

Using Phototherapy Effectively

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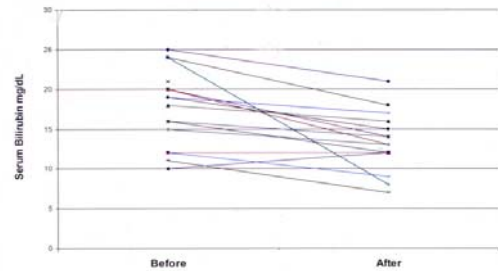
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I have received grant support from Natus Inc for studies on phototherapy

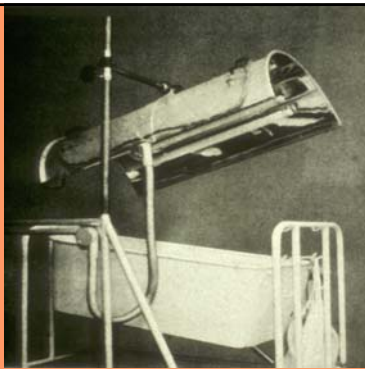


Fig.—Miss J. Ward, S.R.N., in 1936, with one of the earliest of the infants given phototherapy at Rockford General Hospital.

Effect of Sunlight on Jaundiced Preterm Infants
Cremer et al Lancet 1958;1:1094



13 infants exposed for 2 – 4 hours



Cremer et al Lancet 1958; 1: 1094-1097

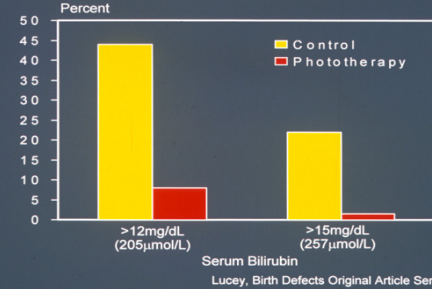
PHOTOTHERAPY - PUBLICATIONS 1958-1965

1. Cremer Lancet 1958;1:1904
2. Franklin Lancet 1958;1:1227
3. Berezin Matern Infanc (S. Paulo) 1960;L9:169
4. Berezin Matern Infanc (S. Paulo) 1960;19:169
5. Ferreira Rev Ass Med Brasil 1960;6:201
6. Ferreira An Brasil Ginec 1960; 49:149
7. Ferreira J Pediat (Rio) 1960;25:12
8. Mellone Rev Paul Med 1960;57:47
9. Peluffo Arch Pediat Urug 1962;33:98

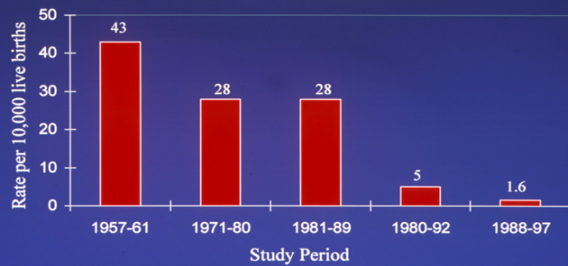
PHOTOTHERAPY – PUBLICATIONS 1958-1965

10. Arocha de Pinango Arch Ven Puer Ped 1963;26:153
11. Berezin Matern Infanc (S. Paulo) 1963;22:529
12. Capozzi Matern Infanc (S. Paulo) 1963;22:529
13. Carvalho Matern Infanc (S. Paulo) 1964;23:427
14. Obes-Polleri Rev Chile Ped 1964;25:638
15. Ballabriga Rev Esp Pediat 1965;21:121
16. Alison Ann Pediat 1966;1:118
17. Croso Minerva Pediat 1964;16:131
18. Sandrucci Minerva Pediat 1965;17:394
19. Mininni Rev Clin Pediat 1964;72:297
20. Lucey Pediatrics 1968;41:1047

Effect of Phototherapy on Prevention of Hyperbilirubinemia in Infants 1000-2500g

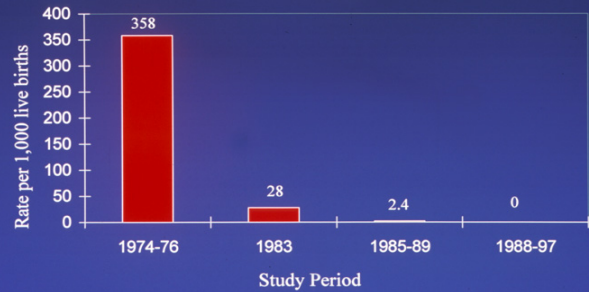


Number of Infants Receiving Exchange Transfusions All Live Births



Maisels MJ. J Perinatol 2001; 21: S93 – S97

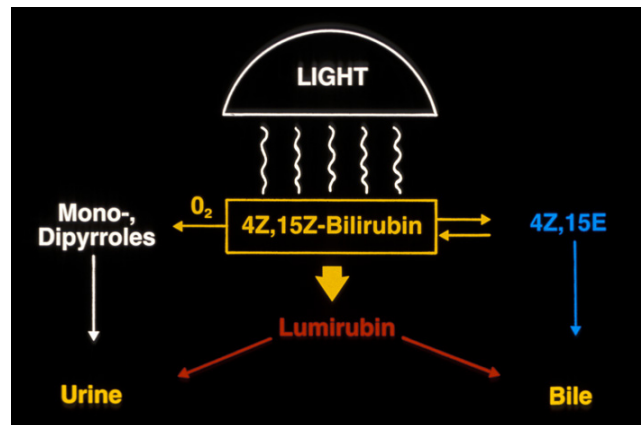
Number of Infants Receiving Exchange Transfusions < 1500 g



Maisels MJ. J Perinatol 2001; 21: S93 – S97

How Does it Work?

- Light delivers energy in the form of photons (like drug molecules)
- Photons are absorbed by bilirubin molecules in skin → therapeutic effect (like binding of drug molecules to a receptor)
- Like drugs, effective phototherapy requires a therapeutic dose



Dosage

- **Drugs – by weight**
- **Photons – by irradiance**

- **Irradiance** - radiant power incident on a surface per unit area of the surface (W/cm^2)

- **Spectral irradiance** - irradiance in a certain wavelength band ($\mu\text{W}/\text{cm}^2/\text{nm}$)

For intensive phototherapy need $30\mu\text{W}/\text{cm}^2/\text{nm}$

- **Spectral power** - average spectral irradiance across a surface area (mW/nm)

- **Most effective wavelengths are in the blue-green spectrum 460 – 490nm (because of optical properties of bilirubin and skin)**

- **Bilirubin absorption peak is at 459 nm**

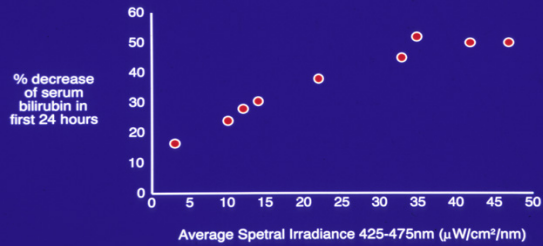
Blue F20T12/B(Fluorescent)

Special Blue F20T12/BB
TL52/20W (Phillips)
NeoBlue (LED)
BiliSoft (LED/fiberoptic)

**Phototherapy
Does Not Use
Ultraviolet Light**

**Phototherapy demonstrates a
clear dose-response relationship**

RELATIONSHIP OF AVERAGE SPECTRAL IRRADIANCE TO PERCENT DECREASE IN SERUM BILIRUBIN
(from data of Tan KL, *Pediatr Res.* 1982;16:670)



The Changing Use of Phototherapy

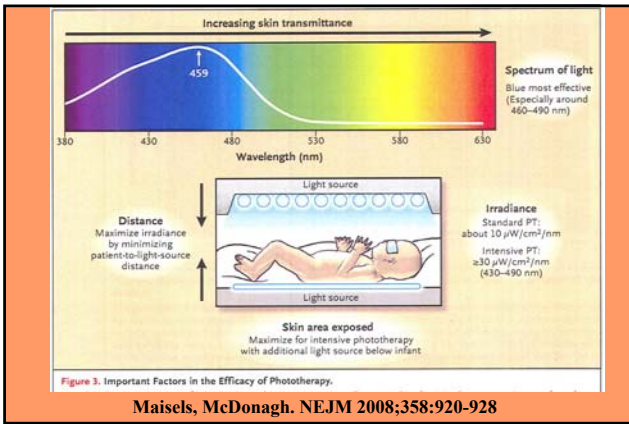
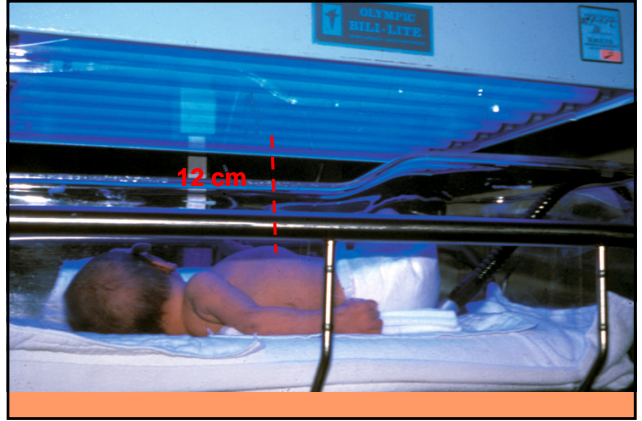
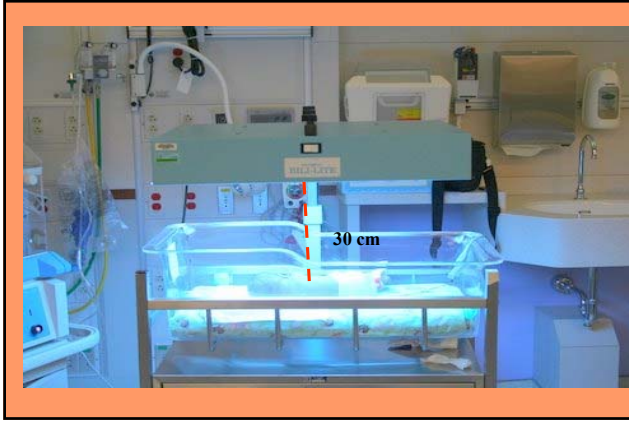
- Prophylactic
- Therapeutic

**Therapeutic Phototherapy
Maximizing Irradiance**

- Special blue tubes or lamps that deliver in 460 - 490 nm spectrum
- Bring light as close to baby as possible (cannot do this with “spot” halide lamps - danger of burn)
- Baby in bassinet, not incubator
- Check with radiometer

Phototherapy....common errors





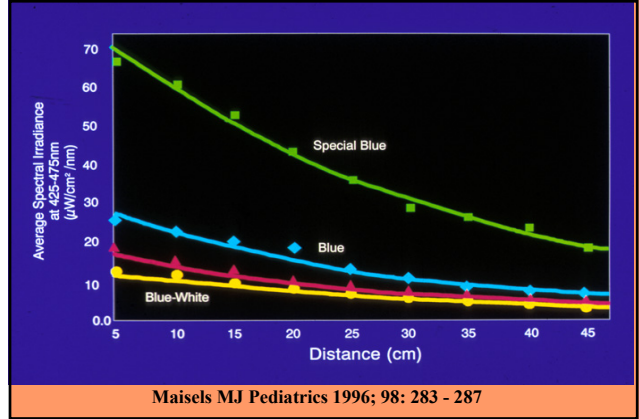
Maisels, McDonagh. NEJM 2008;358:920-928



Variation in Measured Irradiance, $\mu\text{W}/\text{cm}^2/\text{nm}^*$

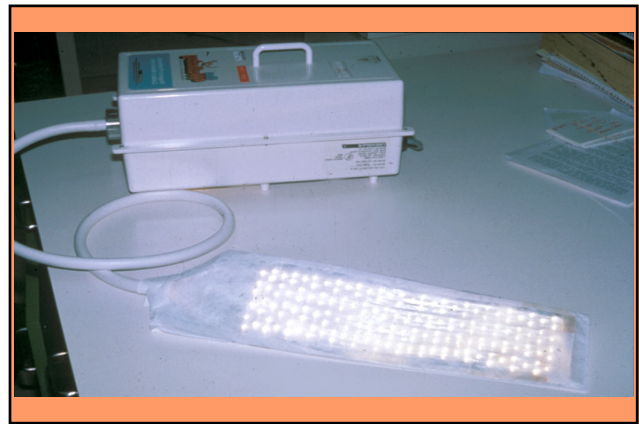
| Light Meter (Manufacturer) [Range, Peak nm] | Halogen Mini-BiliLite (Olympic) 40cm | Halogen Fiberoptic BiliBlanket (Ohmeda) High Setting (Contact) | Fluorescem BiliLite, Model 33 (Olympic) N-4BB; N-4CW 40 cm | LED (noBLUE) (Natus) 30 cm |
|--|--------------------------------------|--|--|----------------------------|
| BiliBlanket Meter II (Ohmeda) [400-520, 450] | 19,5 | 32,9 | 11,0 | 35,7 |
| Olympic Bili-Meter (Olympic) [425-475, 460] | 18,9 | 30,0 | 15,1 | 27,8 |
| Joey, JD-100 (Healthdyne) [420-550, 470] | 40,0 | 37,3 | 18,1 | 61,7 |
| PMA-2123 Bilirubin Detector (Solar Light Co.) [400-520, 460] | 18,3 | 22,5 | 12,4 | 37,8 |

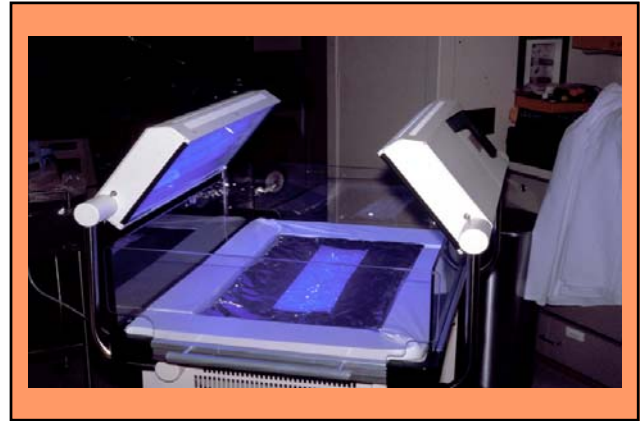
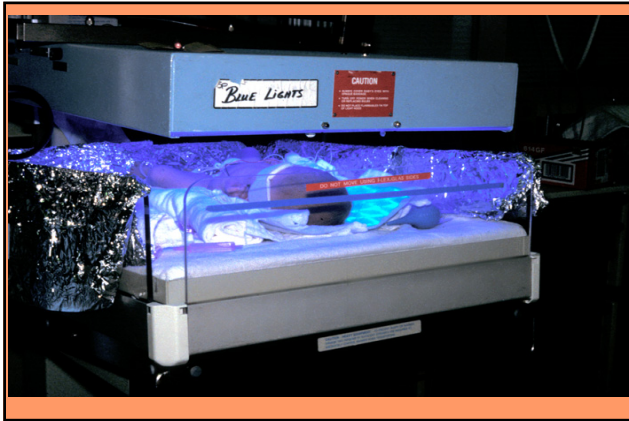
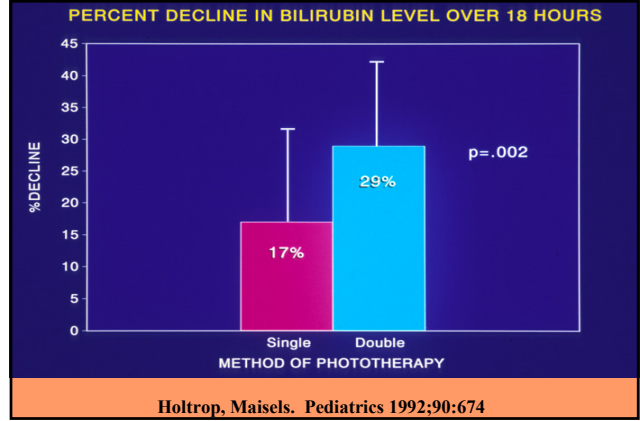
*Area of maximum irradiance
Vreman et al. Semin Perinatol 2004;28:326-333



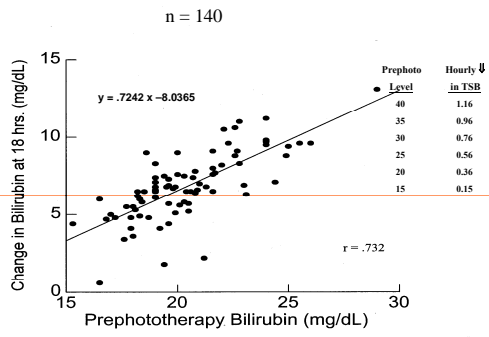
Increase Surface Area

- **Fiberoptic pads**
- **Limitations –**
 \uparrow surface area \rightarrow \downarrow irradiance





Effect of Bilirubin Level on Response to Phototherapy



More light!

Johann Wolfgang von Goethe (1749 – 1832)