Daily Disposable Update: Innovations in Materials, Design and Applications

Susan A. Resnick, OD FAAO FSLS
New York, NY
sresnick525@gmail.com

1

1

Disclosures

- **Consultant/Speaker**
  - **Alcon**
  - **Allergan**
  - **Bausch + Lomb**
  - **JNJ**
  - **RVL Pharmaceuticals**
  - **Santen**
  - **Sight Sciences**
  - **Visioneering Technologies**

2

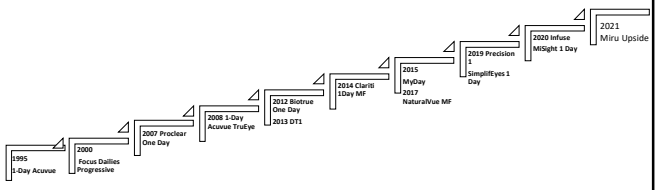
2

- ✓**Prescribing Trends**
- ✓**Clinical Benefits**
- ✓**Lifestyle Benefits**
- ✓**Practice Benefits**
- ✓**Industry Advances**

3

3

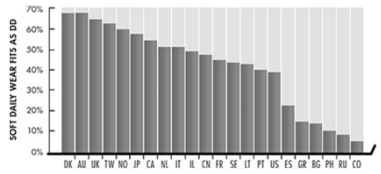
Historical Perspective



4

4

Global Prescribing



Daily disposable prescribing in 2020

https://www.clspectrum.com/issues/2021/january-2021/international-contact-lens-prescribing-in-2020

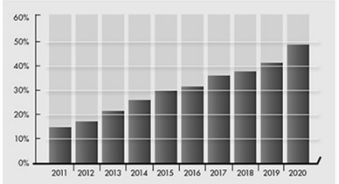
5

5

U.S. Prescribing Trends

Country	Rigid (non-OK)	OK	DD hydrogel	DD SiHy	Reusable DW hydrogel	Reusable DW SiHy	Soft EW
US	20%	0%	9%	27%	5%	37%	3%

https://www.clspectrum.com/issues/2022/january-2022/international-contact-lens-prescribing-in-2021



Percentage of daily disposable lens fittings in the United States over the last 10 years.
https://www.clspectrum.com/issues/2021/may-2021/get-your-daily-dose

6

6

What's Fueling the Growth?

- **Niche product vs. "workhorse" modality**
  - More neophytes starting in this modality
  - Parents will be refit after their kids are fit
  - Expanding parameters and optical designs
- **Cost vs. Value**
  - As more daily disposable lens options have become available, the cost disparity has decreased
  - Once the savings from the lack of care solutions and industry rebates are factored in, the difference in the cost of an annual supply of daily disposable lenses can be as little as 30 cents a day.
  - Convenience = value
- **"Technocentricity"**

7

7

So Why Choose One Day Lenses?

- **Safety**
- **Compliance**
- **Part time wear**
- **Practice Benefits**

Country	Total fits	Mean ± SD age	% female	% new fits	% part time (≤ 3 days)
United States (US)	433	36.4 ± 16.3	61%	28%	10%

https://www.clspectrum.com/issues/2022/january-2022/international-contact-lens-prescribing-in-2021

8

8

Patient Preferences

- **A Hanover Research survey* conducted on behalf of CooperVision provided insights into what lens wearers consider the most important factors when choosing a brand or type of contact lens. (2015)**
- **The survey resulted in 1,193 complete responses from contact lens wearers between 16 and 64 years old.**
- **One of the survey's key findings: patients care about health.**
- **When choosing between two lens brands**, only vision quality ranked higher than health in respondent's decision-making process.**
- **Price ranked last (fifth) as a determining factor.**
- **95% of those health-conscious lens wearers are also willing to pay a higher price for contacts that ensure eye health.*****

*https://coopervision.com/practitioner/build-your-practiceinsight-newsletter/what-are-contact-lens-wearers-willing-pay

**n=1175

***n=564

9

9

Ewwww!!

- 3 in 5 contact lens wearers do not wash their hands prior to handling the lenses.
- 1 in 5 people don't use fresh solution every time they store their lenses.
- 2 in 5 people have put their contact lenses in their mouth to clean them.
- 7 in 10 contact lens wearers admit to swimming in their lenses.

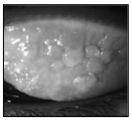
Stone R. The importance of compliance: focusing on the key steps. Poster presented at the annual meeting of the British Contact Lens Association; May 31-June 2, 2007.

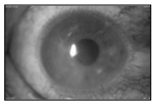
10

10

Safety

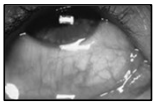
Adverse Events





Papillary response

Infections



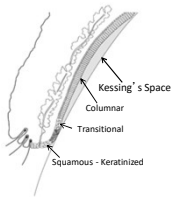
Allergy

11

11

1974- Discovery

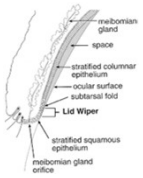
The Palpebral Conjunctiva and GPC



The columnar epithelium is not designed to be rubbed

A two-step pathogenesis

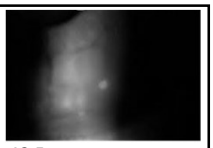
1. Chronic trauma induces inflammation & prepares the tissue for immune sensitization
2. **Exposure to antigens exacerbates immune reaction with resultant GPC**



12

12

Infection



- **The likelihood of having a corneal infiltrative event is 12.5 times greater when wearing reusable lenses compared to when wearing daily disposables (Chalmers et al, 2012).**
- **The rate of developing a moderate-to-severe keratitis is approximately half that of the rate with traditional daily wear lenses (Stapleton and Carnt, 2012).**
- **When adverse events do occur with daily disposables, it appears that they are milder in presentation.**

13

13

Allergy

[1]Hayes VY, Schnider CM, Veys J. An evaluation of 1-day disposable contact lens wear in a population of allergy sufferers. Contact Lens Anterior Eye. 2003; 26(2):85-93.
[2] Hart DE. Deposits and coatings in hydrogel lens/tear film interactions. In: Bennett E, Weissman BA, editors. Clinical Contact Lens Practice. Philadelphia: Lippincott-Raven; 1996; p 3-5,19-20.

- **Seasonal Benefits**
  Daily disposable lenses are particularly beneficial to patients who suffer from redness, itch or tearing caused by chronic or seasonal allergies.[1]
- 67% of patients experience increased comfort with DD during allergy season.
- High replacement frequency reduces build-up of antigens and denatured proteins. [2]

14

14

Adhesion of Pollen Particles to Daily Disposable Soft Contact Lenses [1]

- Pollen particles were experimentally exposed to the contact lens surface of 12 types of SCLs for 1 hour
- SCLs were washed and rinsed with a physiological saline (n=10 for each SCL type). A total of 120 contact lenses were used in this study. The pollen particles attached to the SCL were observed and photographed under a microscope.
- The influence of the materials of the SCLs on the degree of pollen adhesion were investigated.

Clinical Optometry 2021:13 93–101

15

15

Adhesion of Pollen Particles to Daily Disposable Soft Contact Lenses

- The number of residual pollen particles attached to SCLs was in the range from 0–293/area of 200×200 μm
- Percentage of pollen adhesion area of the surface of the SCL was in the range from 0.01% to 3.25%
- There were significant differences in both the number and adhesion area of pollen particles among the 12 types of SCLs tested
- **The portion of pollen adhesion area was lower in the silicone hydrogel lens compared with hydroxyethyl methacrylate-(HEMA-) based SCLs**
  - **The portion of pollen adhesion area was lowest for the silicone hydrogel SCLs made with delefilcon-A**

16

16

Compliance

- **Replacement Frequency**
- **Eye Exam Interval**
- **Revenue Implications**

17

17

Compliance With MRS

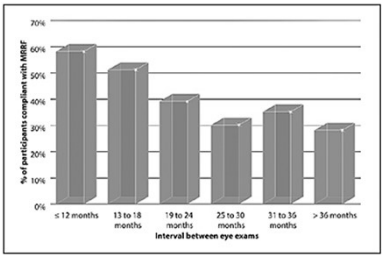
Rueff EM, Wolfe J, Bailey MD. A study of contact lens compliance in a non-clinical setting. *Cont Lens Anterior Eye*. 2019;42(5):557-561. doi:10.1016/j.clae.2019.03.001

18

18

SARAH GUTHRIE, PHD; KATHY DUMBLETON, PHD, MCOPTOM, FAAO; & LYNDON JONES, PHD, FCOPTOM, FAAO

Compliance vs. Eye Exam Interval



http://www.clspectrum.com/articleviewer.aspx?articleID=112026 12/1/14

19

19

Economic Impact

TABLE 1 Optometrist Eye Examinations and Revenue Potential*

	Actual	Potential	Actual % of Potential	Left on the Table
Average revenue per complete exam	$306	$400	77%	23%
Average eyewear sale	$227	$300	76%	24%
Average annual contact lens sale per contact lens exam	$152	$240	63%	37%
Average months elapsed between eye exams	25	18	72%	28%
Average % of potential left due to inaction: 28%				

**Adapted from "The State of the Optometric Profession: 2013"*

TABLE 3 Lifetime Impact of Contact Lens Dropouts*

Practice Data	
Number of annual patients	3,100
Percentage of patients who wear contact lenses	34%
Number of contact lens patients	1,054
Average annual value of a contact lens patient	$275
Average contact lens dropout rate	16%
Average number of contact lens dropouts	169
Annual economic value of your contact lens patients	$46,376
Lifetime economic potential of eliminating your contact lens dropouts	$2,086,920

JOHN RUMPAKIS, OD, MBA, & MILE BRUJIC, OD, FAAO
http://www.clspectrum.com/articleviewer.aspx?articleID=111593

20

20

Industry Strides

Optimizing comfort and health:
- **New materials**
- **Advanced lens features**

Meeting a wider range of visual needs:
- **Astigmatism**
- **Presbyopia**
- **Myopia**

21

21

Material Properties

22

22

Oxygen – Solved

1987 – Beyond Oxygen
First Memorial Morton D. Sarver Lecturer, School of Optometry, University of California, Berkeley, 1987, Donald Korb

Oxygen deprivation is solved
- Dk 24 – Daily Wear
  Holden and Mertz, 1984
- Dk revised to > 100
  Holden, et al, 1984-1989
- Dk of 20 centrally and 30 peripherally
  Brennan, 2013

50 other investigators include:
Polse and Mandell, Fatt, Hill, Mertz, Holden, Efron

Re-evaluating the classic Holden-Mertz oxygen transmission values, researchers estimate that the average Dk/t required to preclude corneal hypoxic changes is 25 Fatt units to 30 Fatt units for daily wear lenses and 125 Fatt units for extended wear lenses.
Fonn D, Bruce A. A review of the Holden-Mertz criteria for critical oxygen transmission. Eye Cont Lens. 2005;31(6):247-51.

Take home for clinician
The cause of symptoms is rarely oxygen deprivation

Daily Wear Contact Lenses Manufactured in Etafilcon A Are Noninferior to Two Silicone Hydrogel Lens Types With Respect to Hypoxic Stress

Noninferiority of etafilcon A, with respect to lotrafilcon and comfilcon, was assumed if the following difference margins of equivalence were met: <1.5% for corneal swelling, <0.5 grade for limbal hyperemia, and <1% area of endothelial blebs

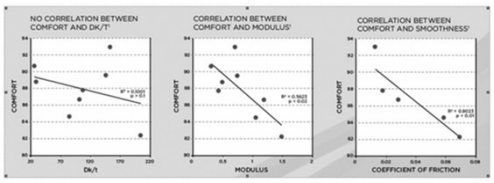
The etafilcon A control lens resulted in corneal deswelling throughout the day as did the SH lens types. Limbal hyperemia and endothelial bleb formation with all lenses were negligible, and noninferiority assumptions were met between the lens types for all outcomes

Szczotka-Flynn LB, Debanne S, Benetz BA, Wilson T, Brennan N. Daily Wear Contact Lenses Manufactured in Etafilcon A Are Noninferior to Two Silicone Hydrogel Lens Types With Respect to Hypoxic Stress. Eye Contact Lens. 2018 May;44(3):190-199. doi:

23

23

Comfort – Dk – Modulus – Lubricity



"The principal lens property associated with end-of-day comfort is coefficient of friction"
Coles & Brennan, 2012

24

24

The Contact Lens and Ocular Surface: Compatibility Challenges

The contact lens surface lacks mucus attaching properties
to host the foundational "mucus"
essential for the formation of an optimal tear film

Results

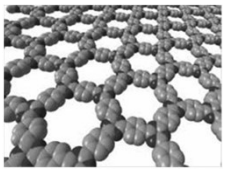
1. CL surface unable to support a tear layer of the thickness to provide hydrodynamic lubrication of the lid wiper
2. Rapid evaporation from the contact lens surface, leading to desiccation stress of the ocular surface
3. Sensation – discomfort and friction-trauma induced by a "dry" CL leading to many sequelae including LWE

25

25

Optimizing Comfort

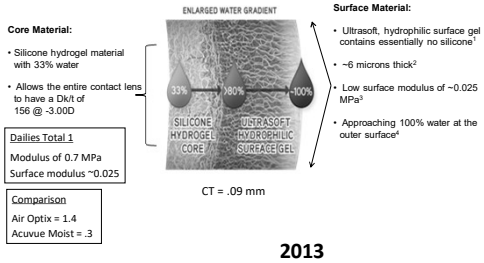
Innovation in Polymers



26

26

Water gradient contact lenses: Dailies Total 1



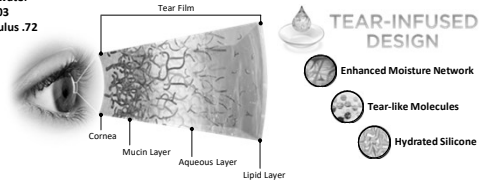
2013

27

27

HydraLuxe™ Technology

Senofilcon A
38% water
Dk 103
Modulus .72



2015

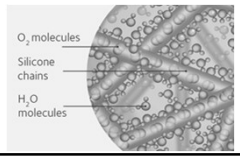
28

28

My Day

Aquaform® Technology

- **a matrix of long silicone chains, hydrogen bonds form to lock water molecules within the lens, for good wettability and a comfortable wearing experience**
- **the long chains mean that less silicone needs to be used to optimize oxygen transmissibility**
- **Reduced silicone content also results in a low modulus, which promotes softness**



2015

Stenfilcon A
54% Water
Dk 80
Modulus .4

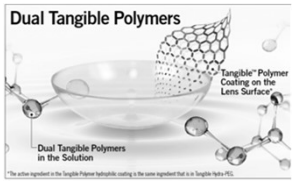
29

29

SimplifEyes with Dual Tangible Polymers

SIMPLIFEyes 1 Day enhanced by tangible

2019



Parameters

Aspheric Hydrogel Lens Enhanced by Dual Tangible Polymers			
Lens Powers (D)	Materials	Base Curve (mm)	Diameter (mm)
+0.50D to +4.00D -0.50D to -6.00D (0.25D steps)	Etafilcon A with Dual Tangible Polymers Class II UVA/UVB Blocker	8.6	14.2

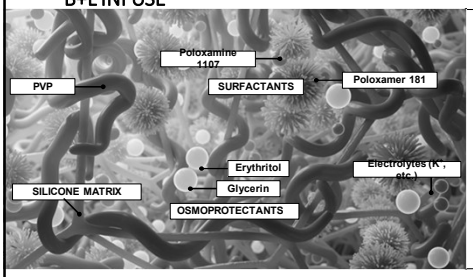
58% H20
Dk 17
Modulus .31

30

30

B+L INFUSE

2020



Kalifilcon A
Dk 107
55% H2O
Modulus .5

The lens material is infused with a proprietary solution containing a blend of surfactants, electrolytes, and osmoprotectants

31

Expanding Parameters

- **Spheres**
- **Torics**
- **Multifocals**

32

32

Spheres/Multifocals

Spheres

- **12.00 to +8.00**
  - **Acuvue Oasys**
  - **Precision 1**
  - **My Day**

Multifocals

- **- 12.25 to +4.00 0.25 Steps**
  - **NaturalVue MF 1 Day**
- **- 10.00 to +6.00**
  - **Dailies Total 1**
  - **Proclear 1 Day**
- -10.00 to +8.00
  - My Day MF

33

33

Torics

Sphere	Cylinder	Axis
• ACUVUE OASYS 1-DAY FOR ASTIGMATISM –6 to Plano (0.25D steps)	• –0.75, –1.25, –1.75 • -2.25	• Full circle 10º steps • 10,20,70,80, 90,100,110,160,170,180
• MYDAY TORIC +0.50 to +6 .00 (0.50D steps)	• -0.75, -1.25, -1.75 • –0.75, –1.25, –1.75 • –2.25	• Full circle 10º steps • 10, 20, 70, 80, 90, 100, 110, 160, 170, 180 • 10, 20, 90, 160, 170, 180
• BIOTRUE ONEDAY FOR ASTIGMATISM –9 to +4	• –0.75, –1.25, –1.75, • –2.25, -2.75	• 10º, 20º, 60º, 70º, 80º, 90º, 100º, 110º, 120º, 160º, 170º, 180º • 10, 20, 90.160, 170,180

34

34

Industry Strides

Presbyopia

35

35

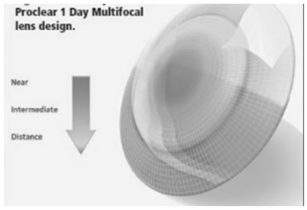
Multifocal Fitting Pearls

- **Know the design**
- **Follow the fitting guide**
- **Use real life viewing**
- **Normal room illumination**
- **See them back quickly**

36

36

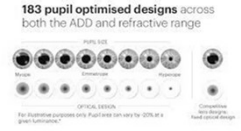
2012



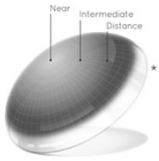
37

37

Biotrue® ONEday for Presbyopia 2014



1-Day Acuvue Moist Multifocal - 2015



DAILIES TOTAL1®Multifocal- 2016

MyDay® daily disposable multifocal - 2021

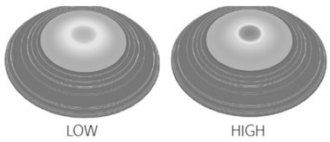
38

38

Miru Upside MF

Menicon

2022



Base Curve	8.40 mm
Diameter	14.2 mm
Power Range	+5.00D to -6.00D (0.25D steps) -6.50D to -10.00D (0.50D steps)

Midafilcon A
H2O 56%
Dk/t 91
Modulus .36

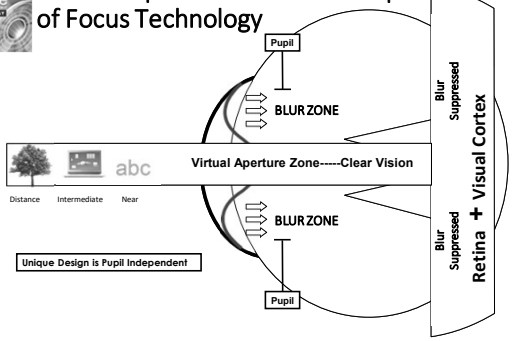
Smart touch package
Menisilk Air – new SiHy
(polymerizes hydrophilic monomers and siloxane components)
Nanogloss Pro - plasma oxidation and plasma coating

39

39

"Virtual Aperture" Extended Depth of Focus Technology

2017



Unique Design is Pupil Independent

40

40

Myopia Control

2017

- **Myopia progression control lens reverses induced myopia in chicks**

  Elizabeth L. Irving, Cristina Yakobchuk-Stanger, OPO, Volume 37, Issue 5 September 2017 Pages 576–584

- **Case Series Analysis of Myopic Progression Control With a Unique Extended Depth of Focus Multifocal Contact Lens**

  Cooper, Jeffrey M.S., O.D.; O'Connor, Brett O.D.; Watanabe, Ronald O.D.; Fuerst, Randall O.D.; Berger, Sharon O.D.; C.O.V.D.; Eisenberg, Nadine O.D.; Dillehay, Sally M. Ed.D., O.D. Eye & Contact Lens: October 19, 2017

NaturalVue MF lens delivered approximately 96% reduction (average of both eyes) of annualized myopic progression in children aged 6 to 19, with 98.4% of the children showing a decrease in the rate of worsening of their myopia.[1]

- **2018: Visioneering Technologies Achieves CE Mark for NaturalVue® Family of 1 Day Contact Lenses**

Indications include unique NaturalVue Multifocal lens for myopia progression control

41

41

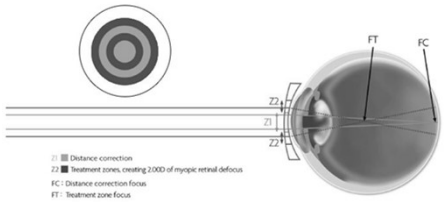
6-Year Myopia Progression Data for NaturalVue Multifocal Announced at American Academy of Optometry's Annual Meeting

- Retrospective cohort analysis – 196 real-world subjects, 6 years of data, 15 practices
- 95% of subjects showed a decrease in myopia progression, with 78% showing a decrease of 70% or more, as compared to baseline
- The average rate of myopia progression slowed by 85% as compared to baseline from 6-72 months
- Axial lengthening was slowed to normal rate of change expected for non-myopic children of a similar age range

42

42

2020



43

43

MiSight 3-Year Data Analysis

A 3-year Randomized Clinical Trial of MiSight Lenses for Myopia Control

Authors: Chamberlain, Paul (1), Peixoto-de-Matos, Sofia (2), Logan, Nicola (3), Ngo, Cheryl (4), Jones, Deborah (5), Young, Grame (6)

- Change in spherical equivalent refraction at 3 years
  - Control (SV): -1.240.61D
  - Test (MiSight): -0.51 0.64D
  - Statistically significant reduction (p<0.001) of -0.73D **(59%)**
- Change in axial length at 3 years
  - Control (SV): 0.620.30mm
  - Test (MiSight): 0.300.27mm
  - Statistically significant reduction (p<0.001) of 0.32mm **(52%)**

44

44

MiSight 6 -year Data Analysis

- The original control group was refit into the dual-focus lens in year four.
- Comparing this population to the children fit with MiSight 1 day at initiation, there have been similar rates of myopia progression and axial length growth in the subsequent three years of assessment
- Nearly one in four children's eyes originally fit with MiSight 1 day remain stable for myopia after six years.
- Evaluating children who were prescribed MiSight® 1 day at the study's initiation, 23% of eyes after year six displayed a total refractive change of less than -0.25D (spherical equivalent)
- The newest findings also suggest that while intervention at an early age is optimal with MiSight® 1 day, commencing treatment at an older age could similarly slow the rate of myopia progression.

45

45

Unique Applications: Present and Future

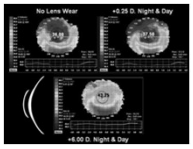
- **Ocular surface "restoration"**
- **Piggyback and "Reverse Piggyback"**
- **Drug Delivery**
- **Biosensing**

46

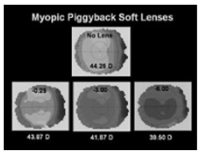
46

Piggybacking

- Traditional "Under"
  - Fitting method
  - Choice of lens power
- Reverse "Over"
  - Diagnostic
  - "Therapeutic"



https://www.clspectrum.com/issues/2005/april-2005/contact-lens-case-reports



https://www.clspectrum.com/issues/2004/march-2004/contact-lens-case-reports

47

47

Drug Delivery

- **Etafilcon A**
- **Approved in Canada and Japan**
- **Contains Ketotifen, an H1 histamine receptor antagonist**
- **Medication is slow released up to 5 hours for 12 hours of relief**
- **Preservative free**

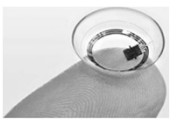
48

48

Biosensing

- Daily disposable silicone hydrogel
- Worn for up to 24 hours
- 14.1 diameter
- 585 µm ct
- 8.4, 8.7, and 9.0 mm base curves
- Embedded within the contact lens are two strain gauges, a microprocessor, and an antenna
- The strain gauges detect changes in corneal shape, and a high correlation between CLS output and imposed IOP has been demonstrated

SENSIMED Triggerfish®



The product received the CE mark in 2010 and was approved by the FDA in **2016**.

49

49

Fitting Set/Inventory

- **Spheres:**

"workhorse" vs. "problem solver"
HEMA and SiHY

- **Torics:**

Extended range vs. limited range
Method of Stabilization
HEMA and SiHY

- **Multifocals:**

Work with a minimum of two designs

Resnick Strategy

"Workhorse" SiHY
Sphere (1)
Toric (1)
MF (1)

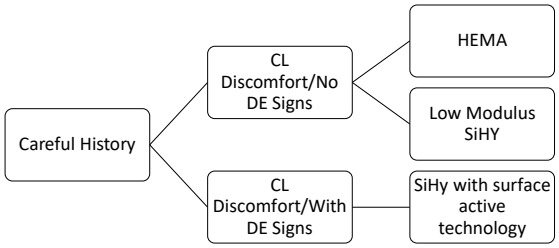
Premium SiHY
Sphere (1)
Toric (1)
MF (1 or 2)

Myopia Control
Center Distance (1)
EDOF (1)

50

50

The Resnick Clinical Selection Strategy



51

51

Environmental Impact

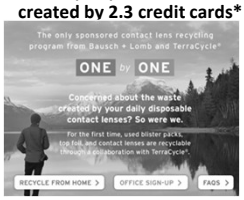
- **15% to 20% of daily disposable contact wearers flush their used lenses down the sink or toilet** The environmental cost of contact lenses. American Chemical Society. August 19, 2018
- **Wastewater treatment facilities aren't designed to fully break down the type of plastics used for contact lenses**
- "Disposable contact lenses are emerging contaminants of concern that cause environmental pollution, present a potential physical threat to susceptible aquatic biota, may contribute to microplastic pollution, and have the potential to adsorb, accumulate, and transport harmful persistent organic pollutants into aquatic and terrestrial environments," Rolsky C, Kelkar V, Halden RU. Chemical and physical changes in a variety of contact lenses during the wastewater treatment processes. Abstract presented at the 256th National Meeting & Exposition of the American Chemical Society, August 20, 2018; Boston.
- **Update your contact lens care education to include proper disposal**

52

52

Go Green

The weight of an annual supply of dehydrated daily disposable lenses (730) was found to be 11.36 grams, or the average waste created by 2.3 credit cards*



clariti® 1 day Net Plastic Neutral Initiative

For every box of clariti® 1 day distributed in the U.S. since January 2021, CooperVision funds the collection, processing, and reuse of general plastic waste that is equal to the weight of the plastic contained in clariti® 1 day lenses and packaging.

*** Routhier et al 2012**
www.terracycle.com/bauschrecyclesinoffice

53

53

54

54

Clearing the Cost Hurdle

Discuss the *Value* before the *Cost*
- **Face the patient directly to deliver your message**
- **"Most contact lens complications are due to dirty lenses and dirty cases"**
- **Share that daily disposable lenses are 12.5x safer!**

Break Down the Numbers
- **No need to purchase care products**
- **Factor in rebates**
- **Break it down into daily cost**

- ***"If you don't throw away the lenses, you throw away the benefits"***
  Dr. Thomas Quinn

55

55

Compete on Service

Subscription Platforms!

- Free ship-to-home for orders
- Free replacement of torn or defective lenses
- Exchanges of unopened boxes
- Assistance with rebate processing
- 100% satisfaction guarantee

56

56

Summary: Practice Growth

- **Patient Selection: Virtually ALL patients are candidates for single use lenses**
- **A "must" for children and adolescents and P/T wearers**
- **Consider differences in materials and designs when conducting your clinical evaluation**
- **Work with at least two different brands in each optical modality.**

Recognize the reasons why patients have not yet moved to daily disposables ahead of time and be ready for the discussion!

57

57

Thank you!

Sresnick525@gmail.com

58

58