Addressing Various Clinical Patient Safety Needs in High-Rise Hospital Design

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• PRESENTERS:
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• PRESENTATION OVERVIEW:
  – Understanding Definition of “Patient Population Classification in regards to Mobility”
  – Determining “Impracticable to Move”
  – Case Study: BC Children’s and Women’s Hospital Redevelopment Project

• OBJECTIVES:
  – Understanding Medical Impracticalities of Moving Patients
  – Understanding High-Rise Acute Care Hospital Smoke Control Requirements
  – Approach & Strategies for Successfully Implementing Smoke Control Systems
1. All Acute Care high rise hospitals should be designed with active smoke control systems, for all floors and all patient types.

2. The VBBL 2010 and CSA Z317.2 HVAC Systems for health care should be amended, and the use of “from which it is impractical to move patients in an emergency” (VBBL 2010, 3.3.3.6. Areas of Refuge) should be replaced with “and all smoke compartments in acute care hospitals regardless of patient/occupant type.”
History of Smoke Control in Vancouver High-Rise Hospitals

- ASHRAE Smoke Control Manual 1992
- NFPA 92A Standard for Smoke-Control Systems
- The following are buildings that were early implementers of smoke controls:
  - Cancer Control Agency of British Columbia (CCABC) 1984
  - Vancouver General Hospital (VGH) 1986
High-Rise Hospital Design - Code Requirements

- Vancouver Building Bylaw 2014
- British Columbia Building Code 2012
- CSA Z317.2 – Specific Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Health Care Facilities
Additional Requirements for High-Rise Hospital Design

- ADDITIONAL REQUIREMENTS FOR HIGH RISE BUILDINGS:
  1. 3.2.6.2 Limits to Smoke Movement
     - Smoke control: In a 2 hour period after the start of a fire, the building shall not contain more than 1% of smoke volume from the fire area’s contaminated air.

  2. 3.2.6.6 Venting to Aid Firefighters:
     - 6 Air Changes per hour of exhaust (or smoke shafts/windows).
     - Fire compartment smoke zone switch at CACF.

Smoke Control vs. Smoke Venting
Additional Requirements for High-Rise Hospital Design Cont’d

3. 3.3.3.5 Compartments and Fire Separations

• Floor areas containing patients (or residents’) sleeping rooms in a care or treatment occupancy – where overnight sleeping accommodation is provided for more than a total of 10 patients or residents – shall conform.

• Except as permitted, a floor area shall be divided into not less than two fire compartments, each no smaller than 1,000 m² in area.
High-Rise Hospital Design – Fire Alarm Response

- **FIRST STAGE FIRE ALARM RESPONSE:**
  - Horizontally relocate patients to an adjacent fire compartment on same floor where practical to do so

- **SECOND STAGE FIRE ALARM RESPONSE:**
  - Vertically evacuate the entire floor via stairwell
  - Relocate patients to lower floors/out of the building

OR

- **Provide an Area of Refuge (Pressurized Zone)**
Areas of Refuge for Care Facilities

- Smoke compartments containing rooms such as operating rooms, recovery rooms, delivery rooms and intensive care units, from which it is impracticable to move patients in an emergency shall be:
  - Separated from adjacent spaces by fire separations having a fire-resistance rating no lower than 1 h.
  - Provided with a mechanical air supply so that during a period of 2 hours after the start of a fire in another space, the compartments will not contain more than 1% by volume of contaminated air from the fire area.

Smoke Compartments are provided with mechanical air supply to pressurize for 2 hours.
Area of Refuge

- An area of refuge provided with mechanical air supply will continue to operate during a fire to assist in keeping the area smoke free.

Pressure difference across a barrier – TRANE Applications Guide, Engineered Smoke Control System

HVAC operation during smoke control – TRANE Applications Guide, Engineered Smoke Control System
Defining: “Impracticable” vs. “Impractical” to Move

• **Vancouver Building Bylaw 2014:**
  - Compartments containing rooms such as operating rooms, recovery rooms, delivery rooms, and intensive care units, *from which it is impracticable to move patients in an emergency* shall be provided with a mechanical supply that will continue to operate during a fire to assist in keeping the areas smoke free.”

• **CSA Z317.2:**
  - “Operating rooms, delivery rooms, intensive care units, and other areas where *it is impractical to move patients in an emergency* shall be provided with a mechanical air supply that will continue to operate during a fire to assist in keeping the areas smoke free.”
Clinical Interpretation: “Impracticable” vs. “Impractical” to Move

- **IMPRACTICABLE**: Patients that are *impossible* to move (specific) – VBBL 2014
- **IMPRactical**: Patients that *cannot realistically* be moved (general) – CSA Z317.2
  - Subtle but important difference - somewhat open to interpretation
  - Difference in Clinical versus Builder interpretation

Example Case Study: BC Children’s and Women’s Hospital – TECK Acute Care Centre
BC Children’s + Women’s TECK Care Facility
CASE STUDY: BC Children’s & Women’s Hospital Project

• VANCOUVER BUILDING BY-LAW (VBBL) REQUIREMENTS

Design-Builder’s Approach:

– Active smoke control designed for levels 1-4 (patients impractical to move)
– Medical/Surgical Inpatient Units (levels 6 & 7) designed with 1-hour passive smoke control system
– Assumed level 6 & 7 patients would move to lower floors
– Clinical interpretation did not agree
Defining “Impractical/Impracticable to Move”
Clinical Interpretation

- Clinical Standpoint - Patients Requiring:
  - Tertiary Care: highly specialized care/treatment over extended time
  - Quaternary Care: Tertiary care + experimental medicine/specialized procedures
  - Surgical Procedures
  - Invasive Procedures
  - Complex respiratory monitoring
  - Metabolic, endocrine, biochemical, gastrointestinal, or rheumatology care
C+W HOSPITAL LEVEL 6 + 7:
Defining “Impractical/Impracticable to Move”
Clinical Interpretation

• Clinical Standpoint - Patients Requiring:
  – Tertiary Care: highly specialized care/treatment over extended time
  – Quaternary Care: Tertiary care + experimental medicine/specialized procedures
Defining “Impractical/Impracticable to Move” Clinical Interpretation

• Clinical Standpoint - Patients Requiring:
  – Surgical procedures and in-patient post-op care/monitoring
  – Invasive “high acuity” post-op monitoring (neuro, heart, orthopedic, lumbar, burns, apnea)
Defining “Impractical/Impracticable to Move”

- Clinical Standpoint - Patients Requiring:
  - Complex respiratory monitoring
  - Metabolic, endocrine, biochemical, gastrointestinal, or rheumatology care
Patients deemed “impractical to move” means: it is more dangerous to move patients than remaining in situ, therefore an active 2-hour mechanical smoke system is required to create an “Area of Refuge”, i.e. defend in place.
CASE STUDY:
BC Children’s & Women’s Hospital Project

• SUMMARY OF CASE STUDY
  – Medical/Surgical Units (levels 6 & 7) will be of a complexity and acuity such that it will be impractical and potentially hazardous to move them in the event of a fire, particularly in a vertical direction
  – Patients on these units would be most safely managed by the provision of smoke handling methods such as those proposed for level 4 and below
  – A reasonable interpretation of the specifications for the Medical/Surgical Inpatient Units would have been that these patients would be most safely managed with a “defend in place strategy”
  – In summary, the clinical opinion overruled the code position. One needs to understand the clinical requirements to interpret the Code
CASE STUDY SUMMARY:
BC Children’s & Women’s Hospital Project

• DIFFERENT LEVELS OF PROTECTION AGAINST FIRE & SMOKE IN A HOSPITAL ENVIRONMENT

  Vancouver Building By-Law (VBBL) and Canadian Standards (CSA):
  – Least moveable patients require greatest protection from fire and smoke
  – Designates Medical/Surgical Units (BCCW levels 6 & 7) as Areas of Refuge for least moveable patients
  – Assumes critical/complex care patients will remain in situ
  – Requires min. 2-hour mechanical air supply pending control of fire
  – Ductwork supplying air requires min. 2-hour protective fire wrap
  – Feeder conduits also required to meet a min. 2-hour rating
FINAL THOUGHTS:

- Major High Rise Acute Care Facilities should have *active smoke control*
- Future Flexibility – Particularly Healthcare

**Recall Supposition:**

1. All Acute Care high rise hospitals should be designed with active smoke control systems, for all floors and all patient types.
2. The VBBL 2010 and CSA Z317.2 HVAC Systems for health care should be amended, and the use of “where impractical to move” should be replaced with “and all smoke compartments in acute care hospitals regardless of patient/occupant type.”
• Including design considerations
• Building Blocking & Stacking
  – They should include well planned smoke compartments connected directly to fire rated shafts

Active smoke control does not necessarily cost more.