

A review of photodiagnostic investigations over 26 years: experience of the National Scottish Photobiology Service (1989–2015)

H Naasan¹, RS Dawe², H Moseley³, SH Ibbotson⁴

Abstract

Background The Scottish Photobiology Service is the national referral pathway for patients with cutaneous photosensitivity diseases in Scotland. We reviewed the pattern of diagnosis of photosensitivity diseases and investigations performed between 1989 and 2015.

Methods and Results Data were collected from the Photodiagnostic Database, annual reports and paper records. The total number of patients assessed each year was stable over the period studied (median 242 [range 231–266]), with most being new patients (median 69 [range 62–73]%). Monochromator phototesting was the most utilised investigation, although the use of provocation testing and photopatch testing has increased. The most common diagnosis was polymorphic light eruption, and there was a trend to increasing diagnosis of photoaggravated atopic eczema.

Conclusions The pattern of diagnosis of photosensitivity diseases remains fairly stable in Scotland and we wish to emphasise the importance of this Scottish specialist service for patients with photosensitivity diseases and referrers.

Keywords: national service, photobiology, photodermatosis, photosensitivity diseases

Declaration of interests: No conflict of interests declared

Correspondence to:

H Naasan
Dermatology Department
Ninewells Hospital &
Medical School
Dundee
UK

Email:

hnaasan@nhs.net

Introduction

Abnormal photosensitivity typically presents as a heightened exaggerated sunburn-like reaction to sunlight or daylight exposure, for example in patients taking photosensitising drugs, or as an abnormal rash, which occurs after sunlight exposure, such as with the commonly occurring ‘prickly heat’ (polymorphic light eruption). Thus, the photosensitivity diseases are a heterogeneous group of disorders that include common conditions such as polymorphic light eruption, and the uncommon and rare photosensitivity diseases: chronic actinic dermatitis, idiopathic solar urticaria, actinic prurigo, hydroa vacciniforme, DNA repair diseases, particularly xeroderma pigmentosum, and some of the cutaneous porphyrias. They may range from causing a minor disruption to life through to being a cause of major morbidity or rarely mortality, as for example in xeroderma pigmentosum. Although patients are often aware of the association between their condition and sun exposure, this is not always the case, particularly if the condition is caused by UVA and/or visible light, meaning that the patient will have problems all year round. Investigation of patients with suspected photosensitivity, in order to define conclusively

whether they are or are not abnormally photosensitive and, if so, which wavelengths they are sensitive to and the degree and type of photosensitivity, is essential for accurate diagnosis, optimised management and holistic patient care.

Photodiagnostic testing is carried out in patients suspected to have abnormal cutaneous photosensitivity. It is undertaken worldwide in selected specialist centres, but in only a few sites in the UK; one being in Scotland, the Scottish Photobiology Service (SPS). This Service is offered as a national service for patients with photosensitivity diseases in Scotland and is funded through NHS National Services Scotland and the National Services Division, which provide commissioning for Scotland’s health and facilitates access for patients to investigations and treatments of a highly specialised nature, often for rare diseases. The Photobiology Unit at Ninewells Hospital in Dundee hosts the SPS and thus accepts referrals from across Scotland.

Phototesting involves use of an irradiation monochromator to determine if there is sensitivity to narrow wavebands of ultraviolet (UVA or UVB) radiation and/or visible light, with light irradiated on small areas of back skin.¹ Other

¹ST6 in Dermatology, ²Consultant Dermatologist, ³Head of Scientific Services, ⁴Professor of Photodermatology, Photobiology Unit, Dermatology Department, University of Dundee, Ninewells Hospital & Medical School, Dundee, UK

investigations may include:

- Provocation testing to larger areas of skin using broadband UVA, UVB and indoor lighting sources
- Minimal erythema dose testing to light sources that can be used therapeutically
- Patch and photopatch testing
- Serology to screen for lupus
- Plasma spectrofluorimetry and porphyria biochemical analysis of blood, erythrocytes, urine and faeces
- Vitamin D levels
- HLA typing
- Skin biopsy

Prevalence of photodermatoses can be estimated based on data from such photodiagnostic units, if it is assumed that the majority of cases pass through such a unit (likely to be a correct assumption for rare and severe diseases, but not for common conditions with a great range of severity such as polymorphic light eruption). For example, a study based on diagnoses made in the SPS on the prevalence of photodermatoses in Scotland, was published in 2009.² Other units have published data on photodermatoses as a percentage of total photodermatoses diagnosed, for example, in New York in 1995,³ in Singapore in 2005,⁴ or in Athens, Greece, in 2003.⁵ None of these studies attempted to estimate prevalence or incidence of photodermatoses; all found polymorphic light eruption to be the most common diagnosis. Prevalence estimates have also been made from questionnaire-based surveys of populations, such as a study of the resident populations of areas within the Yunnan province in China,⁶ and a survey of Swedish pharmaceutical company employees screened for polymorphic light eruption.⁷

In 2009, the Scottish study undertaken in the population reported a prevalence of 16.5 cases per 100,000 population for chronic actinic dermatitis, 4.0 per 100,000 for idiopathic solar urticaria, and 3.3 per 100,000 for actinic prurigo. This study took into account the whole Scottish population when estimating the prevalence of rarer diseases likely to lead to assessment in the Photobiology Unit, finding a prevalence of 0.5 per 100,000 for patients with hydroa vacciniforme and 0.2 per 100,000 cases of xeroderma pigmentosum.²

The aim of this study was to look at the diagnoses made in the Photobiology Unit over time and whether there were any trends in diagnosis of the photodermatoses. We also assessed the incidence of diagnosis of photodermatoses in the Tayside population from data collected in the unit over 26 years. A secondary aim was to assess the activities of the SPS, including the frequency and trends of investigations undertaken.

Methods

Patients are referred from across Scotland to the SPS. The photodiagnostic database spans from 1973 to the present day, with information on new patients investigated in the SPS, their investigations, results and final diagnoses. The database originally consisted of patient records and investigation

findings being kept on a card filing system (1972–1984) but this evolved into an in-house electronic database, which was adapted and transferred to a Microsoft Access database in 2007. This was used to obtain retrospective data for the numbers of patients referred to the SPS, both new and return patients, using predominantly digital data retrieval, with additional manual retrieval of data as required. The location from which patients were referred to the unit and how this has changed over time, were also assessed. Data on the number of new cases of photodermatoses assessed annually over 26 years were collected and trends examined. The pattern of investigations undertaken over time was also assessed.

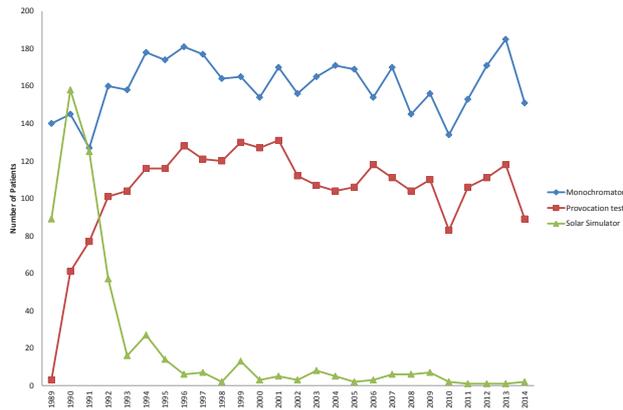
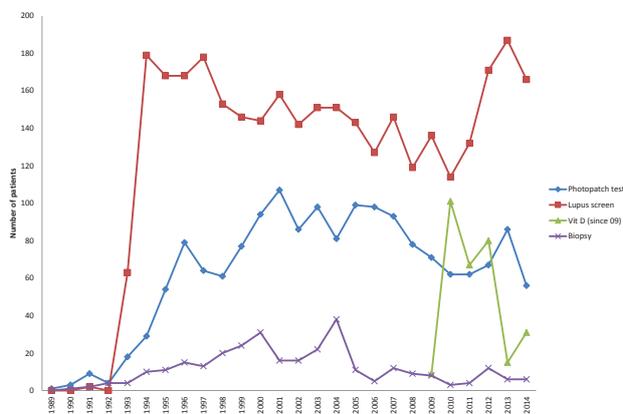
Each new patient is given a unique identifying number in the database. This ensures that return patients' records are not duplicated. Their record is amended, but not overwritten, so that their year of diagnosis remains the original year of assessment. Thus, our figures for diagnosis are only for new patients investigated in the SPS. Each patient is given a primary diagnosis and some may also have a secondary diagnosis. We have used the primary diagnosis for our figures.

Searches were performed for each photodermatosis individually, from 1989 until August 2015. The numbers for primary diagnosis of each photodermatosis per year were recorded. We also used the search function in the database to split this into patients who were resident within the NHS Tayside catchment area and those from outwith the NHS Tayside Health Board area. Census data (2001) were then used to calculate incidence per 100,000 for Tayside patients, for each photodermatosis. Database queries were performed to look into the numbers of each investigation performed from 1989 until 2015, in new patients investigated. The number of each investigation per year was also recorded. 'Others' in the database represented approximately 30% of diagnoses. The cards on which diagnoses were recorded originally were reviewed to obtain information on the actual diagnosis in these cases.

Access to National Services Scotland figures provided the total numbers of new and return patients and total investigations performed each year (April–March). Total investigations included minimal erythema dose testing for both TL01 and UVA, which are not always part of the investigation of photodermatoses, but were included when they were performed in order to give a complete picture of the workload of the SPS. It should be stressed that of patients with cutaneous porphyrias, only the minority are phototested and, as the data assessed in this study only relate to patients who were phototested, the figures do not reflect the prevalence of the porphyrias.

Results

The total number of patients seen in the SPS has remained stable over the period studied, ranging from 231–273 (median 244) per year, with the majority of these being new patients (62–73%, median 69%). This reflects the agreed (with NHS National Services Scotland/National Services Division who

Figure 1a Phototesting, 1989–2014**Figure 1b** Other investigations, 1989–2014. *vitamin D only recorded from 2009 onwards

commission the service) service level of activity of 245 NHS patients in Scotland per year. The majority of referrals are from within Scotland, with less than 12% from the rest of the UK. Over time, the percentage of patients referred from outwith Scotland has reduced, reflecting the development of other units elsewhere in the UK.

Monochromator phototesting was the most frequently used investigation and is considered the gold standard photodiagnostic test used in the SPS. Use of monochromator phototesting remained stable over the 26 years (median 162 [range 127–185] patients who underwent monochromator phototesting per year) (Figure 1a). Provocation testing was increasingly undertaken since 1992 (for example from only 77 patients who underwent provocation testing in 1991 through to a median of 111 [range 83–131] per year for the period 1992–2015) (Figure 1a), and photopatch testing similarly increased in use since 1995 (in only 29 patients in 1994; through to a median of 78 [range 54–107] per year for the period 1995–2015) (Figure 1a). However, solar simulator testing was performed less frequently (maximum use was in 1990 when 158 patients underwent solar simulator phototesting; with only a median of 5 [range 0–24] patients per year undergoing this investigation in the period 1993–2015) (Figure 1a). Skin biopsy was part of the investigation plan for a small number of patients (median of 13 [range 0–57] patients per year). Biochemical and immunological investigations were also performed where relevant, most

Table 1 Other diagnoses, 2011

Diagnosis	No. patients
Photoaggravated (including seborrhoeic dermatitis, other dermatitis, psoriasis, rosacea)	24
Contact dermatitis/allergy	6
Lupus erythematosus	2
Dermatomyositis	1
Telangiectasia	1
Urticaria	1

commonly lupus screening since 1994, and vitamin D testing since 2009 (Figure 1b).

We only collected information on the primary diagnosis. However, some patients will have had more than one diagnosis, for example an immunological photodermatosis combined with photocontact allergy.

We looked in detail at 2011 as we selected this as a typical, representative and relatively recent year within the time period studied (Figure 2a; Table 1). The most common diagnosis was polymorphic light eruption (31%). This was followed by: photoaggravated atopic eczema (7%); chronic actinic dermatitis (6%); idiopathic solar urticaria (2%) and actinic prurigo (1%) (Figure 2a). 20% of patients had not received a formal diagnosis, usually because of atypical or evolving clinical and investigation findings (these patients would have returned for further investigation on other occasions) or had photosensitivity as a diagnosis excluded. 'Other' diagnoses included photoaggravated seborrhoeic eczema (3), rosacea (5), psoriasis (3) or non-specified dermatitis (13) or contact allergy and lupus erythematosus, and constituted 30% of the patients seen in 2011 (Table 1).

Thus, polymorphic light eruption was the most common diagnosis made. However, the numbers diagnosed in the SPS with this condition have fallen over time (Figure 3a), although the numbers per 100,000 population diagnosed in Tayside remained stable at 4–11 per 100,000 per year (Figure 4a).

Comparing the diagnoses of chronic actinic dermatitis and photoaggravated atopic eczema, showed a trend for an increasingly frequent diagnosis of photoaggravated atopic eczema (Figure 3b). In Tayside, the number of new cases referred and diagnosed with chronic actinic dermatitis per 100,000 per year was 0–2, with no clear trends (Figure 4b). There was no trend in the numbers of patients diagnosed with idiopathic solar urticaria in the SPS as a whole.

Regarding the other rare photodermatoses, there was no trend in the numbers of patients diagnosed with xeroderma pigmentosum. There were fewer patients diagnosed with actinic prurigo and hydroa vacciniforme over time (Table 2).

Finally, the number of patients with drug-induced photosensitivity being referred and diagnosed in the unit

Figure 2a All diagnoses, 2011 ('Others' are detailed in Table 1)

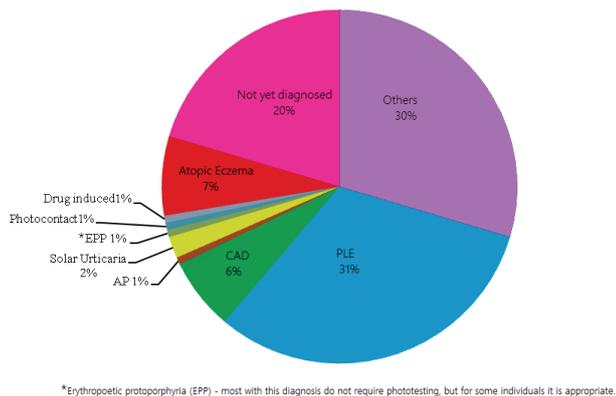


Figure 2b All photodermatoses diagnosed, numbers per year, 1989–2015 (excluding PLE)

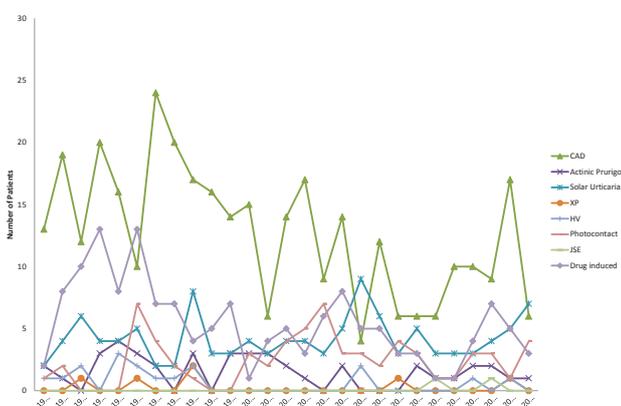


Table 2 Rarer diagnoses, 1989–2015

Diagnosis	No. cases		
	1989–1997	1998–2006	2007–2015
Solar urticaria	37	38	39
Actinic prurigo	18	14	10
Hydroa vacciniforme	13	2	2
Xeroderma pigmentosum	4	0	2
Photocontact	17	27	22
Drug-induced	72	44	32

reduced over time. This was true for total numbers of patients to the SPS and the local incidence of diagnosis in Tayside (Table 2, Figure 4c).

Discussion

Although we have data for numbers of diagnoses per year, we cannot extrapolate these data to cover the whole of Scotland, or even the area of Tayside in the case of many conditions. An example is polymorphic light eruption, as most patients with this condition are not referred for phototesting, the diagnosis being made clinically instead. It is likely that the number of diagnoses of polymorphic light eruption in the SPS has fallen due to increased education and training of referrers and referral only for those with severe or atypical disease,

Figure 3a PLE diagnoses, 1989–2014

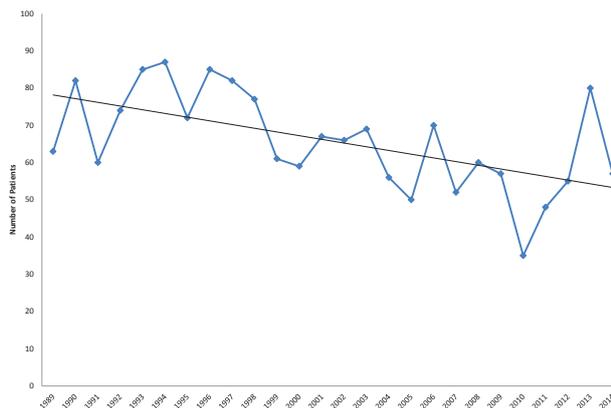
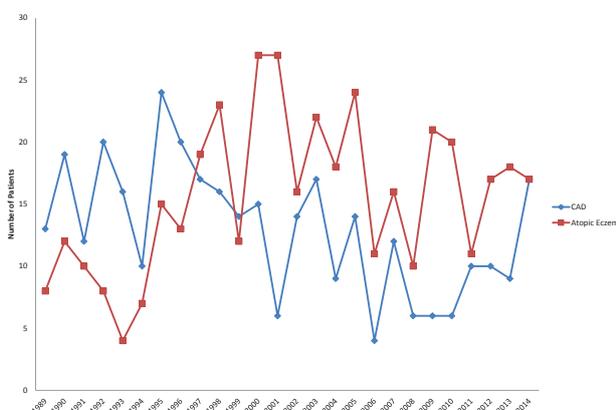


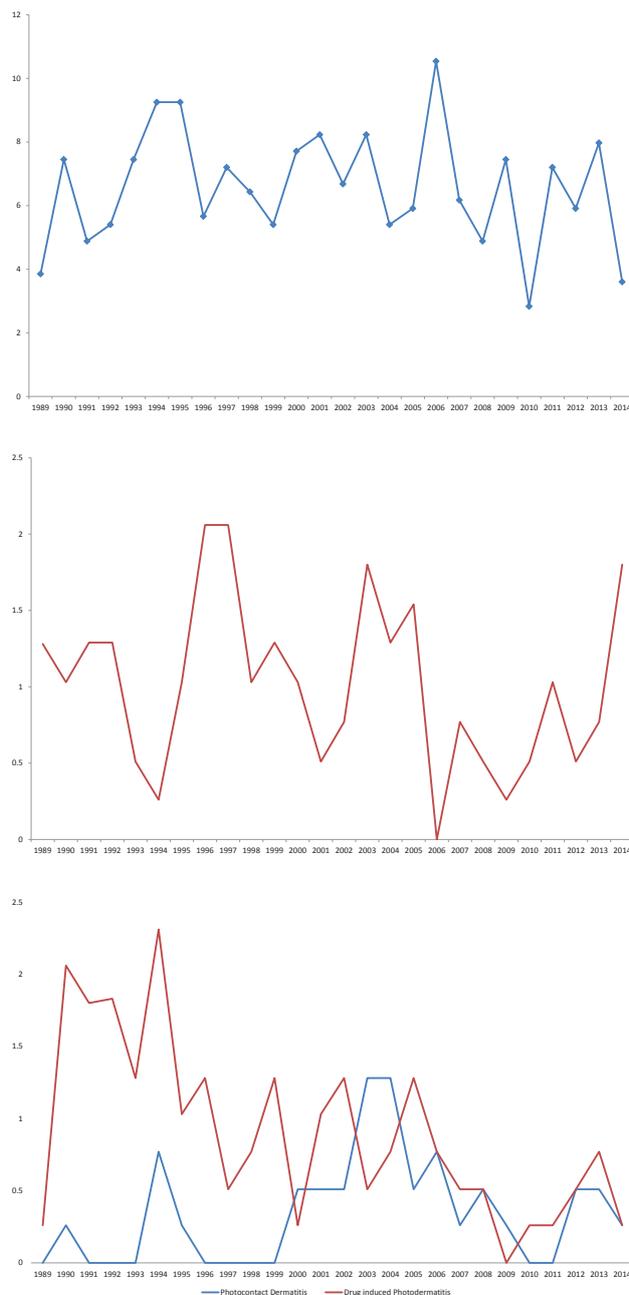
Figure 3b CAD and photoaggravated atopic eczema diagnoses in phototest patients, 1989–2014



and to exclude other photodermatoses. Thus, our data show a reduction in referral rates to the SPS for this condition. The stability of the number of cases diagnosed in the local population may be explained by the fact that patients may have a higher threshold for travelling long distances if they have milder seasonal polymorphic light eruption as we do not consider we are over-diagnosing polymorphic light eruption in the local population.

We were encouraged to see increased numbers of patients diagnosed with photoaggravated atopic eczema as this reflects increased referrals of this patient group in whom it may be clinically impossible to distinguish between chronic actinic dermatitis and photoaggravated atopic eczema. It is important to phototest in these cases as rare

Figure 4a–c Number of new cases diagnosed per 100,000 per year in Tayside patients referred for phototesting, 1989–2011



photodermatoses, in particular chronic actinic dermatitis, must be excluded in this group, as the management approach would be very different. For example, in photoaggravated atopic eczema, monochromator phototesting will typically be normal and UVB phototherapy can be very effective, whereas in chronic actinic dermatitis, monochromator phototesting will be abnormal, typically showing broadband and often disproportionately UVB-weighted abnormal photosensitivity, and UVB phototherapy would be contraindicated as a therapeutic approach.

Drug-induced photosensitivity is being referred to the unit less, and this is likely to be a reflection of increased education and training of referrers and awareness of the entity of drug photosensitivity by clinicians, therefore appropriately stopping

incriminating drugs and reassessing without the need for formal investigation. We continue to see our role in education and training as being important in this regard.

Although we have data for 26 years' worth of referrals to the unit, it was not possible to obtain figures on incidence of the rarer photodermatoses, for example, xeroderma pigmentosum, which has an incidence quoted in the literature of 2.3 per million live births in western Europe.⁸ However, it is likely that for these rarer severe diseases most cases would be referred to the SPS and the reduction in the number of cases of hydroa vacciniforme and actinic prurigo diagnosed over recent years, may well reflect a true reduction in incidence, although we are aware of the need for ongoing training to raise awareness of these rare diseases and to reduce delays in diagnosis.⁹

The SPS also offers the National Porphyria Service. However, many patients with suspected porphyria are not phototested, and instead have biochemical investigations and diagnosis. Importantly, the data presented only relate to patients who were phototested and not to the majority of porphyria patients who are investigated through laboratory biochemical investigations alone.

In summary, we have shown there is a trend for increasing diagnosis of photoaggravated atopic eczema, reflecting an important increase in the numbers of these patients with difficult complex presentations being referred to the SPS for investigation and management. We have shown reduction in the numbers of patients referred with drug-induced photosensitivity, which likely reflects improved education and awareness of this condition among clinicians. Finally, for rare diagnoses such as hydroa vacciniforme and actinic prurigo, we have shown a reduced number of patients diagnosed with these conditions over time.

Chronic and severe photosensitivity of any cause has major adverse impact on quality of life for patients.¹⁰ The numbers of patients seen with the rare photosensitivity diseases of chronic actinic dermatitis, idiopathic solar urticaria, hydroa vacciniforme, actinic prurigo, xeroderma pigmentosum and other DNA repair disorders and the rare cutaneous porphyrias are small and as such it is even more important to highlight awareness of these diseases.

An ongoing challenge and priority for the SPS is to increase understanding and awareness of the cutaneous photosensitivity diseases and the fact they can present in a myriad of heterogeneous and often atypical ways. Awareness of the availability of the SPS and uptake by referrers for centralised, coordinated multidisciplinary investigations and management of patients with severe, complex and often rare disabling photosensitivity disorders is of crucial importance for optimised care. We are exploring ways to disseminate knowledge and uptake of the SPS through Scotland-wide multidisciplinary team meetings and at international level through involvement in the European Rare Disease Network for Skin, in which we will play key roles in developing the inclusion of the photosensitivity diseases. **1**

Acknowledgements

We would like to thank Lynn Fullerton, senior clinical technologist in the Photobiology Unit, for her help with the use of the photodiagnostic database and all technical queries.

References

- 1 Mackenzie LA, Frain-Bell W. The construction and development of a grating monochromator and its application to the study of the reaction of the skin to light. *Br J Dermatol* 1973; 89: 251–64.
- 2 Dawe RS. Prevalences of chronic photodermatoses in Scotland. *Photoderm Photoimmun Photomed* 2009; 25: 59–60.
- 3 Fotiades J, Soter NA, Lim HW. Results of evaluation of 203 patients for photosensitivity in a 7.3-year period. *J Am Acad Dermatol* 1995; 33: 597–602.
- 4 Wong SN, Khoo LSW. Analysis of photodermatoses seen in a predominantly Asian population at a photodermatology clinic in Singapore. *Photoderm Photoimmun Photomed* 2005; 21: 40–4.
- 5 Stratigos AJ, Antoniou C, Papathanakou E et al. Spectrum of idiopathic photodermatoses in a Mediterranean country. *Int J Dermatol* 2003; 42: 449–54.
- 6 Deng D, Hang Y, Chen H et al. Prevalence of photodermatoses in four regions at different altitudes in Yunnan province, China. *J Dermatol* 2006; 33: 537–40.
- 7 Ros AM, Wennersten G. Current aspects of polymorphous light eruptions in Sweden. *Photodermatology* 1986; 3: 298–302.
- 8 Lehmann AR, McGibbon D, Stefanini M. Xeroderma pigmentosum. *Orphanet J Rare Dis* 2011; 6: 70.
- 9 Macfarlane L, Hawkey S, Naasan H et al. Characteristics of actinic prurigo in Scotland: 24 cases seen between 2001 and 2015. *Br J Dermatol* 2016; 174: 1411–4.
- 10 Jong CT, Finlay AY, Pearse AD et al. The quality of life of 790 patients with photodermatoses. *Br J Dermatol* 2008; 159: 192–7.