Radioprotection of staff in nuclear medicine

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Overview

- Introduction
- Situation of NM in the total dose distribution of nuclear workers
- Study 2003-2005 (Dose determining parameters)
- PET study of Health Council (2002-2004)
- Conclusion
Introduction

DOSIMETRY?

Film
↓
image + dose

Tld
↓
dose

Since 1965

Keeping the doses low by setting the standards high
Introduction

Electronic dosemeter (EPD)

Teaching

Reflection

Awareness
Introduction

Dosimetry to evaluate

- Dose limits
- Optimisation
- Radioprotection measures
- Your own dose ‘in competition’ with peers
Overview

- **Introduction**
- **Situation of NM in the total dose distribution of nuclear workers**
  - Study 2003-2005 (Dose determining parameters)
  - PET study of Health Council (2002-2004)
- **Conclusion**
Evolution of 12M doses of nuclear workers in Belgium

Since 1965
Dose distribution of nuclear workers in Belgium
Dose distribution of nuclear workers in a hospital
Overview

• Introduction
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Study 1998 – 2000

- In house study of dosimetry without consultation of the field (20 NM departments)
- Inaccuraccy : no data about working hours

RESULTS
- No significant difference in average doses over the years 1998 –2000 (< 20% variation)
- Highest doses on the group of technologists
Average dose in function of time

- Average 2000
- Average 1999
- Average 1998
Average dose in function of activity

![Bar Chart]

- **Average dose (µSv)**
  - 0
  - 1000
  - 2000
  - 3000
  - 4000
  - 5000
  - 6000

- **Roles**
  - Physician
  - In Vitro Lab
  - Technologist
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Study 2003-2005

- 15 NM departments (1500 - 6000 patients/year)
- 38 Technologists

- In depth evaluation on site by a health physicist
  - Department characteristics
  - Personnel characteristics
Results

- **Average dose of a technologist normalised for Full Time Equivalent (FTE)**
  
<table>
<thead>
<tr>
<th>Year</th>
<th>Dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>6.32</td>
</tr>
<tr>
<td>2004</td>
<td>6.62</td>
</tr>
<tr>
<td>2005</td>
<td>5.96</td>
</tr>
</tbody>
</table>

- **50% doses less than 5 mSv/y (FTE)**
- **Minimum : 1.22 mSv/y**
- **Maximum : 14.43 mSv/y**
Results

- Individual dose (FTE) per # patients per FTE

My dose is 3 mSv (12M), I work 4/5, we do 2500 patients per year and I have a colleague that works full time.

\[
3 \times \frac{5}{4} \times \frac{1}{2500} \times 1.8 = 2.7 \, \mu\text{Sv}
\]
Seniority, working regime

![Graph showing the relationship between seniority, working hours, and individual doses.]

- **Working hours/week**
- **Seniority**
- **Normalised individual doses (FTE, p)**

Since 1965, seniority and working regime have been key factors in maintaining low doses by setting high standards.
Since 1965

Attitude

![Bar chart showing individual dose (FTE) per patient per FTE (µSv) for social behavior, syringe protection, and lead apron. The chart displays the frequency of behaviors as follows:

- **Always**
- **Sometimes**
- **Never**

The chart indicates that syringe protection and lead apron use are more commonly practiced compared to social behavior.]
Results

• Collective dose per # patients

My dose is 3 mSv (12M), (I work 4/5), we do 2500 patients per year and I have a colleague (that works full time) and her doses is also 3 mSv (12M).

\[ \frac{(3 + 3)}{2500} = 2.3 \mu Sv \]
Size hotlab and cameraroom

Collective dose/ # patients (µSv)

- Small
- Medium
- Large

Size hotlab
Size Cameraroom
Overall impression (scored on 5)

Score on 5 point
- Clean?
- Neat?
- Organisation?
- Collective dose / # patients (µSv)

Department
N E C O D K B F A I J H G L M

Keeping the doses low by setting the standards high
Influence of radionuclide therapy
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PET study

- Evaluation of the influence of PET on the occupational dose radiation workers. Do we need to provide guidelines?
- Inaccuracy: not fully completed forms

- 2002-2004
- 8 PET/SPECT (61 technologists) → av. 700 beds
- 13 SPECT (44 technologists) → av. 400 beds
FTE Hp(10) (mSv/y)

Since 1965

Keeping the doses low by setting the standards high

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Keeping the doses low by setting the standards high

Hp(10)/examination (μSv)

![Graph showing Hp(10)/examination (μSv) for 2002, 2003, and 2004, with categories for TOTAL, PET/SPECT, and SPECT.](image)
Work in hotlab?

![Graph showing individual Hp(10)/examination (µSv) levels for different categories: TOTAL, PET/SPECT, SPECT.](image)

- TOTAL
- PET/SPECT
- SPECT

**Individual Hp(10)/examination (µSv):**

<table>
<thead>
<tr>
<th>Category</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PET/SPECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Injection of patients?

![Box plot showing individual Hp(10)/examination (µSv) for TOTAL, PET/SPECT, and SPECT categories.]

- **TOTAL**
- **PET/SPECT**
- **SPECT**
Use of syringe protection?

<table>
<thead>
<tr>
<th>Individual Hp(10)/examination (µSv)</th>
<th>TOTAL</th>
<th>PET/SPECT</th>
<th>SPECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Rare</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Always</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Rare</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Since 1965

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Use of lead apron?

95% rare/never → poor data
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Conclusions

- Important parameters:
  - Attitude of worker
  - Adapted department (design, …)
  - Keep it neat and well organised
  - Seniority – working regime
Conclusions

- PET/SPECT $\approx$ SPECT
  - $\uparrow$ per examination
  - $\downarrow$ number of examinations
- More important to follow RP rules
Conclusions

- Statistic tools on dosimetry shows trends and can reveal dose determining parameters.
- Lack of central database!
- Dosimetry is an instrument in health physics for continuous reduction of individual doses (ALARA).
Thanks to

- Health Council
  - François Jamar
  - Peter Covens
- Belgian Society of Nuclear Medicine