



# An investigation of eye protection for patients receiving PUVA therapy

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Scottish Photobiology Service was established in 1973, to provide a comprehensive diagnostic, therapeutic, and management service for Scottish Patients with Photosensitivity.

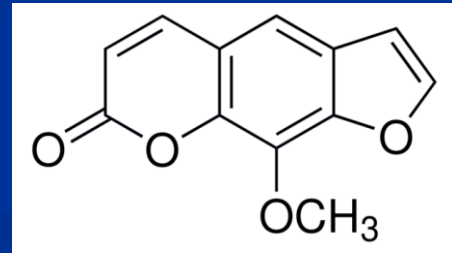
Examples of key activities:

- The National Photodiagnostic service
  - The National Cutaneous Porphyria Service
  - The Scottish Photodynamic Therapy Centre/Phototherapies
  - Teaching and Research Programmes
- etc.....

# PUVA Therapy

## PUVA Therapy:

- P** (Psoralen) Natural Compound that acts as a photosensitiser
- 8-MOP (8-Methoxypsoralen)
  - 5-MOP (5-Methoxypsoralen)



## UVA

Ultraviolet A, 315 nm to 400 nm  
Commonly used in phototherapy.

# Photoprotection and current guidelines

- Psoralen makes the skin and the eyes sensitive to light for some hours.
- Photosensitivity persists for at least 12 hours[1][2], and it could cause ocular risks, like cataracts.
- UV protective goggles are provided to patients during PUVA therapy.
- Protective eyewear must be worn during daylight and indoor light exposure until the end of the day.

[1] M. C. van Praag, L. N. Tseng, A. M. Mommaas, B. W. Boom, and B. J. Vermeer, "Minimising the risks of PUVA treatment," *Drug safety*, vol. 8, pp. 340-349, 1993.

[2] Y. H. Leow and S. N. Tham, "UV-protective sunglasses for UVA irradiation protection," *International journal of dermatology*, vol. 34, no. 11, pp. 808-810, 1995.

# Photoprotection and current guidelines

Protective eyewear must be checked to ensure it complies with the British Association of Dermatologist recommended transmission limits[3]:

<10% at 390 nm

<5% at 380 nm

<2% at 370 nm

<1% at 360 nm

Protective eyewear should have lenses large enough and sit close enough to the face.

[3] H. Moseley, N. Cox, and R. Mackie, "The suitability of sunglasses used by patients following ingestion of psoralen," *British Journal of Dermatology*, vol. 118, no. 2, pp. 247-253, 1988

# An investigation of eyewear protection effectiveness

- Can lens transmission represent the UV protection effectiveness in real-world conditions?
- What makes a good UV-protective eyewear?

# Samples

Table 1. Tested glasses samples

GLASSES TESTED		
Sample No.	Manufacturer	Details
1	Nike	Black Lens, Non-Polarized, wrap-around
2	Foster Grant	Shiny silver metal frame, solid smoke lenses
3	Arnette	Solid tint lens, polarised
4	SelectSpecs	Clear lens, with UV protection
5	Oakley	Wrap-around, polarised
6	3M	Clear UV Protective lens, wrap-around
7	Hype Galaxy	Prescription sunglasses, polarised
8	LG	3D glasses
9	Honda	Wrap-around, tint lens
10	Daavlin	Yellow UV Protective lens
11	Ray-Ban	Shiny silver metal frame, non-polarised
12	Specsavers	Prescription Sunglasses, non-polarised
13	Kongkin (Amazon)	UV, blue light protective, clear arms
14	Kongkin (Amazon)	UV, blue light protective, solid black arms
15	Kongkin (Amazon)	UV, blue light protective, patterned arms
16	Specsavers	Non-UV protective, clear arms

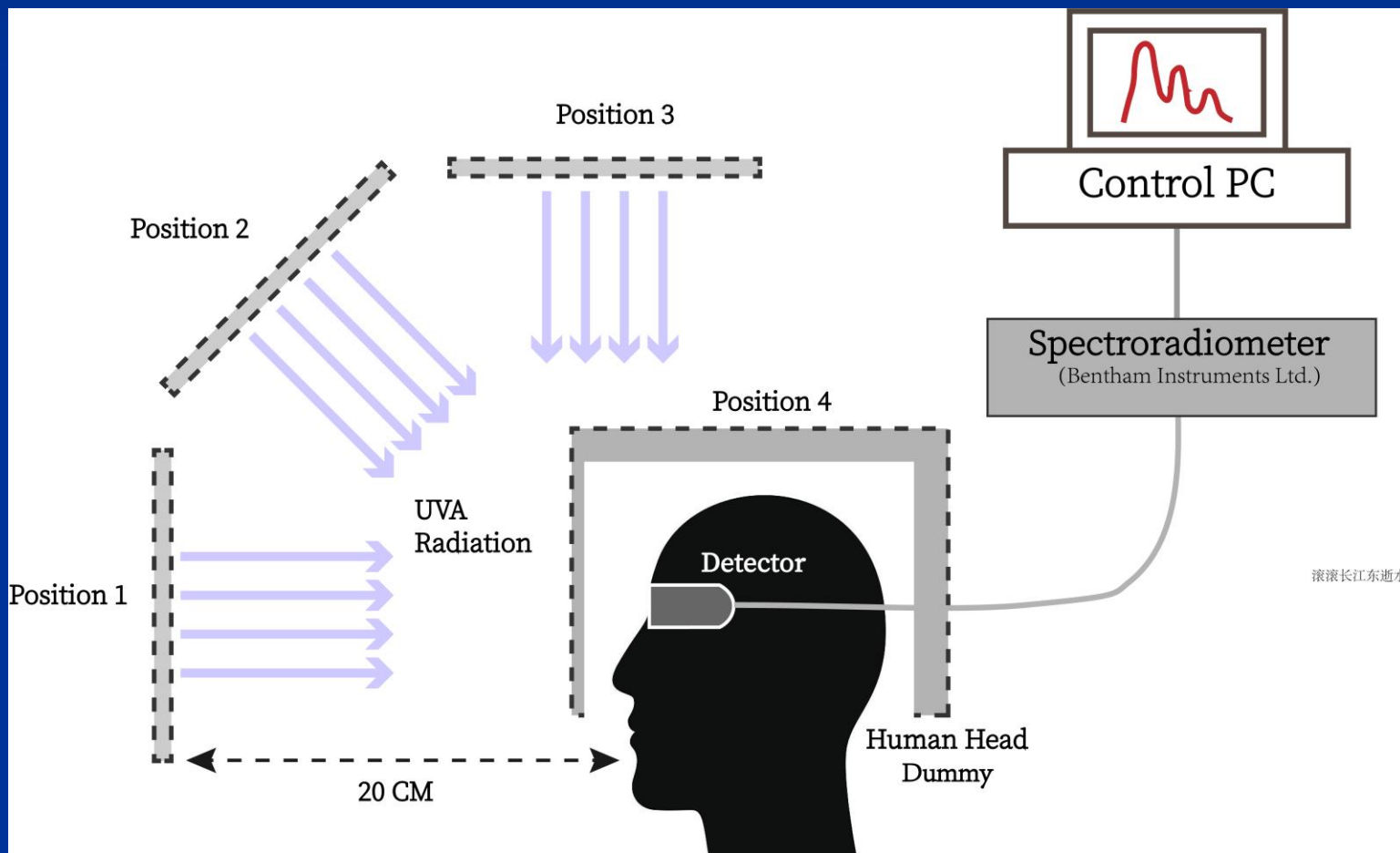
# Methods

- Spectrophotometer Measurement
  - Lens transmission
- Simulated UV exposure measurement (Spectroradiometer, Human head dummy, UVA lamp)
  - Real-world protection effectiveness (controlled light source)
- UVA radiometer measurement (radiometer with UVA detector, human head dummy, natural sunlight)
  - Protection effectiveness for the entire UVA range

# Experiment Setup

- Simulated UV exposure measurement (Spectroradiometer, Human head dummy, UVA lamp)

Figure 1 Illustration of simulated UV exposure using UVA Lamp



# Experiment Setup

- UVA radiometer measurement (radiometer with UVA detector, human head dummy, natural sunlight)
- The detector was aligned at the dummy's eye level, with the glasses on the model. The dummy was positioned on a tripod at a height of 1.75 meters (approximate) to simulate real adult human eye level. These outdoor measurements were conducted under sunny interval conditions in Dundee, Scotland, on 30th August 2024.

# Results

## ○ Spectrophotometer Measurement

Table 2. Lens transmission measured by spectrophotometer

	320 nm	340 nm	360 nm	380 nm
Sample 1	0.0%	0.0%	0.0%	0.0%
Sample 2	0.0%	0.0%	0.0%	0.0%
Sample 3	0.0%	0.0%	0.0%	0.0%
Sample 4	0.0%	0.0%	0.0%	0.0%
Sample 5	0.0%	0.0%	0.0%	0.0%
Sample 6	0.0%	0.0%	0.0%	0.0%
Sample 7	0.0%	0.0%	0.0%	0.0%
Sample 8	$0.1 \pm 0.0\%$	0.0%	0.0%	$0.5 \pm 0.1\%$
Sample 9	0.0%	0.0%	0.0%	0.0%
Sample 10	0.0%	0.0%	0.0%	0.0%
Sample 11	0.0%	0.0%	0.0%	0.0%
Sample 12	0.0%	0.0%	0.0%	0.0%
Sample 13	0.0%	0.0%	0.0%	0.0%
Sample 14	0.0%	0.0%	0.0%	0.0%
Sample 15	0.0%	0.0%	0.0%	0.0%
Sample 16	0.0%	0.0%	$3.2 \pm 0.3\%$	$56.3 \pm 3.6\%$

# Results

- Simulated UV exposure measurement

Relative UV Exposure (RUE)

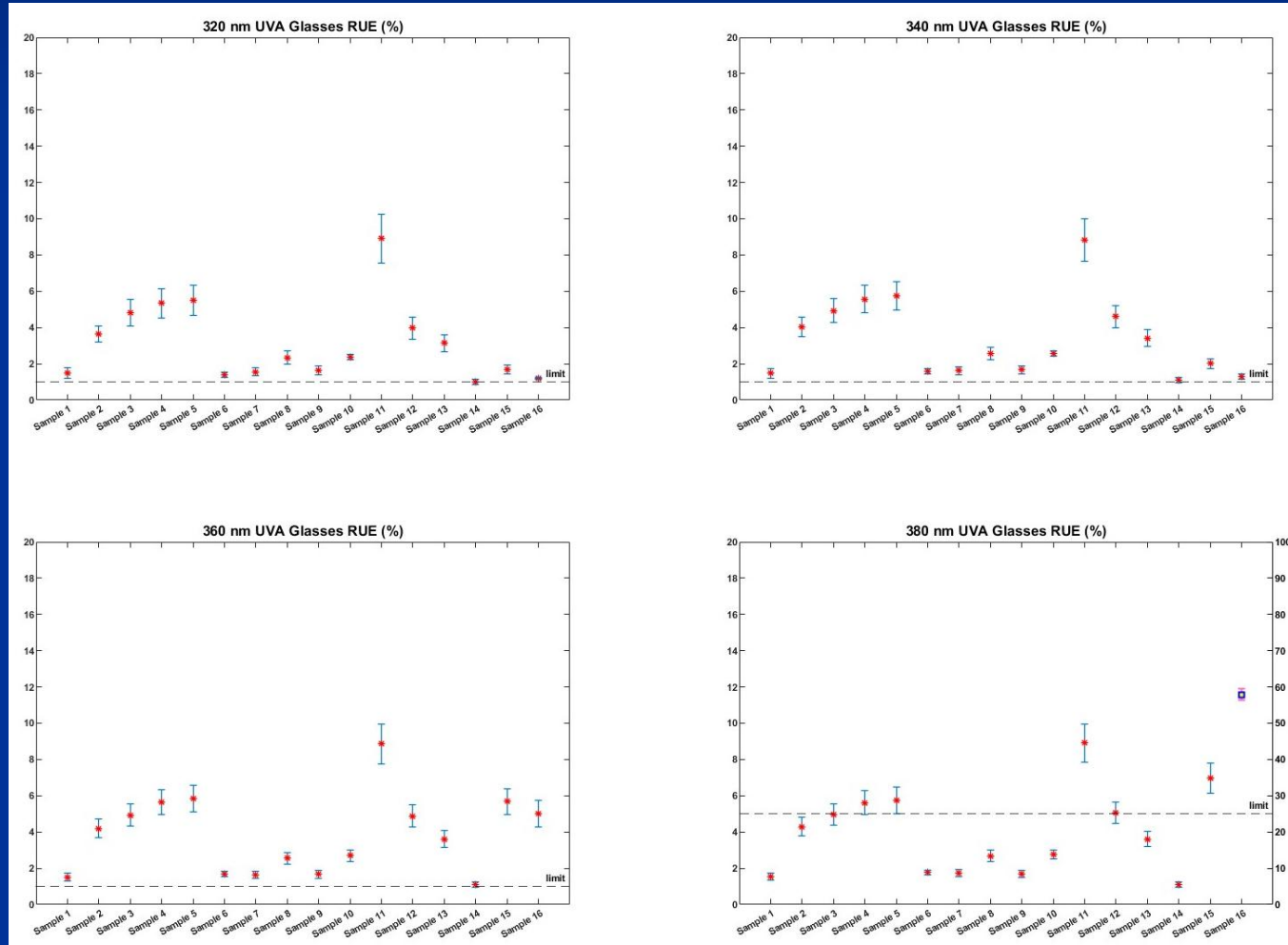
$$RUE(\%) = \frac{Irradiance_S}{Irradiance_R} \times 100\%$$

where: RUE (%) represents the relative UV exposure, *Irradiance<sub>S</sub>* is the irradiance measured with the glasses positioned on the head model, *Irradiance<sub>R</sub>* is the irradiance measured without the glasses

# Results

- Simulated UV exposure measurement

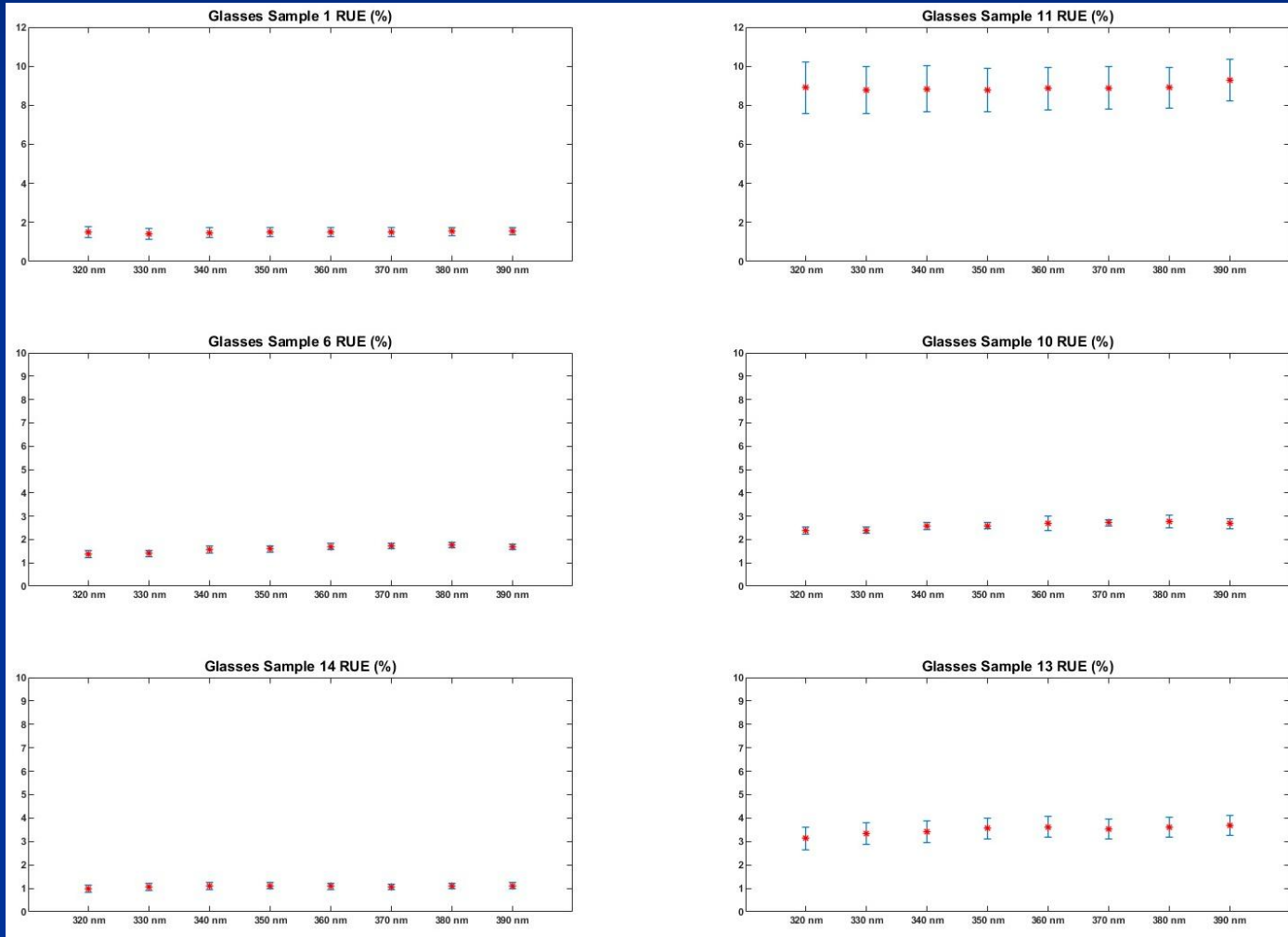
Figure 2. RUE for all glasses



# Results

- Simulated UV exposure measurement

*Figure 3. RUE for grouped glasses*



Sunglasses

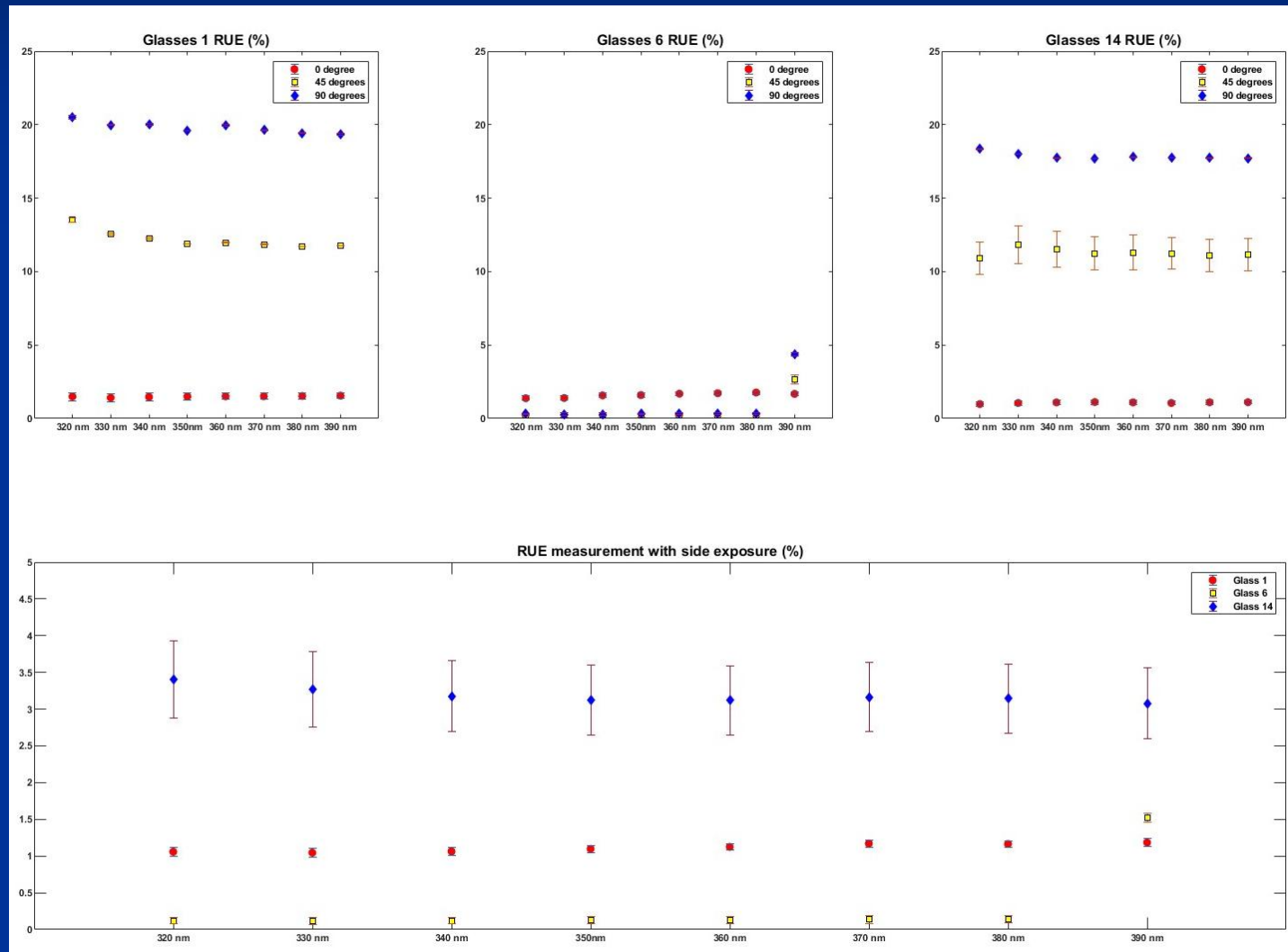
UV protective  
safety eyewear

UV protective  
Reading glasses

# Results

- Simulated UV exposure measurement

Figure 4. RUE for different angles



# Results

- UVA radiometer measurement

Table 3. RUE of Glasses Under Natural Sunlight Exposure

	Measurement 1	Measurement 2	Measurement 3	Average RUE
Glasses 1	7.92%	9.73%	9.03%	8.89%
Glasses 6	1.42%	1.15%	1.04%	1.21%
Glasses 14	1.63%	1.38%	1.48%	1.49%

# Discussion

- Lens transmission and UV protection effectiveness in real-world conditions are two different terms
- Eye protection guidelines for PUVA patients are based on the transmission rate.
- Methodology, eyewear styles, and position of the wearer affect the results.

# Conclusion

- Lens transmission cannot represent the effectiveness of UV protection in real-world conditions.
- Wrap-around, close-fitting eyewear with UV protection should be recommended for PUVA patients. Guidance about how to wear it should also be given.
- Methodology should be standardised across the phototherapy centres.

## ■ Funding Sources

Mingkai Wang is funded by the Medical Laser Research Fund (registered charity SC 037390)

**Thank you!**