Advance Measures in Promoting Radiation Safety for Operating Theatre

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(KWC, HA)
General Information:

- **1 Sievert (Sv)**
  - = 1000 mSv
  - = 1000000 uSv

- **Background Radiation** = 2.2 mSv/yr

- **HK region’s summer time:**
  - HK island = 2.29 – 3.92 uSv/day
  - KWC = 2.84 – 3.75 uSv/day
General Information:

- One Chest X-ray = 20\,\text{uSv}
- Fly from HK to London = 40\,\text{uSv}
- Dose causing different types of biological damages:
  - Dizzy, diarrhoea \sim 1500\,\text{mSv}
  - Induction of Menopause \sim 3000\,\text{mSv}
  - Depression of sperm count \sim 250\,\text{mSv}
  - Skin change \sim 20000\,\text{mSv}
  - Lens Cataract \sim 15000\,\text{mSv}
General Information:

- Annual dose limited = 20 mSv/year
- 20 mSv = ~1000 CXR
Introduction:

- Information from different sources revealed that there was inconsistent safety measures among operating theatre built before year 2002.

- The inconsistency may result in unnecessary exposure to ionizing radiation to the OT staff.
Physicist’s visit has been arranged to measure our environment in all dimensions for level of Radiation leak.

According to the result, measurements have been worked out and improvement project was undertaken.
Objectives:

- To identify possible risks in OT related to Radiation Safety.
- Through out the implemented activity to promote and arouse staff’s concern in Radiation Safety.
- And ease their uncertainty when they knew more.
Methodology:

Arrange Physicist’s visit to measure our environment in all dimensions for level of Radiation leak e.g. inside and outside the theatre to look for the safe margin.
C-arm screening in the theatre on an X-ray Phantom which similar to human body absorbing the radiation. Handheld Surveillance Dosimeter is used to detect radiation level in different distance inside theatre while screening.
Handheld Dosimeter
Handheld Surveillance Dosimeter is also used to detect area outside theatre while screening is undertaken inside theatre. And check for the safe margin outside theatre.
Testing condition
- C-arm: 87 kVp
- Continuous mode: 3.7 mA
- Duration: 10 sec
- Orientation: PA

Survey meter
- Fluke 451P
- Freeze mode
- Background: 0.2 uSv/hr

Scattering material
- CT perspex phantom

Date of measurement
- 9-Aug-2012

Survey performed by:
- Mr. Nelson Lam
- Physicist, PMH

Anesthetist location:
- 1.25 (with lead shield)
- 6 (without lead shield)

Unit: uSv/hr
Result:

- Door from Preparation room = 5.9 \text{uSv/hr}
- Door from Induction room = 8.2 \text{uSv/hr}
- Door from Dirty corridor = 7.9 \text{uSv/hr}
- Theatre Main door = 16 \text{uSv/hr}
- Anesthetist location
  - without Lead Shield = 6 \text{uSv/hr}
  - with Lead Shield = 1.25 \text{uSv/hr}
Result:

- Result showed that the instantaneous dose rate of a “mobile” C-arm exceeds the limit of 3uSv/hr outside the room as reference from the Radiation Ordinance CAP 303 Regulation for “static” Irradiating Apparatus.

- The safest area shown only is the area behind the lead shield 1.25uSv/hr.
Advance actions worked out for the department:

- The number of protective devices has greatly increased based on the actual leak measured by the Physicist.
1. Number of **Lead apron & Neck collar** increased to the level of adequately support 3 theatres.
2. Number of Lead shield increased from 2 to 6. They can also support 3 theatres at the same time for protection of anesthetist and circulating nurse.
3. 2 protective blankets were newly added for the protection of patient.
Clear label were made to identify unsafe zone and warning sign shown that no observer should stand outside the theatre in that zone.
The other improvement work is trying to switch from using ‘continuous’ mode to ‘pulse’ mode of the C-arm machine.

This will significantly reduce the dose rate and also improve life-time of x-ray tube.
Conclusions:

- The result of the environment screening has been brought to HA Radiation Safety Committee for further recommendation.

- The current circumstances is that it involves a significant number of Operating Theatre already-in-operation.
Conclusions:

- Changing all doors to lead-lined in fully operated Theatres is recommended but it is tedious & painful.

- Problem is each lead-lined door weighs heavily. Door frame should also required to be modified.

- Improper installation can be a serious OSH issue.
Conclusions:

- According to the result of this activity, the safety issue in our new block’s Day Surgery Center (2014) is also being concerned and 2 theatres out of 3 were approved to build with lead-lining wall.
Last but not least, the most important issue is the concern of radiation safety among all staff including anesthetists, which have much improved via this activity.
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The End