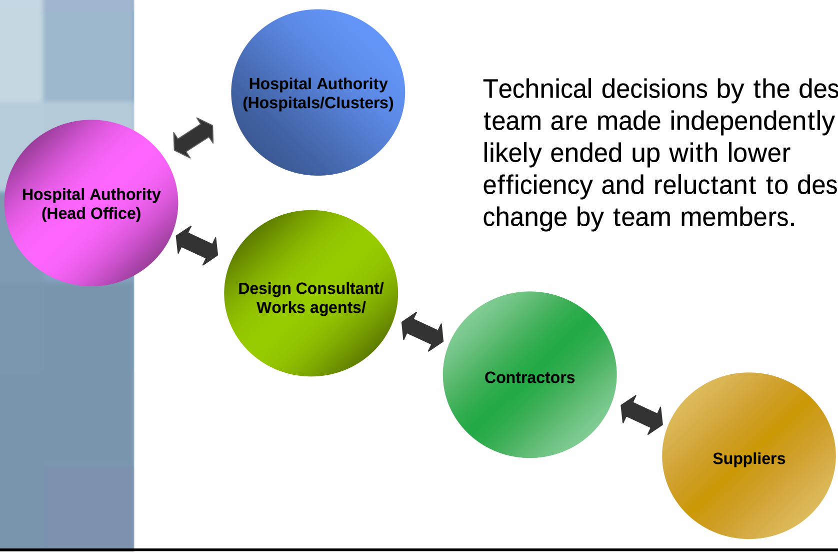
- Encountering different existing hospitals with different layouts and most likely come with site constraints.
- Reducing existing hospital beds capacity to fit in isolation beds setup with larger space requirement.
- Anticipating significant increase on energy use by employing high air changes of 100% hot and humid outside air.
- Designing air-conditioning and mechanical ventilation control for multiple isolation rooms within a single hospital ward.
- Sourcing and securing required major air conditioning and control products within short line.

Operation & Technical Consideration



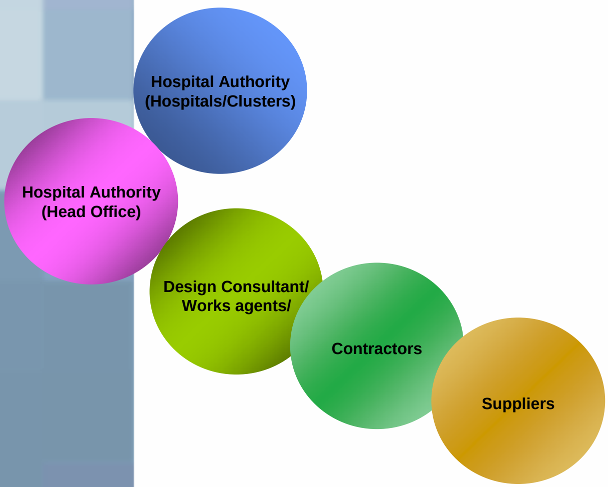
Layout of general patient ward

Traditional Approach

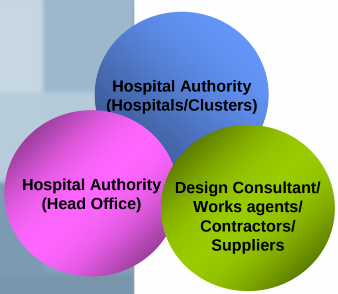


Technical decisions by the design team are made independently and likely ended up with lower efficiency and reluctant to design change by team members.

Integrated Approach



Integrated Approach



“Interaction among all building disciplines, from earliest concept development throughout the building life cycle, in order to achieve integration of design efforts and operation of the total building”

- ASHRAE Technical Committee 7.01 – Integrated Building Design

Integrated Approach - Resolved Issues

- Larger space requirement - Reducing existing hospital bed number issue

Resolution: Single cohort (suspected patient),
Group cohort (confirmed patient)

Integrated Approach - Resolved Issues

- Single cohort ante room - Existing site constraint issue

Resolution: Shared ante room with interlocking doors

Integrated Approach - Resolved Issues

- Single entrance/ exit - Pressure gradient control issue

Resolution: Interlocking doors for ward entrance, gown up area and gown down area

Integrated Approach - Resolved Issues

- Low level exhaust - Narrowing room width issue

Resolution: Tapered exhaust air duct

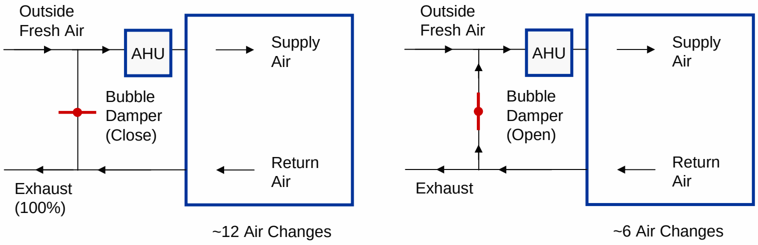
Integrated Approach - Resolved Issues

- Multiple room isolation - Pressure gradient control issue

Resolution: Air tight door, pressure regulated damper, Air flow tracking control system

Integrated Approach - Resolved Issues

- Stringent ventilation - Energy use issue



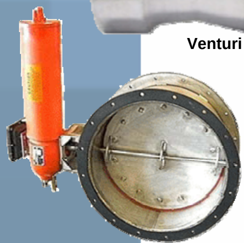
SARS Mode **Non-SARS Mode**

Resolution: SARS mode and non-SARS mode, Bubble tight damper

Integrated Approach - Resolved Issues

- Air-conditioning and mechanical ventilation components - Lead time for delivery issue

Venturi valve



Bubble tight damper

Air tight door

Air handling unit

Resolution: Direct supplier/ manufacturer contact

Integrated Design Process - Manifestation

- Relied upon a multi-disciplinary and collaborative team in making decisions together based on a shared vision and understanding of the project.
- Achieved high performance on the wide variety of social and environmental goals while staying within scheduling constraints.
- Maintained sustainable public hospital services operation under both normal and likely pandemic situations with optimized use of energy.

Thank You