RISK FACTORS FOR CONTACT LENS INDUCED PAPILLARY CONJUNCTIVITIS ASSOCIATED WITH SILICONE HYDROGEL CONTACT LENS WEAR

by

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Risk Factors for Contact Lens Induced Papillary Conjunctivitis Associated with Silicone Hydrogel Contact Lens Wear

Abstract

by

ANGELA TAGLIAFERRI

BACKGROUND: Contact lens induced papillary conjunctivitis (CLPC) was first reported in 1974. With the increased use of silicone hydrogel lenses for extended wear there has been an increase in inflammatory reactions in the eye, including CLPC. The changes that occur in the eye when using an extended wear lens might include: tear stagnation, localized pressure, and a closed eye environment producing an inflammatory condition caused by the frictional rubbing of the lens on the upper palpebral conjunctiva.

METHODS: The Longitudinal Analysis of Silicone Hydrogel Contact Lens (LASH) study conducted in Cleveland, Ohio in 2007-08 included 205 patients fitted with extended wear silicone hydrogel contact lenses and had a primary endpoint of Corneal Infiltrative Events within the year of follow-up following lens fitting. In the present study, patients were identified as experiencing Contact Lens Induced Papillary Conjunctivitis (CLPC) in two ways, either through clinical diagnosis during the LASH study or through a retrospectively applied algorithm to capture substantial changes reported in the eye consistent with CLPC. We investigated the association of [i] the level of bacterial bioburden, [ii] the difference between the base curve of the lens and the curvature of the eye, [iii] the presence of prior adverse events, and [iv] demographic information with the development of CLPC, in a series of logistic regressions. We also modeled the relative hazard of
developing CLPC for patients with “abnormal” vs. normal bioburden, after accounting for other factors. In secondary analyses, we compared the impact of bioburden within Gram + or Gram – classifications, and briefly assessed seasonality of CLPC diagnoses to assess the relationship to Northeast Ohio’s allergy season.

**RESULTS:** Across the follow-up period for the LASH study, 19 patients were diagnosed with CLPC clinically and a total of 52 were diagnosed via the expanded approach - either clinically or via the algorithm. In separate analyses of these “clinically diagnosed” and “expanded” classifications, development of CLPC was not significantly associated either with the presence of bacterial bioburden or with the difference between the base curve of the lens and the curvature of the eye. In logistic regression modeling, we observed nearly significant effects of gender and race on the development of CLPC. Specifically, females displayed an odds ratio of 0.38 [95% CI: 0.14, 1.03] for developing CLPC as compared to males. Asians showed an odds ratio of 3.49 [95% CI: 0.94, 12.49] for developing CLPC as compared to Caucasians. In time-to-event analyses, our Cox Proportional Hazard models indicated significant gender and race differences, specifically, female gender was associated with a relative hazard of 0.32 (95% CI: 0.12, 0.86) for developing CLPC while both Asian (relative hazard: 6.3, 95% CI: 1.76, 22.57) and African- American (5.83, 95% CI: 1.64, 20.67) patients showed increased hazard for CLPC than did Caucasian patients.

**CONCLUSIONS:** Hygiene, environmental factors, and physical characteristics may potentially describe the outcome of developing CLPC, although the only significant associations we could find in this small study were linked to gender
and ethnicity. Our data are not inconsistent with the hypothesis that seasonality plays a role in the development of CLPC, but a larger sample size would be required to confirm this finding.
Specific Aims

Contact lens induced papillary conjunctivitis is defined as “an inflammatory reaction of the upper palpebral conjunctiva that is thought to be a consequence of mechanical trauma and/or an allergic response to lens materials or deposits that accumulate on the lens surface”\(^2\). It is a non-sight threatening, treatable condition\(^3\). The introduction of silicone hydrogel lenses to the market coincides with increasing prevalence of CLPC\(^4\).

This project identifies the possible risk factors for CLPC. The LASH database contains information on demographic and clinical covariates in addition to data regarding the bacterial bioburden on the lenses, lids, and conjunctiva. Information on the ocular surface, corneal and conjunctival staining, corneal contour, dry eye, and mucin ball production is also available. A list of all variables collected in the LASH study is provided in Appendix A.

**Specific Aim 1:**
To identify the risk factor(s) that contributes to the development of CLPC during continuous wear of silicone hydrogel (SH) contact lenses. Determine whether the level of bacterial bioburden, the lens fit (the difference between the corneal and lens curvature), or any demographic covariates contribute to the development of CLPC on a person-level.

**Specific Aim 2:**
To probe lens fit and lens bioburden on an eye-level basis for potential association with CLPC through modeling the hazard of developing CLPC
throughout the study period for patients with "normal" vs. "abnormal" bioburden, then further classifying abnormal bioburden as Gram + vs. Gram - to assess the association of these categories with patterns in CLPC development on an eye-level. As a sub-analysis under Aim 2 to investigate other theories as to the development of CLPC, another regression analysis on the curvature variable will be performed using best fit sphere rather than simK readings to determine if the difference in the curvature of the cornea vs. the curvature of the lens creates a stimulus that leads to CLPC inflammation. It will also be determined if there is a seasonality trend in those that developed CLPC to test if CLPC is seen more during allergy season.
Background

The Condition

Contact lens induced papillary conjunctivitis (CLPC) was first reported by Spring in 1974\(^5\). The incidence of CLPC varies greatly and has been reported anywhere from 1.5 to 47.5\(^3\) (incidence dropped from 36% to 4.5% in a retrospective study performed by Porazinski and Donshik (1999)\(^6\) by switching from a 4+ weeks replacement schedule to replacing the lens anywhere from 1 day to once every 3 weeks). With the increased use of silicone hydrogel lenses for extended wear\(^8\) there has been an increase in inflammatory reactions in the eye, including CLPC\(^3,9\). The changes that occur in the eye when using an extended wear lens might include: tear stagnation, localized pressure, and a closed eye environment producing an inflammatory condition caused by the frictional rubbing of the lens on the upper palpebral conjunctiva\(^3\).

Symptoms that a person experiences with CLPC include: discomfort, itching, foreign body sensation, blurred vision, excess lens movement, a decrease in lens tolerance, and mucous discharge\(^3,5,7,9\). Patients that are diagnosed with CLPC may be told to decrease the amount of time they wear their lenses, clean and/or replace their lenses more frequently, start regular use of enzymatic cleaners to remove accumulated deposits from the surfaces of lenses, change the type of lens (from extended to daily wear), or change the lens type or material\(^3,7,9,10\). Some patients may find they are unable to wear extended-wear lenses because of these problems and must switch permanently to another modality of lens wear\(^10\).
CLPC is one of the most common reasons why contact lens wearers discontinue lens use\textsuperscript{11}. CLPC does not cause permanent damage but is extremely uncomfortable and may require the patient to discontinue contact lens wear until the condition clears. Signs that indicate the presence of CLPC include enlargement of the papillae, often in conjunction with redness of the upper palpebral conjunctiva and lid\textsuperscript{9} (Figure 1). It is diagnosed when the papillae found on the upper eyelid are raised and are 0.3 mm or greater in diameter\textsuperscript{2}.

![CLPC on the inner lid](http://www.clspectrum.com/article.aspx?article=103968)

Figure 1. CLPC on the inner lid

CLPC can present in two ways: local or general. The lid and conjunctiva are categorized into five sections (Figure 2)\textsuperscript{3}. CLPC is classified as general when the papillae are enlarged and spread across the entire palpebral conjunctiva (Figure 3)\textsuperscript{2,3}. Local CLPC is diagnosed when the papillae are confined to at most 2 sections.
Figure 2. The five sections of the eye, as seen from the outside of the lid.

Figure 3. Normal, moderate and severe CLPC:
Photo from: http://www.siliconehydrogels.org/pdf_old/DEC_posters/maxine.pdf

Although it is unclear what causes CLPC, it has been hypothesized that local CLPC is caused by mechanical trauma, while general CLPC is caused by an immunological response to bio-deposits that accumulate on the patients’ contact lenses. Local papillae have been found to develop in an area of
protruding sutures or corneal ulcers\textsuperscript{2,7,10} or in response to the lens' edge\textsuperscript{3} rubbing against the inside of the lid, indicating that constant contact with a stimulus would cause a local irritation. Skotnitsky (2007) found that patients wearing aspheric lenses appear to suffer from local CLPC less than those wearing spherical lenses because the aspheric lens mimics the shape of the cornea more closely\textsuperscript{3}. Dr. Skotnitsky (2005) also noted that contact lens wearers suffering from allergies are more prone to develop general CLPC during allergy season\textsuperscript{7} because of the involvement of Type 1 hypersensitivity and Zhao et al. (2008) discovered a higher level of IgE present in the tears of patients with diagnosed CLPC\textsuperscript{12}. Deposits or exposure of the upper lid to allergens that are found on the contact lens could be the initiating factor and as a result an immunologic reaction occurs\textsuperscript{8}.

\textit{The Lenses}

Silicone hydrogel lenses are one of the most important advances in contact lenses since the first soft hydrogel lens was first introduced in the early 1970s\textsuperscript{2}. Silicone hydrogel lenses became available on the market in 1998\textsuperscript{13}. These lenses were appealing because they offer both the high oxygen permeability of silicone and the comfort and clinical performance of conventional hydrogels\textsuperscript{14}.

The high level of oxygen permeability in a silicone lens is advantageous because lack of oxygen getting through the lens to the conjunctiva and cornea can cause a number of adverse clinical effects\textsuperscript{14}. Skotnitsky et al. (2006) stated that the higher transmissibility of oxygen in comparison to their low oxygen
permeable counterparts has been shown to reduce lens-induced hypoxia cases in lens wearers\textsuperscript{2}. Although the silicone lens allows for an increased length of time the lens can be worn, the risk of infection increases when the lens is worn overnight for all lens types\textsuperscript{2}. Also, silicone lenses have a higher modulus of elasticity which makes them a stiffer lens. This stiffness might contribute the mechanical trauma associated with local CLPC\textsuperscript{3, 15, 16}.

CLPC is associated with all lens types, but research shows that those who wear soft lenses develop the condition more often and it appears more in those that wear their lenses for a more extended period of time\textsuperscript{9}. Skotnitsky (2005) observed a decrease from 40\% to 20\% in the recurrence of CLPC if the patient is refitted with another hydrogel lens or a rigid gas permeable lens\textsuperscript{7}. Other lens' issues also play a role in CLPC including chemistry of the lens, the elasticity of the lens, the edge design, surface properties, how well the lens fit and how often the lens was replaced\textsuperscript{7}, as well as heat sterilization, poor cleaning, and rough contact lens edges\textsuperscript{4, 16}.

The location of the papillae in the different types of lenses has come into question when studying the mechanical effect of CLPC. In a study performed by Korb et al. (1980), those that wore low oxygen permeable soft lenses, the papillae formed along the tarsal plate and progressed up to the margin of the lid, whereas in those patients that wore rigid gas permeable lenses or silicone hydrogels the papillae occurred along the lid margin initially but then over time progressed to the center of the palpebral conjunctiva\textsuperscript{18}.

\textit{The LASH Study}
The Longitudinal Analysis of Silicone Hydrogel Contact Lens study led by Dr. Loretta Szczotka-Flynn in 2007 included 205 patients and had a primary endpoint of Corneal Infiltrative Events (CIEs)\(^1\). Corneal infiltrates are small, hazy, grayish areas composed of inflammatory cells or proteins and appear as a result of a stimulus promoting the leukocytes to enter the cornea. Any loss of integrity in the cornea epithelium might predispose the patient to the initiation of a CIE\(^1\).

LASH was a 12-month prospective cohort study of patients that were chosen from Dr. Szczotka’s clinical practice and from advertisements placed around University Hospitals and Case Western Reserve University. Every subject was fit with lotrafilcon A silicone hydrogel lenses for up to 29 nights (30 days) of continuous wear, with monthly disposal\(^1,17\). Demographic data was collected at baseline and clinical information collected at each subsequent visit.

To collect the bioburden data, cultures of the lid and conjunctiva were performed from samples taken at baseline, and after 1 week and 4 months of wear\(^1\). The contact lenses were also cultured at the one week and four month visit. Cultures were also done during any unscheduled visit where the patient was experiencing discomfort. A separate study database was maintained to capture the bioburden found on the patient’s lens and the number of colony forming units (CFUs) those microbes developed.

Although the main purpose of the LASH study was to determine those microbiologic, clinical, demographic, and behavioral factors associated with CIEs, data were collected to describe any adverse events that were potentially a result of the study lenses. Using the data collected to measure the status of the redness and roughness of the patients’ lids (which are indicators that CLPC is
present) 52 people were identified who had CLPC with half of those being removed from the study or being lost to follow-up (determined by whether the patient had a 12-month visit documented in the study database). These 52 patients are the focus of the thesis research.

**Bioburden Background**

Cultures of the lid and conjunctiva to check for specific bioburden were done at the baseline, 1 week, and 4 month study visits and the contact lenses were also cultured at the one week and four month visits\(^1\). Cultures were also done during any unscheduled visit where the patient was experiencing discomfort.

For the LASH study, 29 different microorganisms and one fungus were identified. Microorganisms were classified as Gram-positive, Gram-negative, or fungal. The breakdown is as follows:

<table>
<thead>
<tr>
<th>Gram-Positive:</th>
<th>Gram-Negative:</th>
<th>Fungal:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baccillus</td>
<td>Achromobacter xylosoxidans</td>
<td>Candida parapsilosis</td>
</tr>
<tr>
<td>Coagulase Negative Staphylococci</td>
<td>Chryseobacterium meningosepticum</td>
<td></td>
</tr>
<tr>
<td>Corynebacterium</td>
<td>E Coli</td>
<td></td>
</tr>
<tr>
<td>Group B Streptococcus</td>
<td>Enterobacter Asburiae</td>
<td></td>
</tr>
<tr>
<td>Lactobacillus sp</td>
<td>Enterobacter cloacae</td>
<td></td>
</tr>
<tr>
<td>Staph Epidermidis</td>
<td>Haemophilus influenza</td>
<td></td>
</tr>
<tr>
<td>Staph hominis</td>
<td>Haemophilus parainfluenza</td>
<td></td>
</tr>
<tr>
<td>Staph saprophyticus</td>
<td>Klebsiella oxytoca</td>
<td></td>
</tr>
<tr>
<td>Staph warneri</td>
<td>Klebsiella pneumoniae</td>
<td></td>
</tr>
<tr>
<td>Staphylococcus Aureus</td>
<td>Moraxella catarrhalis</td>
<td></td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>Ochrobactrum anthropi</td>
<td></td>
</tr>
<tr>
<td>Viridans Strep</td>
<td>Pantoea sp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proteus mirabilis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pseudomonas aeruginosa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pseudomonas fluorescens</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serratia marcescens</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stenotrophomonas maltophilia</td>
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</tbody>
</table>
Currently, there is no published study regarding the connection between bioburden and CLPC specifically. Ozkan et al. (2010) stated that they found an increase in odds for an inflammatory event based on "microbiological analysis", but the specific bioburdens and inflammatory events were not listed\textsuperscript{19}. Sankaridurg et al. (2000) found that colonization of Gram-negative bacteria could lead to corneal infiltrative events in soft contact lens wear\textsuperscript{20}, but CLPC in extended wear has not been mentioned in the literature.

To date, a number of studies in the literature have looked at the effect of Gram-positive and negative bacteria in the eye in contact lens studies. In one study performed by Willcox et al. (2011) they showed that people were three times as likely to suffer from contact lens-induced peripheral ulcers (CLPU) and eight times more likely to suffer from asymptomatic infiltrates (AI) if they were carriers of Gram-positive bacteria on their contact lenses, and five times more likely to develop contact lens-induced acute red eye (CLARE) if they were a carrier of Gram-negative bacteria\textsuperscript{21}. In contract, Baleriola-Lucas et al. (1997) reported that “the presence of Gram-negative bacteria on a contact lens…are significantly associated with ocular inflammation and infection” while “Gram-positive bacteria are not associated with an increased risk of infection or inflammation”\textsuperscript{22}. Contamination in contact lens cases was studied by Willcox et al. (2010) and they published information regarding contamination levels, but did not state whether the patient suffered from any adverse events\textsuperscript{23}. 
Public Health Importance

Although there have been studies done on CLPC, there is still uncertainty noted in the literature amongst physicians and scientists. There are no definite answers as to what causes this inflammatory reaction. Without a definite cause, there is no clear guidance as to what a patient can do to avoid suffering from CLPC.

One of the problems with CLPC is that even with treatment (and eventual cessation of symptoms), the signs of increased papillae in the conjunctiva do not resolve completely and the problem can reappear when the patient resumes contact lens wear\textsuperscript{2}.

With the added convenience of extended wear lenses, more people are interested in wearing this type of lens. A better understanding about the potential risks and how to avoid problems will assist contact lens wearers as to the best way to wear these lenses successfully.
Biomedical Ethics

The original LASH study led by Dr. Szczotka was approved by the University Hospitals Case Medical Center Institutional Review Board. In spring 2011 I was added as an approved person by the IRB to have access to all study information, and per an agreement with University Hospitals I was approved to house study data on my computer located on campus at Case Western Reserve University after having it pass the Tier III checklist by I/T Security. I am CREC certified.

Study participants were chosen from Dr. Szczotka’s existing patient base, chosen from information obtained during their clinical examination, mailings, or chart screenings and phone contact. In addition, there were advertisements in the hospital and university electronic publications or fliers. Individuals were considered potential subjects if they met the following inclusion criteria (obtained from the LASH protocol):

- The patient was at least 15 years old.
- The patient must have had clear corneas and free of any anterior segment disorders.
- The patient must have had a spectacle corrected spherical refractive error between +5.50 D and -11.00 D with less than or equal to 1.00 D refractive cylinder.
- The patient must have been correctable to 20/25 or better with spectacles.
- Flat and steep corneal curvatures from SimK readings must have been between 39.00 D and 48.00 D.
- Could be successfully fit with lotrafilcon A lenses at enrollment visit.
Individuals were not considered eligible based on the exclusion criteria (obtained from the LASH protocol):

- The patient had worn rigid gas permeable lenses within the last 30 days or PMMA (hard) lenses within the last 3 months.
- The patient must not have been a current extended wear user of lotrafilcon A lenses.
- The patient has an autoimmune disease (except for Hashimoto’s Thyroiditis), immunocompromising disease, connective tissue disease, atopic dermatitis, insulin dependent diabetes, or any other systemic disease that in the investigator’s opinion would have affected ocular health.
- The patient was taking chronic systemic medications such as corticosteroids, antimetabolites, or non-steroidal anti-inflammatory agents or any other medication that in the investigator’s opinion would have affected ocular physiology.
- The patient had any ocular disease or condition such as aphakia, corneal dystrophies, corneal edema, external ocular infection, iritis, or had any anterior segment surgery.
- The patient was taking any ocular medications.
- The patient must have had less than or equal to grade 2 on any of the slit lamp observations of: upper tarsal papilla, corneal staining, corneal neovascularization, conjunctival injection, and lid erythema or scales.
- The patient was pregnant at the time of enrollment.

Before participating in the study, potential subjects were presented a written informed consent explaining the procedures, benefits and potential risks. The consent was signed by the participant and Dr. Szczotka and is kept on file along with all other completed patient study forms in the Visual Sciences Coordinating Center (if the patient was age 15-17, the study patient would assent on a separate form and their legal guardian would sign the informed consent). The study adhered to the tenets of the Declaration of Helsinki.
Data was collected from each consented subject at baseline, 1 week and 1, 4, 8, and 12 months. Unscheduled visits happened if unanticipated acute symptomatic events occurred\(^1\). Information from each visit was documented on study forms (forms include a baseline form filled out by the patient, a baseline form filled out by the physician, and follow up forms filled out by the physician). Data collected on the study forms was input into a study database by student workers who were CREC certified.

The risks (obtained from the LASH protocol) a patient could experience were minimal. They are same risks one could potentially experience by wearing extended wear lenses.

Potential risks include:

- Corneal edema
- Corneal abrasion
- Corneal scarring
- Corneal thinning
- Corneal vascularization
- Corneal infiltrates
- Corneal ulcers
- Decrease in contact lens comfort and wearing time
- Reduction in visual acuity
- Redness
- Eye infection

Patients were monitored for complications and any patient experiencing discomfort was encouraged to schedule a visit with the physician immediately. If any adverse reactions were found, the patient was treated or dropped from the study. All adverse events were reported to the IRB.
Methods for Preliminary Research

For the preliminary research, a dataset was created from the baseline information gathered in the LASH study, including demographics and some clinical variables collected at each of the 205 patients’ first visit augmented with some derived information described below, including outcome status, affected date, affected eye, lens fit (difference in base curve of the lens vs. base curve of the eye) and site (lid, lens and/or conjunctiva) of increased bioburden. This initial data set contained no information regarding multiple visits or time-to-event analysis.

The derived variables developed for this initial dataset are:

- **Outcome status (primary outcome)** – lid redness and roughness were documented at every visit. The five sections of the eye were graded on a 0-4 level of severity. CLPC was defined if there was an increase at any follow-up visit in the level of redness and/or roughness greater than or equal to 2 levels from baseline. The list of those affected by this definition was compared to the LASH study’s adverse events reports submitted to the IRB. Only one person was listed on the adverse events reporting as having CLPC that did not have disease based on this definition. This person started the study with a higher baseline level of lid roughness than the other patients (starting at a grade 2 for roughness in the left eye) and the difference calculation performed did not include them to the list of affected patients. They were kept in the CLPC status group since they were clinically diagnosed with CLPC.

- **Affection days** – the baseline visit date was subtracted from the date the affection was first recorded to get the number of days from baseline to affection date.
• Lens fit (difference in the base curve of the lens vs. the base curve of the eye) – the base curve of the eye is a continuous measurement. An average was taken of the flat and steep measurement using keratometry at baseline. The contact lenses used in the study were available in 2 curves: 8.4 and 8.6. The lenses were converted to a diopter (8.4 mm = 40.12 D and 8.6 mm = 39.25 D). The variable is the difference between the average of the flat and steep curve measurements of the eye and the converted lens measurement.

• Bioburden on the lid, lens, or conjunctiva – 30 microbial contaminants were cultured in the LASH study (Appendix B). The lid and conjunctiva were cultured at the baseline visit, and the lids, conjunctiva and lenses were cultured at 1 week visit, 4 month visit or if the patient was experiencing problems or discomfort. There are separate variables for the right and left eye. Levels of bioburden were split into 4 groups: no bacteria (0), normal bacteria present (1), normal bacteria but in abnormal quantities present (2), abnormal bacteria present (3). For the purpose of the preliminary analysis, these groups were collapsed into a dichotomous variable, groups 0 and 1 were classified as “negative bioburden” whereas groups 2 and 3 were classified as “positive bioburden”. A further explanation of how the 4 levels were derived is in Appendix B.

Additional information in the baseline dataset that was used for the preliminary analysis is as follows:

• Age range for patients in the study is from 15-62
• Gender is used as a 0/1 variable (male=0, female=1)
• Ethnicity and education were treated as factor variables. Ethnicity was combined into four levels: Caucasian, Asian, African American and other. Education was defined by four levels: high school, some college, college degree, graduate level.

• Smoking was changed to smoking/non smoking rather than a factor variable of multiple levels used in the LASH study. Since some of the levels had very few people I combined them to have a larger number in each group.

For the preliminary analysis, time-to-event analysis was not done, or any analysis on the individual microorganisms. Basic odds ratios were calculated between the derived bioburden on the lens, lid, and conjunctiva to test if there is an association between excessive bioburden in one of these areas and CLPC.

A McNemar’s odds ratio was done to estimate the odds of having positive bioburden in one part of the eye given that the same area of either eye has positive bioburden. A Cohen’s Kappa statistic was also calculated.

A logistic regression model was fit testing each of the exploratory variables independently to see if they had a significant effect on the outcome of CLPC status. After each was examined individually, they were added to a full model to see the combined effects of the resulting set of variables on the outcome.
Study Population and Subjects

Table 1. Demographic and other baseline summaries, overall and by eventual CLPC status

<table>
<thead>
<tr>
<th>Variables</th>
<th>Full dataset, N = 208</th>
<th>CLPC, n = 52</th>
<th>No CLPC, n = 153</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>157 (76.6%)</td>
<td>30 (75.0%)</td>
<td>118 (77.1%)</td>
</tr>
<tr>
<td>Male</td>
<td>51 (23.4%)</td>
<td>22 (47.7%)</td>
<td>35 (22.9%)</td>
</tr>
<tr>
<td>Age (mean 32.8 y, range 15-62)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 21</td>
<td>28 (12.7%)</td>
<td>4 (7.7%)</td>
<td>22 (14.4%)</td>
</tr>
<tr>
<td>Between 21 and 50</td>
<td>153 (75.5%)</td>
<td>45 (88.6%)</td>
<td>108 (71.1%)</td>
</tr>
<tr>
<td>50+</td>
<td>18 (7.8%)</td>
<td>3 (5.8%)</td>
<td>15 (8.5%)</td>
</tr>
<tr>
<td>Previous soft lens wear experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current or recent Neophytes</td>
<td>152 (74.1%)</td>
<td>37 (71.2%)</td>
<td>115 (75.2%)</td>
</tr>
<tr>
<td>Never wore</td>
<td>21 (10.2%)</td>
<td>7 (13.5%)</td>
<td>14 (9.2%)</td>
</tr>
<tr>
<td>Discontinued more than 12 months ago</td>
<td>32 (15.6%)</td>
<td>8 (15.4%)</td>
<td>24 (15.7%)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>115 (56.1%)</td>
<td>27 (51.9%)</td>
<td>88 (57.5%)</td>
</tr>
<tr>
<td>African-American</td>
<td>49 (23.9%)</td>
<td>14 (26.9%)</td>
<td>35 (22.9%)</td>
</tr>
<tr>
<td>Asian</td>
<td>31 (15.1%)</td>
<td>7 (13.5%)</td>
<td>24 (15.7%)</td>
</tr>
<tr>
<td>Other</td>
<td>10 (4.9%)</td>
<td>4 (7.7%)</td>
<td>6 (3.9%)</td>
</tr>
<tr>
<td>Education (Highest level achieved, 203 reported)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>17 (8.4%)</td>
<td>1 (1.9%)</td>
<td>16 (10.6%)</td>
</tr>
<tr>
<td>Some college</td>
<td>53 (26.1%)</td>
<td>14 (26.9%)</td>
<td>39 (25.8%)</td>
</tr>
<tr>
<td>College Degree (4-year)</td>
<td>61 (30.0%)</td>
<td>17 (32.7%)</td>
<td>44 (29.1%)</td>
</tr>
<tr>
<td>Graduate work</td>
<td>72 (35.5%)</td>
<td>20 (38.5%)</td>
<td>52 (34.4%)</td>
</tr>
<tr>
<td>Smoking Status (201 reported)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>21 (10.4%)</td>
<td>6 (11.5%)</td>
<td>15 (10.1%)</td>
</tr>
<tr>
<td>Never</td>
<td>10 (5.0%)</td>
<td>3 (5.8%)</td>
<td>7 (4.7%)</td>
</tr>
<tr>
<td>Former</td>
<td>170 (84.6%)</td>
<td>43 (82.7%)</td>
<td>127 (85.2%)</td>
</tr>
<tr>
<td>History of previous adverse event (204 reported)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90 (44.1%)</td>
<td>24 (46.2%)</td>
<td>66 (43.6%)</td>
</tr>
<tr>
<td>No</td>
<td>93 (45.6%)</td>
<td>28 (53.8%)</td>
<td>65 (42.6%)</td>
</tr>
<tr>
<td>N/A</td>
<td>21 (10.5%)</td>
<td>0 (0.0%)</td>
<td>21 (13.8%)</td>
</tr>
<tr>
<td>Contact lens power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greater than +/- 5.00 D</td>
<td>63 (30.7%)</td>
<td>1 (1.9%)</td>
<td>62 (40.5%)</td>
</tr>
</tbody>
</table>

Table 1. Demographic and other baseline summaries, overall and by eventual CLPC status

LASH study participants were chosen from Dr. Szczotka’s existing patient base using information obtained during their clinical examination, mailings, or chart screenings and phone contact. In addition, there were advertisements in the hospital and university electronic publications or fliers. Patients were seen at the University Hospitals Case Medical Center in The Eye Institute’s clinic. Demographic information on the subjects is shown in Table 1. A list of the full
inclusion/exclusion criteria is listed in the “Biomedical Ethics” section which starts on page 16.

Patients in the study were current contact lens wearers, or “neophytes” which are those that had never worn lenses or had not worn them for at least a year. Patients were fitted with an extended wear silicone hydrogel lens which would be worn for 30 days. For those patients defined as neophytes, they wore the lenses daily for the first 2 weeks of the study before transitioning into extended wear.

Data Management

Data was collected by Dr. Szczotka during each study visit. A physician baseline form and follow-up form was filled out, and a patient history form was completed by the patient on their first visit (copies of study forms are in Appendix C) and each follow-up visit. All forms are kept in binders in a locked room in the Visual Sciences Coordinating Center at University Hospitals Case Medical Center.

Data entry was performed by students into an Excel workbook. The LASH study was analyzed in SAS and the current study analyses will be completed in R, using Excel for some data management.

Data for this study is housed on a computer located on campus at Case Western Reserve University after having passed the Tier III checklist by I/T Security. The computer is backed up nightly using the Carbonite® program. An additional copy is backed up onto a flash drive which is locked in a secure location on campus.
Preliminary Research Results

Odds ratios were calculated to determine the odds of developing CLPC based on the level of bioburden found in each area of the eye:

<table>
<thead>
<tr>
<th>Area</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Lens</td>
<td>1.47</td>
<td>0.72 3.01</td>
</tr>
<tr>
<td>Left Lens</td>
<td>1.38</td>
<td>0.71 2.68</td>
</tr>
<tr>
<td>Right Lid</td>
<td>1.16</td>
<td>0.52 2.54</td>
</tr>
<tr>
<td>Left Lid</td>
<td>1.36</td>
<td>0.64 2.90</td>
</tr>
<tr>
<td>Right Conjunctiva</td>
<td>1.93</td>
<td>0.79 4.71</td>
</tr>
<tr>
<td>Left Conjunctiva</td>
<td>0.98</td>
<td>0.34 2.84</td>
</tr>
</tbody>
</table>

Table 2. Odds ratios and confidence intervals for odds of developing CLPC based on area of the eye containing positive bioburden

The odds of developing CLPC are increased when there is the presence of bacteria in the eye, either an abundance of normal bacteria (level = 2) or abnormal bacteria not normally found (level = 3). For example, if a patient experienced excessive amounts of normal bacteria or any amount of abnormal bacteria on their right contact lens, their odds were 1.47 times higher of developing CLPC than someone with no bacteria or expected levels of commensal bacteria.

The results of the McNemar’s tests are shown below:

Table 3. McNemar results
The Cohen's Kappa results follow:

Looking at the lens results, while most patients (169/205 = 82%) have similar bioburden in each eye (either both positive [38 patients] or both negative [131 patients],) we observe a McNemar odds ratio of 2.6. This implies that among patients with significant bioburden in exactly one eye, the left lens showed 2.6 times the odds (95% CI: 1.2, 6.0) of bioburden as compared to the right. Cohen's kappa shows moderate agreement (kappa = 0.56) between the right and left lens for bioburden. The Lid and Conjunctiva results, though of lesser interest here, suggest more modest relationships between our indicators of bioburden, with kappa statistics near 0.4.

For the logistic regression model, variables were tested independently against the outcome and then a model was fit with all the variables added. The full model with all the variables included is as follows:

\[
\text{CLPC Status} = f(\text{age} + \text{gender} + \text{ethnicity} + \text{smoking status} + \text{education} + \text{right lens BB} + \text{left lens BB} + \text{right lid BB} + \text{left lid BB} + \text{right conjunctiva BB} + \text{left conjunctiva BB} + \text{right difference} + \text{left difference})
\]

where BB = bioburden and difference = the difference between the base curve of the eye and the curve of the contact lens.
After all the variables were added, education is the only variable to show a significant independent effect on the outcome status of CLPC (increasing levels of education are somewhat associated with higher rates of CLPC after adjusting for our other covariates, but have less significant impact when analyzed in a bivariate model.). Displayed is the regression model breaking out education to look only at its effect on CLPC status:

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>p-value</th>
<th>Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>intercept</td>
<td>-2.77</td>
<td>0.01</td>
<td>-5.67</td>
</tr>
<tr>
<td>educ = some college</td>
<td>1.75</td>
<td>0.10</td>
<td>0.02</td>
</tr>
<tr>
<td>educ = college deg</td>
<td>1.82</td>
<td>0.09</td>
<td>0.11</td>
</tr>
<tr>
<td>educ = graduate</td>
<td>1.82</td>
<td>0.09</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Table 5. Bivariate Model for CLPC with education group only

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>p-value</th>
<th>Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>intercept</td>
<td>-2.98</td>
<td>0.02</td>
<td>-6.20</td>
</tr>
<tr>
<td>age</td>
<td>-0.01</td>
<td>0.56</td>
<td>-0.05</td>
</tr>
<tr>
<td>gender</td>
<td>-0.03</td>
<td>0.94</td>
<td>-0.86</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>-0.13</td>
<td>0.80</td>
<td>-1.22</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>0.60</td>
<td>0.17</td>
<td>-0.26</td>
</tr>
<tr>
<td>ethnicity = other</td>
<td>0.73</td>
<td>0.32</td>
<td>-0.79</td>
</tr>
<tr>
<td>smoking status</td>
<td>0.47</td>
<td>0.41</td>
<td>-0.71</td>
</tr>
<tr>
<td>educ = some college</td>
<td>1.77</td>
<td>0.11</td>
<td>-0.07</td>
</tr>
<tr>
<td>educ = college deg</td>
<td>1.94</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>educ = graduate</td>
<td>2.26</td>
<td>0.04</td>
<td>0.43</td>
</tr>
<tr>
<td>Right Lens</td>
<td>0.14</td>
<td>0.77</td>
<td>-0.81</td>
</tr>
<tr>
<td>Left Lens</td>
<td>0.12</td>
<td>0.79</td>
<td>-0.79</td>
</tr>
<tr>
<td>Right Lid</td>
<td>-0.16</td>
<td>0.74</td>
<td>-1.09</td>
</tr>
<tr>
<td>Left Lid</td>
<td>0.33</td>
<td>0.48</td>
<td>-0.57</td>
</tr>
<tr>
<td>Right Conjunctiva</td>
<td>0.81</td>
<td>0.16</td>
<td>-0.33</td>
</tr>
<tr>
<td>Left Conjunctiva</td>
<td>-0.44</td>
<td>0.50</td>
<td>-1.82</td>
</tr>
<tr>
<td>Right Difference</td>
<td>-0.39</td>
<td>0.25</td>
<td>-1.08</td>
</tr>
<tr>
<td>Left Difference</td>
<td>0.36</td>
<td>0.30</td>
<td>-0.23</td>
</tr>
</tbody>
</table>

Table 6. Full Logistic Regression model for CLPC status using all available predictors
Analytic Strategy for Ongoing Research

A Cox proportional hazards model will describe the hazard of developing CLPC with the covariates used in the initial model plus additional relevant data available in the LASH study.

Further analyses will be done on the curvature variables of the eye in relation to the lens. As mentioned earlier, it has been hypothesized that the lens’ edge can lead to irritation causing local CLPC\(^3\). After determining the best mechanism to test this difference between curvatures, and the best approach to operationalize a measure of lens fit quality it will be assessed whether larger differences or poorer fits are associated with greater risk of developing CLPC.

The seasonality of the data will be assessed to see whether CLPC is more often diagnosed during allergy season.

Bioburden will be studied within categories (specifically, Gram positive and Gram negative) to see if there is an association of certain types of bacteria on developing CLPC.
Methods, Data and Changes to Measures

There are several substantive changes to our database since the preliminary research was complete. First, our principal analyses now focus on eye-level analysis rather than the person-level approach taken initially. In our eye-level database, each patient contributes data from only one eye. Data for the right eye was used for all patients who were never diagnosed with CLPC during the study. If the patient was diagnosed with CLPC in one eye only, all eye-specific covariates were for that eye. If the patient was diagnosed with CLPC in both eyes, the worse eye was used. “Worse” is defined as having a higher level increase of redness or roughness from baseline and/or more areas of the eye were affected.

Next, bioburden data (for those affected with CLPC) was included only if the culture was done prior to the CLPC diagnosis in the affected eye. If there was no culture performed before the diagnosis than the value is listed as missing. For patients who were never diagnosed with CLPC, the data from the worst bioburden culture of the right eye (based on the 0-3 scale) were used. In either instance (CLPC or non-CLPC) if there were 2 instances of the “worst” level of bioburden taking place on different dates, the culture with the most CFUs was used. In other words, if a patient was cultured on two (or more occasions) with having bioburden at a level 3, but one culture produced 10 CFUs but the other produced 100 CFUs, the culture information for 100 CFUs was used.

In addition, a new difference variable was derived for these analyses. In the preliminary analysis, an average was taken of the flat and steep SimK
readings, then the contact lens curve was converted to a dioptic measure, and the difference was taken. In the second analyses, the topographically derived Best Fit Sphere (BFS) was used, which is a more accurate measure of the curvature of the eye. Baseline (or first available, for those without baseline) BFS measurements in the eye eventually diagnosed with CLPC were used. If there was no CLPC diagnosis, the right eye’s information was used. To obtain our revised measure of difference between the eye and the lens, the BFS measurement was subtracted from the lens curvature.

Several new variables were added to these analyses that were not used in the preliminary analysis. In addition to a bioburden indicator variable (0 for negative bioburden/1 for positive bioburden), a bioburden type variable was added (30 levels), as was a Gram positive/negative indicator variable (0=gram negative/1=gram positive). Additional variables were added from the LASH dataset for neophyte status (0=not a neophyte or has previously worn contact lenses recently/1=was a neophyte or has never worn contact lenses or has not worn them within the last 12 months) and whether the patient had any previous adverse events while wearing contact lenses prior to the study (0=no adverse event(s)/1=experienced at least one adverse event).

The models for CLPC status incorporated three different definitions for that outcome. The first dataset identified 52 people as CLPC positive including all of those patients clinically diagnosed by Dr. Szczotka during a study visit and all those patients identified by an algorithm as meeting the CLPC standard. The second dataset identified as CLPC patients just those 19 individuals that were clinically diagnosed (as indicated on the adverse events reports submitted to the
IRB for the LASH study). The 33 patients who qualified as CLPC positive only by algorithm were regarded as CLPC negative in this dataset, with data from their right used in the eye-level analyses. The third dataset identified as CLPC patients the 51 patients diagnosed by algorithm. Only one patient was in Dr. Szczotka’s adverse events report that was not identified by the algorithm. This particular patient had a higher baseline roughness at the start of the study (starting at a roughness grade of 2 rather than a zero as most of the other patients were), and had been clinically diagnosed with CLPC in the left eye.

Having built this new database, the logistic regression model discussed in the preliminary analysis was refit to assess the binary CLPC outcome, using all three definitions. Subsequently, a series of three Cox Proportional Hazards models were fit to assess the time to event results for the same CLPC outcome, again using the three definitions.

In a separate graphical check, seasonality was assessed for the month that CLPC was diagnosed to see if there was a pattern of CLPC presenting itself during allergy season. In Ohio, environmental allergens can be experienced year-round. The most common to the area are tree pollen (March-June), grass pollen (May-July), and Ragweed (August-October)\textsuperscript{25}. 

\textsuperscript{25}
Results

Figure 4 depicts the pattern of retention in the study. It describes the patients that were eventually diagnosed with CLPC by an algorithm and/or clinically diagnosed (52 affected individuals).

Descriptive statistics for bioburden were performed on both an eye level and person level. Table 7 shows the breakdown of each level.
Table 7. Descriptive statistics for person level of bioburden

The descriptive statistics above are on a person-level. This is the only analytic work showing person-level data. As in the first analysis, the breakdown of the categories are: no bacteria (0), normal bacteria present (1), normal bacteria but in abnormal quantities present (2), abnormal bacteria present (3). In the eye-level statistics below, a level of 0 or 1 is collapsed into a “negative bioburden” category, and levels 2 and 3 are considered “positive bioburden”.

Table 8. Descriptive statistics for eye level of bioburden

Also, an additional table shows the breakdown of bioburden (0/1) broken down by area of the eye and the outcome of CLPC by affected eye.
Table 9. Descriptive statistics for each area of the eye by level of “abnormal” bioburden by CLPC status in affected eye

<table>
<thead>
<tr>
<th>Eye level</th>
<th>Lid Bioburden</th>
<th>Conj Bioburden</th>
<th>Lens Bioburden</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>120/153</td>
<td>15/153</td>
<td>33/133</td>
<td>168</td>
</tr>
<tr>
<td>- CLPC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ CLPC</td>
<td>28/35</td>
<td>5/35</td>
<td>8/32</td>
<td>41</td>
</tr>
<tr>
<td>Left</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ CLPC</td>
<td>14/17</td>
<td>2/17</td>
<td>3/17</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>162</td>
<td>22</td>
<td>44</td>
<td>228</td>
</tr>
</tbody>
</table>

Table 10. Odds ratios and confidence intervals for the areas of the eye on CLPC status and binary bioburden variable (0/1)– eye level

<table>
<thead>
<tr>
<th>OR by areas of the eye and CLPC Status</th>
<th>Area</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lid bioburden</td>
<td>1.03</td>
<td>0.48</td>
<td>2.21</td>
</tr>
<tr>
<td>Conjunctival bioburden</td>
<td>1.43</td>
<td>0.55</td>
<td>3.73</td>
</tr>
<tr>
<td>Lens bioburden</td>
<td>0.88</td>
<td>0.40</td>
<td>1.91</td>
</tr>
</tbody>
</table>

When done on an eye level, the conjunctiva is the only area of the eye showing an increase in odds of developing CLPC if negative bioburden is present.

The seasonality of the diagnosis of CLPC was checked to see if it followed allergy season. This was done because has been reported that a reaction to allergens is something common to those suffering from general CLPC. In the dataset with 52 CLPC positive patients, there were 3 that had general CLPC. In the dataset with 19 CLPC positive patients there were only 2. Upon review, the
data does show a pattern of seasonality even with the small number of those listed as general vs. local. The 3 common allergens in Ohio start in March (tree pollen), May (grass pollen), and August (ragweed)\textsuperscript{25} and the graph shows an increase of CLPC diagnosis in those months.

![CLPC Date - 1st instance](image)

Figure 5. Month in which CLPC was diagnosed

The logistic regression model developed in the initial research was repeated to see if the various changes to the data (in particular, a focus on eye-level rather than a person-level analysis) would show a change in the relationship of the predictors of interest with CLPC development. In addition to the variables used in the initial analysis, prior adverse events and neophyte status were added as predictors. The original suggestion of using the Gram level indicator as an interaction variable was not successful due to most (188 of 205) of the bioburden in the sample being Gram positive.
Table 11. Breakdown of Gram +/-

<table>
<thead>
<tr>
<th>Gram +/-</th>
<th>Positive Only</th>
<th>Negative Only</th>
<th>Both</th>
<th>None</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLPC negative</td>
<td>139</td>
<td>0</td>
<td>6</td>
<td>8</td>
<td>153</td>
</tr>
<tr>
<td>CLPC positive</td>
<td>49</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>188</td>
<td>0</td>
<td>8</td>
<td>9</td>
<td>205</td>
</tr>
</tbody>
</table>

In this new logistic regression model since the number of “high school” educated patients in the CLPC group was small they were combined with the “some college” educated group (see table 10a). When this was done it no longer showed a slightly significant unadjusted effect in the bivariate analysis on CLPC as it did in the preliminary analysis. Table 13 shows the results for education level, exclusive of all other predictors.

Table 12. Number of people in combined education categories

<table>
<thead>
<tr>
<th>Variables</th>
<th>Full dataset, N = 205</th>
<th>CLPC, n = 52</th>
<th>No CLPC, n = 153</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education (Highest level achieved, 203 reported)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School/Some College</td>
<td>70 34.5%</td>
<td>15 28.8%</td>
<td>55 36.4%</td>
</tr>
<tr>
<td>College Degree (4-year)</td>
<td>61 30.0%</td>
<td>17 32.7%</td>
<td>44 29.1%</td>
</tr>
<tr>
<td>Graduate work</td>
<td>72 35.5%</td>
<td>20 38.5%</td>
<td>52 34.4%</td>
</tr>
</tbody>
</table>

Table 13. New logistic regression model with eye level data – education only (referent group: “high school” and “some college” combined)

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Confidence Intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.27</td>
<td>0.15</td>
<td>-1.30</td>
<td>0.29</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>college degree</td>
<td>1.42</td>
<td>0.64</td>
<td>3.18</td>
<td>0.41</td>
<td>0.39</td>
</tr>
<tr>
<td>graduate degree</td>
<td>1.41</td>
<td>0.66</td>
<td>3.08</td>
<td>0.39</td>
<td>0.38</td>
</tr>
</tbody>
</table>

A model using baseline demographic data and no clinical data was run. No covariate is significant in this model. Age was used in a univariate linear model and combined with education to see if there was a correlation with these two variables. After the linear model, a non-linear model using 10-year cut points
and a cubic spline model was used for age. None of these models produced significant results.

Table 14. Logistic regression model with baseline demographics and education

Since the main hypothesis of the study was to see if bioburden had a significant role in the outcome of CLPC, or if the lens' edge caused the inflammation, a few logistic regression models with looking at the impact of these issues on CLPC were done.

Table 15. Logistic regression model with bioburden only (0/1 indicator)

Table 16. Logistic regression model with bioburden and difference variables only

In none of these instances is there a significant effect. Looking at bioburden or the difference variable without adjustment did not yield a significant effect.
When all the variables are added to the model, no variable shows a significant effect associated with the odds of developing CLPC.

Table 17. Full logistic regression model with eye level data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>Confidence intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.32</td>
<td>0.07</td>
<td>1.44</td>
<td>-1.15</td>
<td>0.14</td>
</tr>
<tr>
<td>age</td>
<td>0.99</td>
<td>0.95</td>
<td>1.03</td>
<td>-0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>female</td>
<td>0.85</td>
<td>0.37</td>
<td>2.01</td>
<td>-0.16</td>
<td>0.43</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>0.54</td>
<td>0.17</td>
<td>1.52</td>
<td>-0.61</td>
<td>0.55</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>1.23</td>
<td>0.48</td>
<td>3.05</td>
<td>0.20</td>
<td>0.47</td>
</tr>
<tr>
<td>ethnicity = Other</td>
<td>1.82</td>
<td>0.39</td>
<td>7.92</td>
<td>0.60</td>
<td>0.75</td>
</tr>
<tr>
<td>smoking status</td>
<td>1.19</td>
<td>0.37</td>
<td>3.50</td>
<td>0.18</td>
<td>0.56</td>
</tr>
<tr>
<td>educ = college deg</td>
<td>1.88</td>
<td>0.76</td>
<td>4.81</td>
<td>0.63</td>
<td>0.47</td>
</tr>
<tr>
<td>educ = graduate</td>
<td>1.86</td>
<td>0.74</td>
<td>4.82</td>
<td>0.62</td>
<td>0.48</td>
</tr>
<tr>
<td>Difference in curvature</td>
<td>1.20</td>
<td>0.26</td>
<td>5.60</td>
<td>0.18</td>
<td>0.78</td>
</tr>
<tr>
<td>Lid bioburden</td>
<td>0.83</td>
<td>0.34</td>
<td>2.10</td>
<td>-0.19</td>
<td>0.46</td>
</tr>
<tr>
<td>Conjunctiva bioburden</td>
<td>1.05</td>
<td>0.32</td>
<td>3.13</td>
<td>0.04</td>
<td>0.57</td>
</tr>
<tr>
<td>Lens bioburden</td>
<td>0.70</td>
<td>0.29</td>
<td>1.62</td>
<td>-0.35</td>
<td>0.44</td>
</tr>
<tr>
<td>Neophyte</td>
<td>2.04</td>
<td>0.82</td>
<td>5.06</td>
<td>0.71</td>
<td>0.46</td>
</tr>
<tr>
<td>Previous adverse events</td>
<td>1.31</td>
<td>0.62</td>
<td>2.77</td>
<td>0.27</td>
<td>0.38</td>
</tr>
</tbody>
</table>

A Cox Proportional Hazard (CPH) model was performed on the first dataset containing all 52 positive CLPC patients.

Table 18. Cox Proportional Hazard Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hazard Ratio</th>
<th>Confidence intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0.99</td>
<td>0.95</td>
<td>1.02</td>
<td>-0.01</td>
<td>0.39</td>
</tr>
<tr>
<td>female</td>
<td>0.90</td>
<td>0.44</td>
<td>1.84</td>
<td>-0.11</td>
<td>0.37</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>1.04</td>
<td>0.40</td>
<td>2.68</td>
<td>0.04</td>
<td>0.94</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>1.86</td>
<td>0.85</td>
<td>4.04</td>
<td>0.62</td>
<td>0.40</td>
</tr>
<tr>
<td>ethnicity = Other</td>
<td>1.54</td>
<td>0.52</td>
<td>4.57</td>
<td>0.43</td>
<td>0.56</td>
</tr>
<tr>
<td>smoking status</td>
<td>1.60</td>
<td>0.63</td>
<td>4.04</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>educ = college deg</td>
<td>1.83</td>
<td>0.80</td>
<td>4.17</td>
<td>0.61</td>
<td>0.42</td>
</tr>
<tr>
<td>educ = graduate</td>
<td>1.63</td>
<td>0.74</td>
<td>3.58</td>
<td>0.49</td>
<td>0.40</td>
</tr>
<tr>
<td>Difference in curvature</td>
<td>1.26</td>
<td>0.36</td>
<td>4.41</td>
<td>0.23</td>
<td>0.64</td>
</tr>
<tr>
<td>Lid bioburden</td>
<td>0.63</td>
<td>0.29</td>
<td>1.40</td>
<td>-0.46</td>
<td>0.40</td>
</tr>
<tr>
<td>Conjunctiva bioburden</td>
<td>1.30</td>
<td>0.49</td>
<td>3.43</td>
<td>0.26</td>
<td>0.50</td>
</tr>
<tr>
<td>Lens bioburden</td>
<td>0.69</td>
<td>0.34</td>
<td>1.42</td>
<td>-0.37</td>
<td>0.37</td>
</tr>
<tr>
<td>Neophyte</td>
<td>1.93</td>
<td>0.92</td>
<td>4.04</td>
<td>0.66</td>
<td>0.58</td>
</tr>
<tr>
<td>Previous adverse events</td>
<td>1.54</td>
<td>0.82</td>
<td>2.91</td>
<td>0.43</td>
<td>0.32</td>
</tr>
</tbody>
</table>

The CPH model shows a nearly significant increase in the hazard of developing CLPC based on being a neophytes, but not statistically significant at a 5% significance level.
Results using those clinically diagnosed or by algorithm only

The logistic regression model and CPH model were run on two additional datasets. The second dataset differed in that only those clinically diagnosed with CLPC were included as the CLPC positive patients. The third dataset had 51 patients diagnosed with CLPC based on an algorithm only.

Clinically Diagnosed:

The second dataset includes only 19 CLPC positive patients that were diagnosed by Dr. Szczotka during a clinical visit. Being female or Asian are the only variables that, unadjusted, shows a barely significant effect on the outcome of CLPC:

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Confidence Intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.2</td>
<td>0.09</td>
<td>0.4</td>
<td>-1.61</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>female</td>
<td>0.36</td>
<td>0.14</td>
<td>1.03</td>
<td>-0.98</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Table 19. Logistic regression model with eye level data – gender only (referent group: male)

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Confidence Intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.06</td>
<td>0.02</td>
<td>0.11</td>
<td>2.90</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>3.49</td>
<td>0.94</td>
<td>12.49</td>
<td>1.25</td>
<td>0.04</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>2.53</td>
<td>0.75</td>
<td>8.63</td>
<td>0.93</td>
<td>0.6</td>
</tr>
<tr>
<td>ethnicity = other</td>
<td>4.54</td>
<td>0.60</td>
<td>23.84</td>
<td>1.51</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Table 20. Logistic regression model with eye level data – ethnicity only (referent group: Caucasian)
Adding those variables into a single model has the following results:

Table 21. Logistic regression model with eye level data – gender and ethnicity only

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Confidence intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.11</td>
<td>0.04</td>
<td>0.28</td>
<td>-2.21</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>female</td>
<td>0.35</td>
<td>0.12</td>
<td>1.04</td>
<td>-1.04</td>
<td>0.54</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>3.05</td>
<td>0.80</td>
<td>11.10</td>
<td>1.11</td>
<td>0.09</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>3.20</td>
<td>0.92</td>
<td>11.42</td>
<td>1.16</td>
<td>0.06</td>
</tr>
<tr>
<td>ethnicity = other</td>
<td>3.95</td>
<td>0.51</td>
<td>21.47</td>
<td>1.37</td>
<td>0.13</td>
</tr>
</tbody>
</table>

When adding all the variables into a single model, being female still shows a significant effect in decreasing the probability of developing CLPC while ethnicity no longer shows a significant effect. All areas of bioburden in the eye and the difference variable did not show a significant effect, regardless of adjustment. Note that there were no smokers of the 19 who were CLPC positive, so this model is likely overreaching to include that variable. For that reason, smoking has been removed.

Table 22. Full logistic regression model – clinically diagnosed

The Cox Proportional Hazards model was run on the second dataset.

Being female decreases a patient’s hazard of developing CLPC, while being
Asian, African American or having previous adverse events all show an increase in the hazard of developing CLPC over time.

<table>
<thead>
<tr>
<th>Hazard Ratio</th>
<th>Confidence intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0.97</td>
<td>0.91</td>
<td>1.04</td>
<td>-0.03</td>
</tr>
<tr>
<td>female</td>
<td>0.25</td>
<td>0.08</td>
<td>0.76</td>
<td>-1.39</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>3.98</td>
<td>1.02</td>
<td>15.56</td>
<td>1.38</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>5.47</td>
<td>1.25</td>
<td>23.92</td>
<td>1.70</td>
</tr>
<tr>
<td>ethnicity = Other</td>
<td>3.53</td>
<td>0.65</td>
<td>19.12</td>
<td>1.26</td>
</tr>
<tr>
<td>educ = college deg</td>
<td>1.29</td>
<td>0.25</td>
<td>6.62</td>
<td>0.26</td>
</tr>
<tr>
<td>educ = graduate</td>
<td>1.66</td>
<td>0.42</td>
<td>6.66</td>
<td>0.51</td>
</tr>
<tr>
<td>Difference in curvature</td>
<td>3.04</td>
<td>0.36</td>
<td>25.62</td>
<td>1.11</td>
</tr>
<tr>
<td>Lid bioburden</td>
<td>0.38</td>
<td>0.10</td>
<td>1.42</td>
<td>-0.96</td>
</tr>
<tr>
<td>Conjunctiva bioburden</td>
<td>0.56</td>
<td>0.06</td>
<td>5.36</td>
<td>-0.57</td>
</tr>
<tr>
<td>Lens bioburden</td>
<td>0.39</td>
<td>0.08</td>
<td>1.91</td>
<td>-0.95</td>
</tr>
<tr>
<td>Neophyte</td>
<td>1.15</td>
<td>0.30</td>
<td>4.43</td>
<td>0.14</td>
</tr>
<tr>
<td>Previous adverse events</td>
<td>3.50</td>
<td>1.15</td>
<td>10.02</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Table 23. Cox Proportional Hazard model – clinically diagnosed

<table>
<thead>
<tr>
<th>Hazard Ratio</th>
<th>Confidence intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>female</td>
<td>0.32</td>
<td>0.12</td>
<td>0.86</td>
<td>-1.13</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>6.30</td>
<td>1.76</td>
<td>22.57</td>
<td>1.84</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>5.83</td>
<td>1.64</td>
<td>20.67</td>
<td>1.76</td>
</tr>
<tr>
<td>ethnicity = other</td>
<td>3.57</td>
<td>0.71</td>
<td>17.82</td>
<td>1.27</td>
</tr>
<tr>
<td>Previous adverse events</td>
<td>2.58</td>
<td>1.01</td>
<td>6.57</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Table 24. Cox Proportional Hazard model – clinically diagnosed with significant variables
Figure 6. Survival curves for significant variables
Diagnosed by algorithm only:

When running the logistic regression models on the dataset of those patients diagnosed by an algorithm, the results are almost identical to the first dataset. This was expected due to only one person being re-labeled as CLPC negative.

In the full model, no variable shows a significant effect.

Table 25. Full logistic regression model – algorithm only

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Confidence intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.22</td>
<td>0.04</td>
<td>1.02</td>
<td>-1.52</td>
<td>0.06</td>
</tr>
<tr>
<td>age</td>
<td>0.99</td>
<td>0.95</td>
<td>1.03</td>
<td>-0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>female</td>
<td>0.97</td>
<td>0.42</td>
<td>2.34</td>
<td>-0.03</td>
<td>0.43</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>0.59</td>
<td>0.19</td>
<td>1.67</td>
<td>-0.52</td>
<td>0.34</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>1.28</td>
<td>0.50</td>
<td>3.21</td>
<td>0.25</td>
<td>0.47</td>
</tr>
<tr>
<td>ethnicity = other</td>
<td>1.94</td>
<td>0.42</td>
<td>8.50</td>
<td>0.66</td>
<td>0.38</td>
</tr>
<tr>
<td>smoke</td>
<td>1.25</td>
<td>0.39</td>
<td>3.68</td>
<td>0.22</td>
<td>0.56</td>
</tr>
<tr>
<td>educ = college deg</td>
<td>1.71</td>
<td>0.68</td>
<td>4.38</td>
<td>0.54</td>
<td>0.47</td>
</tr>
<tr>
<td>educ = graduate</td>
<td>1.67</td>
<td>0.74</td>
<td>4.84</td>
<td>0.62</td>
<td>0.48</td>
</tr>
<tr>
<td>Difference in Lens Curvature</td>
<td>1.37</td>
<td>0.29</td>
<td>6.48</td>
<td>0.32</td>
<td>0.78</td>
</tr>
<tr>
<td>Presence of Lid Bioburden</td>
<td>0.93</td>
<td>0.38</td>
<td>2.41</td>
<td>-0.08</td>
<td>0.87</td>
</tr>
<tr>
<td>Presence of Conjunctival Bioburden</td>
<td>1.06</td>
<td>0.33</td>
<td>3.24</td>
<td>0.08</td>
<td>0.57</td>
</tr>
<tr>
<td>Presence of Lens Bioburden</td>
<td>0.72</td>
<td>0.29</td>
<td>1.67</td>
<td>-0.33</td>
<td>0.44</td>
</tr>
<tr>
<td>Neophyte</td>
<td>2.16</td>
<td>0.66</td>
<td>5.36</td>
<td>0.77</td>
<td>0.46</td>
</tr>
<tr>
<td>Previous adverse events</td>
<td>1.39</td>
<td>0.66</td>
<td>2.96</td>
<td>0.33</td>
<td>0.38</td>
</tr>
</tbody>
</table>

No other variables showed an effect when put in the model alone or in combination with other variables.
For the Cox Proportional Hazards model, the outcome is almost identical to the first dataset: African American ethnicity, education, and neophyte status play only a nearly significant role in increasing the hazard of developing CLPC.

Table 26. Cox Proportional Hazard model – algorithm only

<table>
<thead>
<tr>
<th>Hazard Ratio</th>
<th>Confidence intervals</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0.99</td>
<td>0.95</td>
<td>1.02</td>
<td>-0.01</td>
</tr>
<tr>
<td>female</td>
<td>0.97</td>
<td>0.46</td>
<td>2.03</td>
<td>-0.03</td>
</tr>
<tr>
<td>ethnicity = Asian</td>
<td>1.11</td>
<td>0.43</td>
<td>2.87</td>
<td>0.10</td>
</tr>
<tr>
<td>ethnicity = AA</td>
<td>1.93</td>
<td>0.88</td>
<td>4.23</td>
<td>0.66</td>
</tr>
<tr>
<td>ethnicity = Other</td>
<td>1.80</td>
<td>0.54</td>
<td>4.80</td>
<td>0.47</td>
</tr>
<tr>
<td>smoking status</td>
<td>1.69</td>
<td>0.67</td>
<td>4.28</td>
<td>0.53</td>
</tr>
<tr>
<td>educ = college deg</td>
<td>1.69</td>
<td>0.74</td>
<td>3.90</td>
<td>0.53</td>
</tr>
<tr>
<td>educ = graduate</td>
<td>1.65</td>
<td>0.75</td>
<td>3.64</td>
<td>0.50</td>
</tr>
<tr>
<td>Difference in curvature</td>
<td>1.41</td>
<td>0.40</td>
<td>4.97</td>
<td>0.34</td>
</tr>
<tr>
<td>Lid bioburden</td>
<td>0.59</td>
<td>0.27</td>
<td>1.31</td>
<td>-0.53</td>
</tr>
<tr>
<td>Conjunctiva bioburden</td>
<td>1.38</td>
<td>0.52</td>
<td>3.67</td>
<td>0.32</td>
</tr>
<tr>
<td>Lens bioburden</td>
<td>0.71</td>
<td>0.35</td>
<td>1.47</td>
<td>-0.34</td>
</tr>
<tr>
<td>Neophyte</td>
<td>2.05</td>
<td>0.97</td>
<td>4.33</td>
<td>0.72</td>
</tr>
<tr>
<td>Previous adverse events</td>
<td>1.81</td>
<td>0.85</td>
<td>3.07</td>
<td>0.48</td>
</tr>
</tbody>
</table>
Conclusions

The dataset containing all CLPC patients (regardless of diagnosis) and the dataset containing just those diagnosed by an algorithm produced essentially identical results. While those datasets show no significant covariates suggesting an influence on CLPC, the dataset containing clinically diagnosed patients shows an increase in the relative hazard of developing CLPC based on being male, of Asian or African-American ethnicity or having previous adverse events.

Seasonality does appear to play a role in when the inflammation occurs. The three major allergy seasons in Ohio start in March, May, and August, and there is an increase in CLPC diagnosis during those months.

These results provide no additional credence to the hypotheses of linking either bioburden or difference in lens curvature to the onset of CLPC. Additional analyses would be beneficial to perform if a larger sample size became available. Thirty types of bacterial bioburden were categorized and analyzed as a binomial variable (presence or absence) and looked at separately for the lid, lens, and conjunctiva. The lens fit variable used the difference between the Best Fit Sphere measurement and the lens curve, and either alone or in conjunction with other variables available, neither the curvature difference nor the bioburden variables proved to show any significant effect.
Discussion

Our main analyses assessed whether lens fit and/or levels of bioburden are factors in the development of the inflammatory response, Contact Lens Induced Papillary Conjunctivitis. While we were unable to find statistically significant results, we did observe higher odds ratios for patients with poorer fit and with higher levels of bioburden, and in some cases the confidence intervals for these odds ratios included quite large associations (OR > 3: see Table 16.) This suggests that the presence of microorganisms in the eye (or on the lens) or poor lens fit could potentially contribute to the inflammatory response. The larger count of affected CLPC patients was based on an algorithmic rather than clinical diagnosis, and this could have diluted the strength of the findings. In the clinically diagnosed dataset, females displayed a nearly significant odds ratio of 0.38 [95% CI: 0.14, 1.03] for developing CLPC as compared to males (table 19). Asians showed an odds ratio of 3.49 [95% CI: 0.94, 12.49] for developing CLPC as compared to Caucasians (table 20).

Allergies have been suspected as playing a role in the development of CLPC\(^7,8\). While this research did not rule out a pattern of seasonality we have insufficient evidence to claim that this would cause “general” CLPC (affecting 3 or more areas of the eye). With only 3 of the 52 affected patients in the study diagnosed with general CLPC, the findings do not match prior hypotheses. Since a clinical diagnosis was not done differentiating local from general CLPC, it is not certain that these results truly follow the monthly pattern described by seasonal allergens. A larger dataset and revised design would be necessary to determine...
if diagnosis followed the allergy seasons of the specific year (using pollen counts) and whether the patient was diagnosed with general or local CLPC.

Cox Proportional Hazard models also indicated significant gender and race differences, specifically, female gender was associated with a relative hazard of 0.32 (95% CI: 0.12, 0.86) for developing CLPC while both Asian (relative hazard: 6.3, 95% CI: 1.76, 22.57) and African- American (5.83, 95% CI: 1.64, 20.67) patients showed increased hazard for CLPC as compared to Caucasian patients (table 23). The physiology of the different ethnicities could account for the increase in CLPC development, whereas hormonal or genetic differences would have to be further analyzed to explain the difference between males and females. Hygiene practices could also be compared if that data were to be collected in further studies.

No prior studies researched for the background of these analyses determined that demographic variables have an impact on the development of CLPC. The analysis does follow the results of past studies showing lens curvature and bioburden potentially causing CLPC. An attempt was made to break down the levels of bioburden into Gram positive and negative categories to test the theories of those levels but there were not enough patients in each category to perform a successful result. Any attempts to study the bioburdens specifically were also unsuccessful due to small numbers of patients across a large number of different microorganisms cultured.
Although CLPC is a treatable condition, when larger datasets become available the analysis should be duplicated to see if the lens fit or specific bioburdens become more significant.
Appendix

A. LASH codebook

B. Bioburden collected during LASH study

C. LASH study forms
LASH STUDY CODEBOOK:

Locked Baseline History3:

(A) CaseID
Three digit number code

(B) DOS
Date of Service
MM/DD/YY

(C) DOB
Date of Birth
MM/DD/YYYY

(D) DISC
(E) AEOD
(F) DateOD
(G) AEOS
(H) DateOS
(I) MICROOD10
(J) MICROOD20
(K) MICROOS10
(L) MICROOS20

(M) Age
In months

(N) Gender
Male = 0
Female = 1

(O) Ethnic
Caucasian = 1
Asian = 2
African American = 3
Other = 7

(P) Smoke
No = 0
Yes = 1

(Q) Occupation
Enter as written

(R) Educ
High School = 1
Some College = 2
College Degree = 3
Graduate Work = 4

(S) CL-HX

(T) Never
Never worn lenses
Blank or 1

(U) Stopped
I wore lenses in the past but stopped

(V) MonthsLast
# of months it has been since patient has not worn lenses

(W) ReasonStop1
(X) ReasonStop2
(Y) ReasonStop3
(Z) ReasonStop4
Discomfort = 1
Poor vision = 2
Dryness = 3
Handling problems = 4
Cost of lenses = 5
Inconvenience = 6
Recurrent redness = 7
Other=8

(AA) StopType (what type of lenses did you wear when you stopped?)
Soft = 1
RGP = 2
PMMA = 3

(AB)CurrentCL
Currently wearing contacts
Blank or 1

(AC)MonthsNow
# of months patient has been wearing contacts
(AD) TypeNow (type of lenses worn now)
Soft = 1
RGP = 2
PMMA = 3

(AE) PolymerNow
SILICONE HYDROGEL =1
LOW DK HYDROGEL =2
UNKNOWN =3

(AF) CareNow
PEROXIDE =1
MPDS BIGUANIDE =2
MPDS OPTI FREE =3
GENERIC OR OPTI ONE =4
UNKNOWN OR VARIABLE =
SALINE OR NONE =6

(AG) Mode
Daily Wear (lenses out every night) = 1
Extended Wear (lenses in when you sleep) = 2

(AH) NightsEW
How many nights in a row do you sleep in your lenses?
None = 0
1=1
2=2
3=3
4=4
5=5
6=6
7=7-14
15=15-21
22=22-31

(AI) Dispose
How often do you replace your lenses with a fresh pair?
Daily = 0
Weekly = 1
2 Weeks = 2
Monthly = 3
3 Months = 4
6 Months = 5
Yearly = 6

(AJ) PrevAE1
(AK) PrevAE2
(AM) PrevAE3
(AN) PrevAE4
Which of the following conditions have you experienced with your lenses in the past?
None = 0
Stopped wearing lenses for a period of time = 1
Allergies or itchy eyes = 2
Ability to wear lenses for only a limited period of time = 3
Eye Infection = 4
Eye abrasion/scratched eye = 5
GPC = 6
Corneal Infiltrates = 7
Experienced problems when wearing lenses overnight = 8
Deposits on lenses = 9
Red Eyes = 10
Dry Eyes = 11
Painful Eyes that require emergency visit to hospital = 12

(AO) Systemic
Text of systemic issues

(AP) Meds
Text of current medications

Complete for Survival Analysis:

(A) CaseID
Three digit number code

(B) DOS
Date of service
MM/DD/YYYY

(C) DateValue
(D) **DAYSSINCEBASE**
Days since the baseline visit

(E) **DaysSinceLast**
Days since the last study visit

(F) **TimeVisit**
Length of visit converted to military time

(G) **TimeAwake**
Number of hours since patient woke up

(H) **VISIT**
Study visit number

(I) **VisitID**
Baseline=0
2DW=1
1EW=2
1CW=3
4CW=4
8CW=5
12CW=6
Unscheduled=7

(J) **RVADist**
RIGHT Visual Acuity Distance with current lenses
4m = 1
1m = 2

(K) **RVALetters**
RIGHT Visual Acuity Letters with current lenses
10-70

(L) **LVADist**
LEFT Visual Acuity Distance with current lenses
4m = 1
1m = 2

(M) **LVALetters**
LEFT Visual Acuity Letters with current lenses
10-70

(N) **LensesYN**
Currently have lenses in?
No = 0
Yes = 1

(O) **ODBC**
RIGHT base curve of current lens

(P) **ODRx**
RIGHT power of current lens

(Q) **OSBC**
LEFT base curve of current lens

(R) **OSRx**
LEFT power of current lens

Following lists current correction method:

(S) **SpecsYN**
Glasses?

(T) **NoCorrecYN**
No correction?

(U) **OtherCLYN**
Other contacts?

(V) **WhyNoCL**
why no lenses? (text field)

(W) **BaseRVADist**
Baseline RIGHT Visual Acuity Distance with study lenses
4m = 1
1m = 2

(X) **BaseRVALetters**
Baseline RIGHT Visual Acuity Letters with study lenses
10-70

(Y) **RBaseCorrec**

(Z) **RMonoOR**
RIGHT monovision over refraction
(AA) RMonoLetters
RIGHT monovision letters correct

(AB) BaseLVADist
Baseline LEFT Visual Acuity Distance with study lenses
4m = 1
1m = 2

(AC) BaseLVALetters
Baseline LEFT Visual Acuity Letters with study lenses
10-70

(AD) LBaseCorrec

(AE) LMonoOR
LEFT monovision over refraction

(AF) LMonoLetters
LEFT monovision letters correct

(AA) LBaseRx
Baseline visit LEFT power of new lens

(AI) RBaseBC
Baseline visit RIGHT base curve of new lens

(AJ) RBaseCL
New lens given at baseline visit (brand)

(AK) Rmodality

(AL) Rdispose

(AM) LBaseRx
Baseline visit LEFT power of new lens

(AN) LBaseBC
Baseline visit LEFT base curve of new lens

(AO) LBaseCL
New lens given at baseline visit (brand)

(AP) Lmodality

(AQ) Ldispose

(AR) RORsph
RIGHT over refraction

(AS) RMonoYN
RIGHT mono?
No = 0
Yes = 1

(AT) ROrLetters
RIGHT number of letters

(AU) LORsph
LEFT over refraction sphere

(AV) LMonoYN
LEFT mono?
No = 0
Yes = 1

(AW) LOrLetters
LEFT number of letters

(AX) Rfrontdry
RIGHT surface dryness
0-4

(AY) RfrontDep
RIGHT front surface deposits
0-4

(AZ) Rbackdeb
RIGHT back surface debris
0-4

(BA) Lfrontdry
LEFT surface dryness
0-4

(BB) LfrontDep
LEFT front surface deposits
0-4
<table>
<thead>
<tr>
<th>Codebook</th>
<th>Description</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BC</strong> Lbackdeb</td>
<td>LEFT back surface debris</td>
<td>0-4</td>
</tr>
<tr>
<td><strong>BD</strong> RMvt</td>
<td>RIGHT movement</td>
<td>Reduced unacceptable = 1, Reduced acceptable = 2, Optimal = 3, Excessive acceptable = 4, Excessive unacceptable = 5</td>
</tr>
<tr>
<td><strong>BE</strong> LMvt</td>
<td>LEFT movement</td>
<td>Reduced unacceptable = 1, Reduced acceptable = 2, Optimal = 3, Excessive acceptable = 4, Excessive unacceptable = 5</td>
</tr>
<tr>
<td><strong>BF</strong> Rfit</td>
<td>RIGHT fit</td>
<td>Unacceptably tight = 1, Acceptably tight = 2, Optimal = 3, Acceptably tight = 4, Unacceptably tight = 5</td>
</tr>
<tr>
<td><strong>BG</strong> Lfit</td>
<td>LEFT fit</td>
<td>Unacceptably tight = 1, Acceptably tight = 2, Optimal = 3, Acceptably tight = 4, Unacceptably tight = 5</td>
</tr>
<tr>
<td><strong>BH</strong> RSph</td>
<td>RIGHT sphere</td>
<td></td>
</tr>
<tr>
<td><strong>BL</strong> LSph</td>
<td>LEFT sphere</td>
<td></td>
</tr>
<tr>
<td><strong>BM</strong> Lcyl</td>
<td>LEFT cylinder</td>
<td></td>
</tr>
<tr>
<td><strong>BN</strong> Laxis</td>
<td>LEFT axis</td>
<td></td>
</tr>
<tr>
<td><strong>BO</strong> LVA</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BP</strong> Rflat</td>
<td>RIGHT K reading flat</td>
<td></td>
</tr>
<tr>
<td><strong>BQ</strong> RFlatAxis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BR</strong> Rsteep</td>
<td>RIGHT K reading steep</td>
<td></td>
</tr>
<tr>
<td><strong>BS</strong> RSteepAxis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BT</strong> Rpach</td>
<td>RIGHT pachymetry reading</td>
<td></td>
</tr>
<tr>
<td><strong>BU</strong> Lflat</td>
<td>LEFT K reading flat</td>
<td></td>
</tr>
<tr>
<td><strong>BV</strong> LFlatAxis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BW</strong> Lsteep</td>
<td>LEFT K reading steep</td>
<td></td>
</tr>
<tr>
<td><strong>BX</strong> LSteepAxis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BY</strong> Lpach</td>
<td>LEFT pachymetry reading</td>
<td></td>
</tr>
<tr>
<td><strong>BZ</strong> RBleph</td>
<td>RIGHT Blepharitis</td>
<td>None = 0, Trace = 1, Mild = 2, Moderate = 3, Severe = 4</td>
</tr>
</tbody>
</table>
(CA) RMeibomian
RIGHT Meibomian Gland Dysfunction
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CB) RMicroscyst
RIGHT Epithelial Microcysts
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CC) REdema
RIGHT Corneal Edema
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CD) RNeovasc
RIGHT Corneal Neovascularization
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CE) RInfiltrates
RIGHT Corneal Infiltrates
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CF) ROther
RIGHT Other
None = 0
Trace = 1
Mild = 2
Moderate = 3

(CG) LMeibomian
LEFT Meibomian Gland Dysfunction
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CH) LMicroscyst
LEFT Epithelial Microcysts
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CI) LEdema
LEFT Corneal Edema
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CJ) LNeovasc
LEFT Corneal Neovascularization
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

(CL) LINfiltrates
LEFT Corneal Infiltrates
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

**CM** L Other
LEFT Corneal Infiltrates
None = 0
Trace = 1
Mild = 2
Moderate = 3
Severe = 4

**CN** ODBulbarRed2
RIGHT Bulbar redness zone 2

**CO** ODBulbarRed3
RIGHT Bulbar redness zone 3

**CP** ODBulbarRed4
RIGHT Bulbar redness zone 4

**CQ** ODBulbarRed5
RIGHT Bulbar redness zone 5

**CR** OSBulbarRed2
LEFT Bulbar redness zone 2

**CS** OSBulbarRed3
LEFT Bulbar redness zone 3

**CT** OSBulbarRed4
LEFT Bulbar redness zone 4

**CU** OSBulbarRed5
LEFT Bulbar redness zone 5

**CV** ODLIMBALRed2
RIGHT Limbal redness zone 2

**CW** ODLIMBALRed3
RIGHT Limbal redness zone 3

**CX** ODLIMBALRed4
RIGHT Limbal redness zone 4

**CY** ODLIMBALRed5
RIGHT Limbal redness zone 5

**CZ** OSLIMBALRed2
LEFT Limbal redness zone 2

**DA** OSLIMBALRed3
LEFT Limbal redness zone 3

**DB** OSLIMBALRed4
LEFT Limbal redness zone 4

**DC** OSLIMBALRed5
LEFT Limbal redness zone 5

**DD** ODConjStain2
RIGHT Conjunctival Staining zone 2

**DE** ODConjStain3
RIGHT Conjunctival Staining zone 3

**DF** ODConjStain4
RIGHT Conjunctival Staining zone 4

**DG** ODConjStain5
RIGHT Conjunctival Staining zone 5

**DH** OSConjStain2
LEFT Conjunctival Staining zone 2

**DI** OSConjStain3
LEFT Conjunctival Staining zone 3

**DJ** OSConjStain4
LEFT Conjunctival Staining zone 4

**DK** OSConjStain5
LEFT Conjunctival Staining zone 5

**DL** ODLidRed1
RIGHT Lid Redness zone 1

**DM** ODLidRed2
RIGHT Lid Redness zone 2

**DN** ODLidRed3
RIGHT Lid Redness zone 3
Thesis codebook_ATAG

(DO) ODLidRed4
RIGHT Lid Redness zone 4

(DP) ODLidRed5
RIGHT Lid Redness zone 5

(DQ) OSLidRed1
LEFT Lid Redness zone 1

(DR) OSLidRed2
LEFT Lid Redness zone 2

(DS) OSLidRed3
LEFT Lid Redness zone 3

(DT) OSLidRed4
LEFT Lid Redness zone 4

(DU) OSLidRed5
LEFT Lid Redness zone 5

(DV) ODLidRough1
RIGHT Lid Roughness zone 1

(DW) ODLidRough2
RIGHT Lid Roughness zone 2

(DX) ODLidRough3
RIGHT Lid Roughness zone 3

(DY) ODLidRough4
RIGHT Lid Roughness zone 4

(DZ) ODLidRough5
RIGHT Lid Roughness zone 5

(EE) OSLidRough5
LEFT Lid Roughness zone 4

(EF) ODinfnum1
RIGHT number of corneal infiltrates zone 1

(EG) ODinfnum2
RIGHT number of corneal infiltrates zone 2

(EH) ODinfnum3
RIGHT number of corneal infiltrates zone 3

(EI) ODinfnum4
RIGHT number of corneal infiltrates zone 4

(EJ) ODinfnum5
RIGHT number of corneal infiltrates zone 5

(EK) OSinfnum1
LEFT number of corneal infiltrates zone 1

(EL) OSinfnum2
LEFT number of corneal infiltrates zone 2

(EM) OSinfnum3
LEFT number of corneal infiltrates zone 3

(EN) OSinfnum4
LEFT number of corneal infiltrates zone 4

(EO) OSinfnum5
LEFT number of corneal infiltrates zone 5

(EP) ODinfSize1
RIGHT size of corneal infiltrates zone 1

(EQ) ODinfSize2
RIGHT size of corneal infiltrates zone 2

(ER) ODinfSize3
RIGHT size of corneal infiltrates zone 3

(ES) ODinfSize4

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RIGHT size of corneal infiltrates zone 4

(ET) ODiInfSize5
RIGHT size of corneal infiltrates zone 5
(EU) OSInfSize1
LEFT size of corneal infiltrates zone 1

(EV) OSInfSize2
LEFT size of corneal infiltrates zone 2

(EW) OSInfSize3
LEFT size of corneal infiltrates zone 3

(EX) OSInfSize4
LEFT size of corneal infiltrates zone 4

(EY) OSInfSize5
LEFT size of corneal infiltrates zone 5

(EZ) ODiInfType
RIGHT infiltrate type

(FA) OSInfType
LEFT infiltrate type

(FB) eventualODinf
(FC) EventualOSinf
(FD) xyz

(FE) ODSymptoms
RIGHT symptoms
None = 0
Mild = 1
Moderate = 2
Severe = 3

(FF) ODLids
RIGHT Lid Swelling
Absent = 0
Present = 2

(FG) ODConjRed
RIGHT Conjuctival Redness
Absent = 0
Localized = 1

(FO) ODLensdc
RIGHT effect of lens discontinuation
Resolving = 0
No change = 1
Slight worsening = 2

Generalized = 2

(FH) ODShape
RIGHT Infiltrate Shape
Round = 1
Irregular = 3

(FI) ODSize
RIGHT Infiltrate Size (largest)
<= 1.0mm = 1
1.0-2.0 = 2
>=2.0 = 3

(FJ) ODNumber
RIGHT Infiltrate number
1-4 = 1
5-10 = 2
>10 = 3

(FK) ODSStaining
RIGHT Flourescein Staining
Absent = 0
Present = 1

(FL) ODSsurround
RIGHT Surrounding Cornea
Clear = 0
Slight haze = 1
Severe haze = 2

(FM) ODEndothelium
RIGHT Endothelial Debris
Absent = 0
Present = 1

(FN) ODHypopyon
RIGHT Hypopyon
Absent = 0
Present = 2
Thesis codebook_ATAG

Significant worsening = 3

(FP) ODTotal
RIGHT Total points

(FQ) OSSymptoms
LEFT symptoms
None = 0
Mild = 1
Moderate = 2
Severe = 3

(FR) OSLids
LEFT Lid Swelling
Absent = 0
Present = 2

(FS) OSConjRed
LEFT Conjunctival Redness
Absent = 0
Localized = 1
Generalized = 2

(FT) OSShape
LEFT Infiltrate Shape
Round = 1
Irregular = 3

(FU) OSSize
LEFT Infiltrate Size (largest)
<= 1.0mm = 1
1.0-2.0 = 2
>=2.0 = 3

(FV) OSNumber
LEFT Infiltrate number
1-4 = 1
5-10 = 2
>10 = 3

(FW) OSStaining
LEFT Flourescein Staining
Absent = 0
Present = 1

(FX) OSSurround
LEFT Surrounding Cornea
Clear = 0
Slight haze = 1
Severe haze = 2

(FY) OSEndothelium
LEFT Endothelial Debris
Absent = 0
Present = 1

(FZ) OSHypopyon
LEFT Hypopyon
Absent = 0
Present = 2

(GA) OSLensdc
LEFT effect of lens discontinuation
Resolving = 0
No change = 1
Slight worsening = 2
Significant worsening = 3

(GB) OSTotal
LEFT Total points

(GC) RtrialBC1
RIGHT trial lenses base curve pair 1

(GD) RtrialRx1
RIGHT trial lenses power pair 1

(GE) DisenseR1yn
Dispense RIGHT pair one? y/n?

(GF) ReasonR1n
If GE = n, why?

(GG) LtrialBC1
LEFT trial lenses base curve pair 1

(GH) LtrialLx1
LEFT trial lenses power pair 1

(GI) DisenseL1yn
Dispense LEFT pair one? y/n?
(GJ) ReasonL1n
If GI = n, why?

(GK) RtrialBC2
RIGHT trial lenses base curve pair 2

(GL) RtrialRx2
RIGHT trial lenses power pair 2

(GM) DisenseR2yn
Dispense RIGHT pair two? y/n?

(GN) ReasonR2n
If GM = n, why?

(GO) LtrialBC2
LEFT trial lenses base curve pair 2

(GP) LtrialLx2
LEFT trial lenses power pair 2

(GQ) DisenseL2yn
Dispense LEFT pair two? y/n?

(GR) ReasonL2n
If GQ = n, why?

(GS) RDispRx
RIGHT dispensed lenses power

(GT) RDispBC
RIGHT dispensed lenses base curve

(GU) LDispRx
LEFT dispensed lenses power

(GV) LDispBC
LEFTTT dispensed lenses base curve

(GW) ROR (sphere)
RIGHT over refraction

(GX) Rmono
RIGHT Check if mono
No = 0
Yes = 1

(GW) Rdispletters
RIGHT # of letters correct

(GZ) LOL
LEFT over refraction

(HA) Lmono
LEFT Check if mono
No = 0
Yes = 1

(HB) Ldispletters
LEFT # of letters correct

(HC) Rdispdry
RIGHT front surface dryness
None = 0
Very slight = 1
Mild = 2
Moderate = 3
Severe = 4

(HD) Rdispdebris
RIGHT back surface debris
None = 0
Very slight = 1
Mild = 2
Moderate = 3
Severe = 4

(HF) Ldispdry
LEFT front surface dryness
None = 0
Very slight = 1
Mild = 2
Moderate = 3
Severe = 4
(HG) Ldispdep
LEFT front surface deposit
None = 0
Very slight = 1
Mild = 2
Moderate = 3
Severe = 4

(HH) Ldispdebris
LEFT back surface debris
None = 0
Very slight = 1
Mild = 2
Moderate = 3
Severe = 4

(HI) FINALRVA
RIGHT final visual acuity
# of letters correct

(HJ) FINALLVA
LEFT final visual acuity
# of letters correct

(HK) Rdispmvt
RIGHT dispensed lenses movement
Reduced unacceptable = 1
Reduced acceptable = 2
Optimal = 3
Excessive acceptable = 4
Excessive unacceptable = 5

(HL) Ldispmvt
LEFT dispensed lenses movement
Reduced unacceptable = 1
Reduced acceptable = 2
Optimal = 3
Excessive acceptable = 4
Excessive unacceptable = 5

(HM) RdispFit
RIGHT Fit Characteristics
Unacceptably tight = 1
Acceptably tight = 2
Optimal = 3
Unacceptably tight = 4

(HN) LDispFit
LEFT Fit Characteristics
Unacceptably tight = 1
Acceptably tight = 2
Optimal = 3
Acceptably tight = 4
Unacceptably tight = 5

(HO) RtearsYN
RIGHT collect tears at baseline?
1 = Yes
0 = No

(HP) LTearsYN
LEFT collect tears at baseline?
1 = Yes
0 = No

(HQ) RculturesYN
RIGHT cultures collected as baseline?
1 = Yes
0 = No

(HR) LCulturesYN
LEFT cultures collected as baseline?
1 = Yes
0 = No

(HS) RlenscollectYN
RIGHT collect lenses?
1 = Yes
0 = No

(HT) LlenscollectYN
LEFT collect lenses?
1 = Yes
0 = No

(HU) PotentialAEYN
Potential adverse event
1 = Yes
0 = No
(HV) PATIENTCONTINUING
Is the patient continuing?
Continuing=1
Discontinuing=2
Temporary discontinuation=3
Completed the study=4

(HW) SchirmerOD
RIGHT Schirmer’s test result

(HX) SchirmerOS
LEFT Schirmer’s test result
1 = CNS
2 = Staphylococcus Aureus
3 = Stenotrophomonas maltophilia
4 = Lactobacillus sp
5 = Staph Epidermidis (added to group 1)
6 = Viridans Strep
7 = Haemophilus parainfluenza
8 = Ochrobactrum anthropi
9 = Klebsiella oxytoca
10 = Corynebacterium
11 = Staph warneri (added to group 1)
12 = Staph hominis (added to group 1)
13 = Achromobacter xylosoxidans
14 = Baccillus
15 = Enterobacter Asburiae
16 = Serratia marcescens
17 = Enterobacter cloacae
18 = Pseudomonas aeruginosa
19 = Proteus mirabilis
20 = Group B Streptococcus
21 = Streptococcus pneumoniae
22 = Candida paropsilosis
23 = Pantoea sp
24 = Staph saprophyticus (added to group 1)
25 = Klebsiella pneumoniae
26 = Chryseobacterium meningosepticum
27 = Pseudomonas fluorescens
28 = Moraxella catarrhalis
29 = E Coli
30 = Haemophilus influenza

If bacteria 1,8,13, 14, or 22 was detected and there were less than or equal to 10 colony forming units then the patient was classified as group 1.

If bacteria for these same groups were detected but the colony forming units were greater than 10 the patient was classified as group 2.

If bacteria was defined as 10 and the colony forming units were less than or equal to 100 then the patient was classified as group 1. Colony forming units greater than 100 was classified as group 2.

Bacteria 2,3,4,6,7,9,15,17,19,18,20,21,23,25,26,27,28,29,30 was classified as group 3 regardless of number of colony forming units
LASH Contact Lens Study Patient Baseline History

Patient ID

Visit Date (MM/DD/YY)

Patent Demographic Information

Patient Date of Birth (MM/DD/YY)

Gender
- Male
- Female

Ethnic Identification
- Indian
- Caucasian
- Native American
- Asian
- Hispanic
- African American
- Other

Do you smoke?
- No
- Former smoker
- Yes, < 1/2 pack per day
- Yes, more than 1/2 pack per day

Occupation

Highest Level of Education
- High school
- Some college
- College degree
- Graduate work

Contact Lens History

1. Previous Contact Lens Use (answer only one section).

- I have never worn contact lenses.

- I wore contact lenses in the past, but stopped.

  a. How long has it been since you wore contact lenses? _____ years _____ months

  b. Why did you stop wearing contact lenses?

     - Discomfort
     - Poor vision
     - Dryness
     - Handling problems
     - Cost of lenses
     - Inconvenience
     - Recurrent redness
     - Other 

  c. What type of contact lenses did you wear?

     - Soft
     - RGP
     - PMMA

- I currently wear contact lenses (complete next section)

Contact Lens History - for Current Contact Lens Wearers

1. How long have you worn contact lenses? _____ years _____ months

2. What type of lenses do you wear?

     - Soft
     - RGP
     - PMMA

3. What brand of lenses do you currently wear? ________________

     - Don't know

4. What brand of lens case do you use? ________________

     - Don't know

5. What is your lenses wear schedule?

     - Daily Wear: I usually wear my lenses out every night
     - Extended Wear: I usually wear my lenses all the time

6. In a typical month, how many nights in a row do you usually wear overnight to your lenses?

     - None
     - 1
     - 2
     - 3
     - 4
     - 5
     - 6
     - 7-14
     - 15-21
     - 22-31

    - Don't know

7. Which of the following best describes how often you replace your lenses with a fresh new pair?

     - Daily
     - Weekly
     - Biweekly
     - Monthly
     - BiMonthly
     - BiAnnually
     - Monthly
     - Yearly
     - Other: __________________________
### Questions Cont. Current and Previous Contact Lens Wearers:

8. Which of the following conditions have you ever experienced with your contact lenses? Fill in all that apply

- NONE of these Conditions
- Stopped wearing lenses for a period of time
- Allergies or itchy eyes
- Ability to wear lenses for only a limited period of time
- Eye infection
- Eye abrasion/irritated eye
- GPC (Giant papillary conjunctivitis – bumps on inside of eye lid)
- Corneal infiltrates
- Experienced problems when wearing lenses overnight
- Deposits on lenses
- Red eyes
- Dry eyes
- Painful eyes which required an emergency visit to eye doctor or hospital

### List systemic Conditions


### List Medications


### LASH Contact Lens Study Investigator Baseline Form

#### Visual Acuity with Current Correction

<table>
<thead>
<tr>
<th>Test Distance</th>
<th>OD</th>
<th>1m</th>
<th></th>
<th>Test Distance</th>
<th>OS</th>
<th>1m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letters Correct</td>
<td></td>
<td></td>
<td></td>
<td>Letters Correct</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Indicate correction method:
  - Spectacles
  - No correction
  - Contacts
  - Monovision Near eye

- Over refraction for near eye
- Letters Correct

#### Current Contact Lens Information (If Known)

<table>
<thead>
<tr>
<th>Power</th>
<th>OD Base Curve</th>
<th>Power</th>
<th>OS Base Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+/-)</td>
<td></td>
<td>(+/-)</td>
<td></td>
</tr>
</tbody>
</table>

- Brand

- Recommended replacement schedule:
  - Daily
  - Weekly
  - 2 Weeks
  - Monthly
  - 3 Months
  - 6 Months
  - Yearly
  - Other

- Wear schedule:
  - ODW
  - EW

#### Best Spectacle Refraction

<table>
<thead>
<tr>
<th>OD</th>
<th>Sphere</th>
<th>Cylinder</th>
<th>Axis</th>
<th>Letters Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+/-)</td>
<td>. . .</td>
<td>. .</td>
<td>x</td>
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</table>

<table>
<thead>
<tr>
<th>OS</th>
<th>Sphere</th>
<th>Cylinder</th>
<th>Axis</th>
<th>Letters Correct</th>
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</thead>
<tbody>
<tr>
<td>(+/-)</td>
<td>. . .</td>
<td>. .</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

#### Simulated Keratometry (Orbscan II)

<table>
<thead>
<tr>
<th>OD</th>
<th>@</th>
<th>@</th>
<th>Pachos</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>@</td>
<td>@</td>
<td>Pachos</td>
</tr>
</tbody>
</table>

#### Biomicroscopy (without lenses)

<table>
<thead>
<tr>
<th>OD</th>
<th>None</th>
<th>Trace</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>All Clear</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>OD</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>OS</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

- Biopharbitis
- Meibomias Gland Dysfunction
- Epithelial Microeystis
- Corneal edema
- Corneal Neovascularization
- Corneal infiltrates
- Other (describe below)
### CCLRU SCALES

**Limbal & Bulbar Redness and Conjunctival Staining**

- **B** = Bulbar redness
- **L** = Limbal redness
- **C** = Conjunctival staining

<table>
<thead>
<tr>
<th>OD</th>
<th>OS</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="OD BLC" /></td>
<td><img src="image" alt="OS BLC" /></td>
</tr>
</tbody>
</table>

**Corneal Staining**

- **T** = Type
- **E** = Extent
- **D** = Depth
- **Den** = Density

<table>
<thead>
<tr>
<th>OD</th>
<th>OS</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="OD TEDen" /></td>
<td><img src="image" alt="OS TEDen" /></td>
</tr>
</tbody>
</table>

**Type**
1. Micropunctate
2. Macropunctate
3. Contacnest
4. Macropunctate
5. Patch
6. Dimple Veil

**Surface Area**
1. 1 - 15%
2. 16-30%
3. 31-45%
4. >45%

**Depth**
1. Superficial epithelium
2. Deep epithelium, delayed stromal glow
3. Immediate localized stromal glow
4. Immediate diffuse stromal glow

**Density**
1. Very Slight
2. Slight
3. Moderate
4. Severe
LASH Contact Lens Study Investigator Follow-Up Form Page 3

CCLRU SCALES CONT.

**Lid Redness + Roughness**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Redness</th>
<th>Roughness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Lid Redness + Roughness**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Redness</th>
<th>Roughness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Corneal Infiltrates (Draw)**

<table>
<thead>
<tr>
<th>Zone</th>
<th># In each zone</th>
<th>Size of each</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
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</tbody>
</table>

Diagnosis: CLPU CLARE IK AI MK

<table>
<thead>
<tr>
<th>Symptom</th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
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</thead>
<tbody>
<tr>
<td>Lid Swelling</td>
<td>Absent</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conjunctival Redness</td>
<td>Absent</td>
<td>Localized</td>
<td>Generalized</td>
<td></td>
</tr>
<tr>
<td>Infiltrate Shape</td>
<td>Round</td>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infiltrate Size [largest]</td>
<td>&lt;1.0mm</td>
<td>1.0-2.0mm</td>
<td>&gt;2.0mm</td>
<td></td>
</tr>
<tr>
<td>Number of Infiltrates</td>
<td>1-10</td>
<td>&gt;10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorescein Staining</td>
<td>Absent</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surrounding Cornea</td>
<td>Clear</td>
<td>Slight haze</td>
<td>Severe haze</td>
<td></td>
</tr>
<tr>
<td>Epithelial Defects</td>
<td>Absent</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypopyon</td>
<td>Absent</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect of Lens Discontinuation</td>
<td>Resolving</td>
<td>No change</td>
<td>Slight worsening</td>
<td>Significant worsening</td>
</tr>
</tbody>
</table>

Diagnosis: CLPU CLARE IK AI MK

**TOTAL**
### LASH Contact Lens Study Investigator Baseline Form

**Patient ID**

**Visit Date (MM/DD/YY)**

---

**Trial Lenses**

<table>
<thead>
<tr>
<th>Scales</th>
<th>OD</th>
<th>OS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pair 1</td>
<td></td>
</tr>
<tr>
<td>Dispense?</td>
<td>Base Curve</td>
<td></td>
</tr>
<tr>
<td>O Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O No</td>
<td>Power:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>If NO, why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Use # from scale for applicable reasons.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pair 2</td>
<td></td>
</tr>
<tr>
<td>Dispense?</td>
<td>Base Curve</td>
<td></td>
</tr>
<tr>
<td>O Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O No</td>
<td>Power:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>If NO, why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Use # from scale for applicable reasons.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Pair 3</td>
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</tr>
<tr>
<td>Dispense?</td>
<td>Base Curve</td>
<td></td>
</tr>
<tr>
<td>O Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O No</td>
<td>Power:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>If NO, why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Use # from scale for applicable reasons.)</td>
<td></td>
<td></td>
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<tr>
<td>Other</td>
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</table>

**Dispensed Lenses**

<table>
<thead>
<tr>
<th>OD</th>
<th>OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+/-) Power</td>
<td>Base Curve</td>
</tr>
<tr>
<td></td>
<td></td>
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</table>

---
LASH Contact Lens Study Investigator Baseline Form

<table>
<thead>
<tr>
<th>Patient ID</th>
<th>Visit Date (MM/DD/YY)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/ /</td>
</tr>
</tbody>
</table>

**OD Spherical over refraction**

<table>
<thead>
<tr>
<th>Sphere</th>
<th>Check if mono</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OS Spherical over refraction**

<table>
<thead>
<tr>
<th>Sphere</th>
<th>Check if mono</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Lens Surface Evaluation**

<table>
<thead>
<tr>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- front surface dryness
- front surface deposit
- back surface debris

---

**VA with final lenses**

<table>
<thead>
<tr>
<th>OD @ 4 m</th>
<th>OS @ 4 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letters Correct</td>
<td>Letters Correct</td>
</tr>
</tbody>
</table>

---

**Overall Movement**

<table>
<thead>
<tr>
<th>Reduced Unacceptable</th>
<th>Reduced acceptable</th>
<th>Optimal</th>
<th>Excessive acceptable</th>
<th>Excessive unacceptable</th>
<th>Reduced Unacceptable</th>
<th>Reduced acceptable</th>
<th>Optimal</th>
<th>Excessive acceptable</th>
<th>Excessive unacceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>○</td>
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<td>○</td>
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</tr>
</tbody>
</table>

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**Fit Characteristics**

<table>
<thead>
<tr>
<th>Unacceptably Tight</th>
<th>Acceptably Tight</th>
<th>Optimal</th>
<th>Acceptably Tight</th>
<th>Unacceptably Tight</th>
<th>Unacceptably Tight</th>
<th>Acceptably Tight</th>
<th>Optimal</th>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

---

**Collect tears at baseline**

Check if done: ○ OD ○ OS

**Collect cultures at baseline**

Check if done: ○ OD ○ OS

**Is patient continuing?** ○ Yes ○ No

**Next scheduled visit:** 2EW 1EW

**Wearing schedule prescribed until next visit:**

- Daily wear
- 6 slight EW

**Investigator Signature**

Date

**COMMENTS**
References


