Illumination of x-rays: the usual lights exposed

G R J C Blackshaw, J A Gostling, B N Appleton, N Pearce, G V Thomas, W G Lewis

METHODS

Light intensity was measured using a standard light meter (Profisix, Gossen Foot-un, Lichtmetechnik, Nurnberg, Germany) at a constant 30 cm from the source. A control group of 10 individual x-ray viewing boxes (Wardray Premise Limited, Hampton Court Estate, Surrey, UK), each (four 18 watt bulbs) part of a bank of eight, present in the offices of 10 consultant radiologists, were compared with six other light sources (10 of each type) available on a district general hospital ward (Royal Gwent Hospital, Newport, South Wales, UK, longitude 3° west, latitude 51°35’ north). The light sources were as follows: ward x-ray viewing boxes (H A West [X-ray] Limited, 41 Watson Crescent, Edinburgh, UK, four 18 watt bulbs), ward ceiling lights (36 watts fluorescent light tubes), and ward windows facing south, north, east, and west. Ward window daylight intensity measurements were performed at 09:00 hours on two separate days (weather overcast and sunny) during December 2001. All luminant surfaces and windows were cleaned immediately before the light readings were taken. The relationship of illuminance (E, measured in lux) to light intensity (B, measured in candelas) is given by the equation:

\[
E = \frac{r^2}{B(r^2 + d^2)}
\]

where \(r\) represents the radius of the disc of the light source, and \(d\) represents the distance from the light source to the photometer (30 cm).

Table 1 Median light intensity; figures are median (range)

<table>
<thead>
<tr>
<th>Light source</th>
<th>Illuminance (lux x1000)</th>
<th>Light intensity (candela)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultant radiologists’ viewing boxes</td>
<td>11.0 (9.17–14.67)</td>
<td>3503 (2919–4671)</td>
</tr>
<tr>
<td>Ward viewing boxes</td>
<td>1.05 (0.58–2.43)</td>
<td>334 (185–760)</td>
</tr>
<tr>
<td>Ward ceiling light</td>
<td>2.2 (18.3–29.3)</td>
<td>7020 (3850–9359)</td>
</tr>
<tr>
<td>Ward window: sunshine</td>
<td>2.3 (1.4–4.6)</td>
<td>742 (445–1464)</td>
</tr>
<tr>
<td>North facing</td>
<td>14.6 (9.17–22.0)</td>
<td>4669 (2918–7004)</td>
</tr>
<tr>
<td>East facing</td>
<td>36.67 (18.3–44.0)</td>
<td>11673 (5836–14008)</td>
</tr>
<tr>
<td>West facing</td>
<td>22.0 (18.3–29.3)</td>
<td>7003 (5838–9338)</td>
</tr>
<tr>
<td>Ward window: overcast</td>
<td>2.3 (1.87–2.8)</td>
<td>742 (594–891)</td>
</tr>
<tr>
<td>South facing</td>
<td>4.6 (2.8–9.17)</td>
<td>1464 (891–2918)</td>
</tr>
<tr>
<td>East facing</td>
<td>1.87 (1.4–2.33)</td>
<td>594 (445–742)</td>
</tr>
<tr>
<td>West facing</td>
<td>2.33 (1.87–2.8)</td>
<td>742 (594–891)</td>
</tr>
</tbody>
</table>

*p<0.0001, **p=0.003, Mann-Whitney U test, compared with control.
Statistical analysis
Statistical analysis for non-parametric data was used. Data analysis was carried out with the Statistical Package for Social Sciences version 11 (SPSS, Chicago, Illinois, USA).

RESULTS
The relative median intensities of the individual light sources are shown in Table 1, and all the measured data are shown as a scatter plot in Fig 1. The light sources that were consistently closest in intensity to the British Institute of Radiology guidelines for viewing radiographs were the consultant radiologists’ viewing boxes and daylight from a north facing hospital window.

The relationship of illuminance to light intensity is proportional to the radius of the disc of light, the distance of the photometer from the light, and also the ambient light. This complex equation may explain why the hospital ward viewing boxes failed to meet the light intensity guidelines. In contrast, the quality of daylight from a northerly direction in the northern hemisphere of the world, and conversely from a southerly direction in the southern hemisphere has long been favoured by artists and photographers alike, for its even intensity and absence of shadow. In the early days of photography, when suitable artificial light was a scarce resource, the photographer who wanted to work indoors required a specially adapted “daylight studio” admitting the maximum amount of daylight, but not direct sunlight. The majority of such studios had a glass roof facing north at a minimum angle of 60° to prevent the direct intrusion of sunlight.

In conclusion, the frequently practised and time saving manoeuvre of holding radiographs up to the nearest bright light need not necessarily constitute bad medical practice. If the results of this study are representative, doctors in the northern hemisphere (latitudes of around 50°) without ready access to an adequate x-ray viewing box should feel confident that other convenient sources of light, preferably daylight from a north facing window, provides light of consistent and adequate intensity regardless of the prevailing weather conditions with which to illuminate and interpret an x-ray film.

DISCUSSION
“Light—God’s eldest daughter is a principal beauty” (Thomas Fuller 1661).

It is assumed widely and asserted confidently that an x-ray viewing box provides the only adequate source of light with which to view and interpret x-ray films. This assumption is challenged by the results of our study. Indeed, the only two sources of light which were consistently closest to the British Institute of Radiology guidelines were the consultant radiologists’ viewing boxes and daylight from a north facing hospital window.

Authors’ affiliations
G R J Blackshaw, J A Gostling, B N Appleton, W G Lewis, Department of Surgery, Royal Gwent Hospital, Newport
N Pearce, Department of Medical Photography, Royal Gwent Hospital, Newport
G V Thomas, Department of Radiology, Royal Gwent Hospital, Newport

REFERENCES
Illumination of x-rays: the usual lights exposed

G R J C Blackshaw, J A Gostling, B N Appleton, N Pearce, G V Thomas and W G Lewis

Postgrad Med J 2003 79: 99-100
doi: 10.1136/pmj.79.928.99

Updated information and services can be found at:
http://pmj.bmj.com/content/79/928/99

These include:

References
This article cites 2 articles, 0 of which you can access for free at:
http://pmj.bmj.com/content/79/928/99#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/