During 2010, 34,436 CAs and 29,932 PCIs were performed in the Left ventriculography were performed in 57.7% of CAs and 49.4% of the PCIs were ad hoc. High exposure levels at risk for deterministic effects (DAP >300 mGy.cm²) were estimated at interventional reference point (CD, mGy) were found in 0.7% and 4.1% of the procedures, respectively. Heterogeneity between centers was high for DAP (Figure 1) and CD, and less apparent for fluoroscopy time (Figure 2).

Table 1. Radiation Dose Indicators for CA and PCI

<table>
<thead>
<tr>
<th>DAP, Gy.cm²</th>
<th>CA Alone</th>
<th>Elective PCI</th>
<th>CA + Ad-hoc PCI</th>
<th>All PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Range</td>
<td>10-3163</td>
<td>10-3163</td>
<td>10-3163</td>
<td>10-3163</td>
</tr>
<tr>
<td>Number of frames</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Range</td>
<td>5-1065</td>
<td>5-1065</td>
<td>5-1065</td>
<td>5-1065</td>
</tr>
<tr>
<td>Cumulative dose, mGy</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Range</td>
<td>0-770</td>
<td>0-770</td>
<td>0-770</td>
<td>0-770</td>
</tr>
</tbody>
</table>

1. Baseline
- During 2010, 34,436 CAs and 29,932 PCIs were performed in the 44 centers included into the analysis. Data were obtained for 33,937 CAs (96% of the total activity, IQR of centers 95-100%) and 27,826 PCIs (96%, IQR 96-100%).
- 86% of the PCIs were ad hoc.
- Left ventriculography were performed in 57.7% of CAs and 49.4% of PCIs; 6.2% of CAs and 21.8% of ad hoc PCIs were emergency procedures.
- Radial approach was used in 70.4% of CAs and in 68.2% of all PCIs.

2. Radiation dose parameters
- DAP was registered routinely in 91.7% of the centers (91.5% of CAs and 91.1% of PCIs). Fluoroscopy time was registered routinely in 87.5% of centers and in 83.1% of procedures. Number of frames, number of runs, and CD were registered routinely in 20.8%, 29.2%, and 47.9% of the centers, and in 16.4%, 19.8%, and 32.3% of the procedures, respectively.
- Median, quartiles, and extreme values of parameters are shown in Table 1.
- Reference levels are defined by the 75th percentile: RL for DAP: 45 Gy.cm² for CA and 95 Gy.cm² for overall PCI.
- Heterogeneity between centers was high for DAP (Figure 1) and CD, and less apparent for fluoroscopy time (Figure 2).

3. High doses
- High exposure levels at risk for deterministic effects (DAP >300 Gy.cm² and CD >3 Gy) were found in 0.7% and 4.1% of the procedures, respectively.

Conclusions
- This survey showed a very high rate of compliance with dose registration during CA and PCI in French nonacademic hospitals.
- New reference levels were established for the main dose parameters (DAP, 45 Gy.cm² for CA, 95 Gy.cm² for PCI).
- Heterogeneity between centres was high.
- Between 1% and 4% of procedures delivered high radiation doses to patients, likely to induce deterministic skin effects.

Multicentre national survey of patient exposure to X-rays during coronary angiography and percutaneous transluminal coronary intervention. The RAY’ACT study

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Purpose
- Patient exposure to radiation from invasive cardiac procedures is high and may be deleterious. Few multicentre data from large populations exist concerning radiation doses to patients during coronary angiography (CA) and percutaneous coronary interventions (PCI).
- Purpose: To evaluate practices for the protection from radiation of patients during CA and PCI, and to establish new reference values, according to the recommendations of the Euratom Council and the International Commission on Radiological Protection.

Methods
- Multicenter, nationwide, French survey, conducted in non-university public hospitals, which represent >30% of the national activity, and 60% of the emergency cases.
- Radiation parameters from 35,257 CAs and 28,604 PCIs performed at 48 centres during 2010 and routinely registered in professional software were extracted and retrospectively analysed. 4 centres were excluded for analysis (no registration of radiation dose parameters in 2010). Extreme values were validated and/or corrected by centres.
- Dose-area product (DAP, Gy.cm²), fluoroscopy time (FT, min), number of acquired frames (NF) and runs (NR), and cumulative dose estimated at interventional reference point (CD, mGy) were analysed separately for CAs and PCIs (elective and ad hoc pooled).
- Reference levels (RL) were defined by the 75th percentile of the distributions.

Declaration of interest
The authors have no conflict of interest to declare. This study was conducted independently by the College National des Cardiologues des Hôpitaux.