MANAGED CLINICAL NETWORK SCOTLAND
Photonet

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(Protocol added September 2010)
Meter calibration should take account of the Scottish UV Dosimetry Guidelines (Photodermatology, Photoimmunology & Photomedicine 17:230-233, 2001). The meter may be sent to a calibration laboratory or calibrated in-house using either a lamp-based or detector-based technique. Calibration must be traceable to the National Physical Laboratory.

(a) Calibration Laboratory

1. The Calibration Laboratory should perform the calibration as described in the outline below. These are not detailed protocols and it is essential that calibration is overseen by a competent physicist who is knowledgeable in ultra-violet radiation dosimetry.

2. The laboratory should have a quality assurance scheme.

(b) Lamp-based Calibration

1. Calibration should be traceable to the National Physical Laboratory.

2. The meter must be calibrated using the same type of lamp as used clinically.

3. The meter should be positioned at a reproducible distance from a bank of the appropriate type of UV lamps.

4. Meter reading should be compared with that from a calibrated double grating spectroradiometer with cosine angular response (f2 error less than 10%) at a bandwidth of 1 nm.

5. The meter display should be adjusted or a correction factor applied to give the true UV irradiance as measured by the spectroradiometer over the desired wavelength interval.

6. For a UVA meter specify UVA (315-400 nm); for a broad-band UVB meter specify UVB (280-315 nm); for TL01 specify extended UVB (280-320 nm). Alternatively, total UV (250-400 nm) may be specified provided this is clearly stated.

7. Overall accuracy should be ±10% and the calibration should be performed annually.
(c) Detector-based Calibration

1. Calibration should be traceable to the National Physical Laboratory.

2. The meter and calibrated detector should be positioned at a reproducible distance from an irradiation spectroradiometer.

3. The meter reading should be compared with that from the calibrated detector at each wavelength.

4. The angular response of the meter should be determined.

5. Meter correction factors should be determined using appropriate spectra for the required type of lamp and angular response for an extended source, typical of a treatment cabin.

6. For a UVA meter specify UVA (315-400 nm); for a broad-band UVB meter specify UVB (280-315 nm); for TL01 specify extended UVB (280-320 nm). Alternatively, total UV (250-400 nm) may be specified provided this is clearly stated.

7. Overall accuracy should be ± 10 % and the calibration should be performed annually.
Meter calibration should take account of the Scottish UV Dosimetry Guidelines (*Photodermatology, Photoimmunology & Photomedicine* 17:230-233, 2001). Overall responsibility for UV dosimetry at each treatment center should be ascribed to a Responsible Person. This should be a Medical Physicist who is knowledgeable in the evaluation of ultra-violet radiation measurements.

(a) Designated Patient Irradiance

1. Designated Patient Irradiance (DPI) is defined as the mean irradiance incident on a patient of average height and build in a whole body treatment unit at chest, waist and knee level. At each level, irradiance should be determined on the anterior, posterior, right and left surfaces, that is at 12 body sites.

2. Measurements should be carried out on the investigator in the treatment cabin in the same position as adopted by the patients.
3. It is desirable that the patient should turn during treatment to average out any areas of high or low irradiance. The investigator should seek to reproduce the practice adopted at the treatment center.

4. Lamps should be operated for a 5-minute warm-up period before irradiance measurements are made. The DPI may be measured by the direct or indirect method.

5. The dose received by the patient in the treatment unit is taken to be the product of the DPI and duration of exposure.

6. Measurements may be carried out using different direct or indirect methods provided they can be related to the DPI as defined above. If the method used introduces a discrepancy <5% this is acceptable without correction to the DPI, provided this is documented.

(b) Direct Method

1. The investigator must measure the irradiance at the specified sites, whilst standing in the unit.

2. Care must be taken to ensure that the field of view of the meter is not restricted by any part of the body or clothing.

3. The investigator should take readings in more than one orientation if the practice is for the patient to turn during treatment.

4. The DPI should be calculated from the mean irradiances.

5. All measurements should be properly documented.

(c) Indirect Method

1. The irradiance from each bank of lamps in the treatment unit should be measured, in a reproducible manner, while the unit is unoccupied.

2. The mean value of these measurements is multiplied by a correction factor to obtain the DPI.

3. The investigator should determine the appropriate correction factor, either by direct measurement or reference to published values.

4. Determination of the correction factor should be properly documented.

(d) Safety

1. Ultra-violet radiation is potentially harmful.

2. A risk assessment should be carried out.
3. Safety guidelines should be issued to cover all staff working in the vicinity of the treatment units.

4. Staff should exercise prudent avoidance and ensure that skin and eyes are not exposed unnecessarily to ultra-violet radiation.

(e) Lamp Replacement

1. Lamps should be replaced under the supervision of the designated responsible person according to a pre-arranged policy.

2. Lamps may be changed individually according to the results of the patient dose calibration to keep the DPI steady to within ± 10%.

3. Alternatively, lamps may all be changed at the same time provided treatment times are adjusted as necessary.

4. When individual lamps are replaced, care should be exercised to ensure that two new lamps are not placed side by side.

5. Staff should be aware that changing the lamp in front of the in-built sensor will change the treatment times displayed on the unit.

6. Irradiances from different sides of the cabinet should be balanced to within ± 10%.
The term “ceiling dose/exposure” is often used but perhaps, wrongly, implies that this is an absolute maximum number of exposures, hence the choice of phrase “action level” here. This is to imply a number of exposures at which careful consideration should always be given as to whether or not further treatments should be given but not an absolute limit.

Guidance on such an action level is difficult to issue in the absence of adequate human data about the carcinogenic risk of narrow-band UVB. Two studies, one of very small numbers of patients, and the other of greater numbers (but of patients who had received only small to moderate numbers of treatments and limited follow-up), have not detected any definite increased risk of skin cancer likely to be attributable to narrow-band UVB. Few studies addressing the issue of possible carcinogenicity of broad-band UVB have been conducted but the overall impression has been that any increased risk of skin cancer is low. This was borne out by a recent study of risk of non-melanoma skin cancer attributable to UVB (predominantly broad-band) in the North American PUVA follow-up study cohort. The adjusted (taking into account known risk factors including PUVA exposure) incidence rate ratio for squamous cell carcinoma for >300 vs. <300 UVB treatments was estimated at only 1.37 (95% CI 1.03 to 1.83). Whether or not the risk with narrow-band UVB is lower or higher than with broad-band UVB is not known.

It has been estimated, based on the assumption that NB-UVB is as carcinogenic as sunlight, that 1000 treatments, with one treatment course a year, to whole-body (face unshielded during treatment) would lead to a lifetime relative risk of non-melanoma skin cancer of 2. The letter in which these estimates were presented considered that a “risk-taker” would accept a relative risk of 2 (i.e. an increase in lifetime risk to 2 in 100 vs. 1 in 100; ISD Scotland National Statistics give prevalence of non-melanoma skin cancers as 0.9%). Recent British Photodermatology Group guidelines using the same estimates suggested that 450 treatments might be a reasonable ceiling dose for whole-body treatment (with the corresponding number for treatments with face-shielded of >1000 treatments) based on the assumption of an “average” attitude to risk. Such an average attitude to risk was conservatively taken as acceptance of a relative risk no higher than 1.5 (i.e. accepting an increase in chance of getting a non-melanoma skin cancer from 2 in 200 to 3 in 200).

On the basis of this limited evidence 500 treatments would seem to be an appropriate, cautious, action level cumulative number of exposures. This is not a lifetime limit but a guide as to the cumulative exposure after which particularly careful consideration should be given to the possible risks of NB-UVB versus the risks of alternatives.

References


DOSIMETRY PROTOCOL No. 4
CALIBRATION OF HYBEC MED TESTERS

(Protocol added September 2010)

To calibrate the Hybec MED tester, you will need:- the Hybec tester itself, a mask to exclude extraneous light (see fig 2.), a suitable radiometer (I used an IL1400 for this purpose), timer, eye protection and gloves.

The tester has 10 sets of apertures, giving progressively lower outputs between windows. The highest output is given by window number 1 (on the upper row, nearest the handle). The windows are then numbered up to 5 on the upper row then 6 - 10 on the lower row, but in the opposite direction (i.e. the lowest output, window 10, is closest to the handle). (see fig 3.)
Method

- Switch on the Hybec MED tester for 10 minutes before starting readings to allow the output of the lamp to settle.

- Place the mask over aperture 1 (to ensure that only light from that aperture is measured.)

- Slowly scan across the aperture to find the highest reading - note this reading.

- Move the mask to the next aperture and repeat the procedure.

- Repeat the above for all 10 apertures.

- Switch off unit for 10 minutes.

- Repeat the above, but this time start at aperture 10.

- Again, cool down for 10 minutes before proceeding.

- Repeat the above starting with window 1.

- Repeat the whole process again starting at window 10.

(i.e. 4 sets of readings with 10 minutes warm-up before readings and 10 minutes cool-down after readings, alternating highest to lowest and lowest to highest outputs).

By using the attached spreadsheet, the calculations can be carried out and graphs produced.

The report sheet can then be printed out and included with the tester documentation.
## Appendix 1. Example of completed spreadsheet

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<td>Kevin Campbell</td>
<td>25th August 2009</td>
<td>IL1400 #7191 TLST 7MM #28103 SEL005 #1172</td>
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### MEASUREMENTS (mWcm⁻²)

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<th>RUN 3</th>
<th>RUN 4</th>
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Appendix 2. Example of finished certificate

Tester model H606 serial 81597B

date 25th August 2009

Tested by Kevin Campbell

Test equipment IL1400 #7191 TLST 7MM #28103 SEL005 #1172

Summary of results

Maximum output 3.97mWcm²

Percentage of maximum output per window

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