

# Optometry and Vision Science

## Understanding Infection Prevention Practices in Optometry Clinics

--Manuscript Draft--

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<b>Full Title:</b>	Understanding Infection Prevention Practices in Optometry Clinics
<b>Short Title:</b>	Infection Prevention: Optometry Clinics
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<b>Funding Information:</b>	
<b>Abstract:</b>	<p><b>Significance:</b> Los Angeles County Department of Public Health (LAC-DPH) investigated an outbreak of epidemic keratoconjunctivitis secondary to adenovirus linked to a single optometry clinic between June-July 2017. Sub-optimal infection prevention practices were identified in the implicated clinic.</p> <p><b>Purpose:</b> To determine infection prevention practices in optometry clinics within Los Angeles County.</p> <p><b>Methods:</b> A 17-question survey on infection prevention practices among a sample of optometry providers in the county was conducted by LAC-DPH. The survey was administered via emails sent to a local optometric society's listserv and in-person at a local continuing education event for optometrists. The results were analyzed and are represented as percentages.</p> <p><b>Results:</b> There were 42 responses, 20 via the online survey (response rate 15%) and 22 via the in-person survey (response rate 22%). More than half had no written hand-hygiene policy (58.5%, n=24/41), 46.2% (n=18/39) did not wear gloves while examining patients with eye drainage and about half (48.6%, n=18/37) did not use droplet precautions for patients with respiratory symptoms. The vast majority used multi-dose eye-drop vials (92.5%, n=37/40) but 41.6% (n=15/36) did not discard the vial if the tip came into contact with conjunctiva/ skin/ environmental surface. To ensure a clean tonometer for each patient, the majority (68.4%, n=26/38) used 70% isopropyl alcohol, 47.4% (n=18/38) used non-contact tonometers and 23.6% (n=9/38) used disposable tips (answers not mutually exclusive); none used bleach.</p> <p><b>Conclusions:</b> Our data highlight several areas of concern in the practice of Standard or Transmission-based Precautions in the sampled population. One, hand hygiene policies are not well-enforced. Two, Personal Protective Equipment are not appropriately used while examining potentially infectious patients. Three, eyedrop vials are not consistently discarded if contaminated with eye secretions. Lastly, a large proportion of surveyed practices use inadequate disinfection techniques of tonometers.</p>
<b>Keywords:</b>	Infection Control; Optometry Clinics; Tonometers; Multi-dose Eye Drop Vials



## Response to Reviewers' Comments

Please upload a "Detailed response to review" which responds to ALL of the Editors' and reviewers' comments below. The response MUST include all of the comments of the Editors and reviewers, followed by a point-by-point explanation of how each comment has been addressed in the revised manuscript and referred to by the line number where each change can be found in the revised text. Changes in the revision MUST ALSO be highlighted in the revised text by using a different colored font(s) or yellow highlighting. If you feel that a particular comment need not be addressed in the detailed response, it is equally important that you explain why in your response.

Editors' comments:

Thank you for submitting your work to Optometry and Vision Science. The reviewers, topical editor, and I think this study will be of interest to the readers of OVS, but also believe that some issues need to be addressed in order to advance it toward publication. As you see below, the reviewers' comments should help guide you in revising the paper.

- Thank you for the opportunity of submitting our work to your journal. Please see the responses and edits made as requested (changes made are in red font).

Please follow the Managing Editor's instructions below regarding your OVS Announces synopsis image.

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Reviewer #1:

There is no statement of compliance with standard ethical guidelines etc. Were the appropriate approvals obtained? Please supply details.

- The survey was part of an outbreak investigation. The investigation took place a few months prior to the survey administration. Since the data collection was not part of a research study, did not contain identifying information and was voluntary, we did not pursue Institutional Review Board approval. We edited two sentences in the methods section to explain this:
  - Lines 92-94: *"The Los Angeles County Department of Public Health conducted a survey among a sample of optometry providers in Los Angeles County as part of the investigation of the aforementioned outbreak."*
  - Lines 104-105: *"The survey consisted of multiple-choice questions, none of which asked for identifying information, and was administered in two formats: online and in-person."*

Were respondents asked about their awareness of the CDC, or other, discipline specific guidelines (eg, Tyhurst & Hettler Optometry 2009, 80, 613 or Lakkis et al Clinical & Exp Optom (2007) 90, 6, 434,) prior to the survey?

- We did not ask respondents about their awareness of the CDC or other discipline-specific guidelines in the survey. We did inquire about the awareness of a hand-hygiene policy in the clinic, the results of which are outlined in lines 121-123:
  - *"The majority of the respondents 68.3% (n=28/41) either did not have a hand hygiene policy or were unaware of its presence."*

Is it possible they were working to other, albeit outdated, guidelines rather than being completely ignorant?

- Our study did not collect information to determine which guidelines were being used by the respondents. We rather asked questions which aimed at understanding the infection prevention practices within the clinic, irrespective of the guideline being followed. It is therefore possible that outdated guidelines were being used.

18:...it is difficult to monitor the current state of infection control practices in optometry clinics until there is an infectious outbreak reported.. Why so? Can't the monitoring procedures used in the current manuscript be applied at any time? Perhaps there is heightened incentive to conduct monitoring in the aftermath of an outbreak, but then responses may be unrepresentative of the true situation, due to responders being sensitized to the danger. Wouldn't it actually be better to have conducted this survey at a time remote from an outbreak? Please comment on how these factors may influence interpretation of the outcomes (presumably the true picture would be worse?).

- Unlike hospitals and some other healthcare facilities like optometry clinics are not closely monitored by authorities like Centers for Medicare and Medicaid Services, the Joint Commission, etc., for infection prevention and control practices. It is therefore difficult to monitor their infection prevention and control practices until an outbreak occurs, at which time breaches in their practices are identified. While the survey used in the manuscript is helpful in monitoring practices, it is not ideal since it is a subjective report of infection prevention and control practices rather than objective measurements.
- We agree that surveys conducted in the immediate aftermath of an outbreak may indeed give a skewed picture of actual infection prevention and control practices. We have added this as a limitation, lines 197-199:
  - *“The survey was conducted in the months following the outbreak and results might reflect a heightened awareness of infection control practices.”*

34:... a sample of optometry providers....

a) Please outline the procedure used to determine what sample size would be appropriate for this survey.

b) The methods outlined here are unlikely to deliver a random sample of the available clinics in the area. Can the outcomes be said to be valid in this light? Please comment on the how the sampling methods affect the interpretation of the data.

c) Were all the respondents Board certified optometrists? If not, please give details.

- (a) There was no sample size calculated because this was not meant to be a research study but rather part of an outbreak investigation. It was determined that any responses received through the survey would be informational. We have added clarifying language in lines 94-95 as below:
  - *“Sample size calculations were deferred since it was determined that any responses received through the survey would be informational for the outbreak investigation.”*
- (b) The study team used a convenience sample to distribute the survey, i.e., the Department of Public Health partnered with Los Angeles County Optometric Society to distribute the survey. All members of the society and those that attended a continuing education event hosted by the society were given the opportunity to respond to the survey. We have added the sampling description between lines 95-100 and the limitation of this method in lines 191-193, as below:

- Lines 95-100: *“The identified sample was one of convenience and not a random sample to allow for an easier data collection. The Department of Public Health partnered with Los Angeles County Optometric Society to deliver the survey, where all members of the society and those who attended one of the continuing education events hosted by the society were given the opportunity to respond to the survey.”*
- Lines 192-194: *“The sample was one of convenience and the response rate was relatively low (~18%), making generalizability of results difficult.”*
- (c) We did not collect information on the board certification of respondents and therefore are not able to comment whether all the respondents were board certified optometrists. It could be assumed however, that a majority of respondents were board certified based on the fact that the convenience sample consisted of members of the Los Angeles County Optometric Society and optometrists who attended a continuing education event. We have added a statement describing this between lines 100-102 as below:
  - *“While the study team did not collect information on the board certification status of respondents, it can be assumed that the majority were board-certified based on the characteristics of the selected sample.”*

59: Please define the term "eye drainage".

- The study team defined eye drainage as discharge from the eye like mucous, pus or tears, which maybe infectious. The definition was not made available to the respondents in the survey and may therefore have been misinterpreted. We therefore added this as a limitation in lines 195-197 as below:
  - *“The study only relied on subjective interpretation of survey questions and therefore some answers may reflect misinterpretation of questions by respondents rather than actual practice.”*

63: ....among practices: 92.5% (n=37/40) compared to 35.9% (n=14/39) respectively... This sentence seems incomplete. Is something missing?

- The sentence referred to is complete. We have rephrased the sentence for better comprehension, lines 132-133:
  - *“Use of multi-dose eye-drop vials was more popular (92.5%; n=37/40) than single-use eye-drop vials (35.9%; n=14/39) among practices.”*

71: "A third of the respondents, 34.2% (n=13/38), performed tonometry on patients with conjunctivitis or eye discharge" How many of these used a "non-contagious" method, e.g. non-contact, or with effective disinfection between patients?

- Of the respondents that perform tonometry on patients with conjunctivitis or eye discharge (13/42), 10 (77%) ensure a clean tonometer by using a noncontact tonometer and/or disposable tips, 3 (23%) used a non-suitable method of disinfection, i.e. wiping the tip with 70% isopropyl alcohol/alcohol wipe and air drying. We've added a sentence to this effect, lines 142-143:
  - *“Among these, 23% (3/13) inappropriately disinfected the instrument by wiping the tip with 70% isopropyl alcohol/alcohol wipe and air drying.”*

## Conclusions

a) There are several imperatives stated in the Conclusions for which there is no support in the data as presented. These would be better couched in terms of recommendations. For example, "Based on the survey results, infection prevention practices in optometry clinics are sub-optimal and require improvement to comply with current guidelines. It is recommended that administrative resources be set aside in optometry clinics to ensure the implementation of adequate infection prevention practices like having a hand-hygiene policy and conducting regular audits. Likewise, knowledge and practice of Standard Precautions should be improved, particularly while examining patients with eye discharge, respiratory symptoms and while using multi-dose eye-drop vials.

b) The final sentence concerning tonometer disinfection (128-130), is a restatement of a specific guideline and not a Conclusion of this study. In any case, the point has already been mentioned earlier in the manuscript (109) so it should be deleted as a conclusion.

c) Please make sure the Abstract Conclusions are consistent with (read the same as) those in the main body of the text.

Statements such as "Commonly used disinfectants like 70% alcohol wipes or 3% hydrogen peroxide have been associated with adenovirus outbreaks" may be true but they do not result from data presented in the current work.

- Based on comments a), b) and c) regarding the conclusions of the study, the conclusion section of the manuscript and the abstract have been edited. The rephrased conclusions are now between lines 47-52 in the abstract and lines 202-207 in the manuscript:
  - *"Our data highlight several areas of concern in the practice of Standard or Transmission-based Precautions in the sampled population. One, hand hygiene policies are not well-enforced in surveyed practices. Two, Personal Protective Equipment are not appropriately used while examining potentially infectious patients. Three, eyedrop vials are not consistently discarded if contaminated with eye secretions. Lastly, a large proportion of surveyed practices use inadequate disinfection techniques of tonometers. Overall, infection prevention practices in optometry clinics are sub-optimal<sup>2</sup> and must be improved."*

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Reviewer #2:

General comment - an important reference regarding infection control guidelines for optometrists has been overlooked in the intro and discussion. Please refer to Lian et al

2016 <https://www.ncbi.nlm.nih.gov/pubmed/28597930>

- The reference article has guidelines endorsed by Optometry Australia but there wasn't any mention of a national-level endorsement. The study team had therefore not previously referenced this article. We have now referenced the article in the introduction, lines 61-63:
  - *"Additionally, Optometry Australia and the American Academy of Ophthalmology have issued infection prevention guidelines for optometrists, eye care services and operating areas.<sup>3,4</sup>"*

Line 5 - it would be helpful to define standard and transmission-based precautions and what the difference is as additional background for the reader. Please include

- As suggested by reviewer, we added descriptions on Standard and Transmission-based precautions in the introduction, lines 64-69:  
*"Optometrists must be aware of Standard Precautions which entails appropriate hand hygiene, use of Personal Protective Equipment (e.g., gloves, masks, gowns), safe*



*injection practices, safe handling of contaminated surfaces/equipment and respiratory hygiene. Outpatient settings are not always well-designed to practice Transmission-based Precautions like Contact Precautions and Airborne Precautions, and therefore staff should be trained to triage patients who may need these precautions early.”*

Line 25 - can you please include some more details on what these suboptimal infection prevention practices were?

- The main lapses in infection prevention practices during the stated outbreak were around disinfection of slit-lamps, tonometers and inappropriate administration of eye drops. This has been added to the introduction section, lines 82-84:
  - *“The investigation uncovered sub-optimal infection prevention practices in the clinic, particularly around disinfection of instruments, and eye drop administration, which contributed to the epidemic keratoconjunctivitis outbreak.”*

Line 34 - is it possible to include a copy of the survey or a link to where it could be downloaded, for future use?

- A copy of the survey has been added in the Appendix, lines 284 onwards.

Line 40-41 - In the results section, the denominator keeps changing varying from 29-41. Please add an explanation here as to why this is.

- Not all respondents answered all the questions on the survey. That is why the denominator varies between questions. We have added a sentence to explain this in lines 116-117:
  - *“Not all respondents completed the survey in its entirety, resulting in a varied number of responses received for each question.”*

Discussion paragraph 2 - this whole paragraph essentially repeats the results instead of discussing them in reference to the greater body of infection control literature. It would be better to include some recommendations on appropriate hygiene procedures and include comparisons to other published surveys completed in other professions. E.g. how did those surveyed here compared to results found in other infection control studies.

- We thank the reviewer for the recommendation. We have updated paragraph 2 in the discussion section, lines 157-174, which now reads as follows:  
*“Investigations of several epidemic keratoconjunctivitis outbreaks from different states have consistently identified lapses in appropriate infection control methods surrounding hand hygiene, use of Personal Protective Equipment, use of eyedrop vials and disinfection of environmental surfaces and instruments.<sup>6,9</sup> Prior evidence has shown sub-optimal hand hygiene compliance among physicians in an ophthalmology clinic (~74%).<sup>7</sup> Hand hygiene audits with education have been shown to be effective in improving hand hygiene.<sup>8</sup> Our data showed a large proportion of respondents (68.3%) did not have a hand-hygiene policy in their practice/were unaware of its presence, and about half (53.7%) had no hand-hygiene audits performed, suggesting opportunities for improvement in this practice. Similarly, a... ..eye or respiratory symptoms.”*

Line 110 - there is a lot of debate about the best method for disinfection of tonometers (see Lian

et al 2016). I think it would be worthwhile adding here that practitioners should also consider manufacturer recommended disinfection procedures for all equipment, not just tonometers.

- We appreciate the reviewer's suggestion and agree with the same. We have incorporated this suggestion in lines 183-185:
  - *"Three, policies on disinfection of **all** instruments like tonometers should be updated regularly, taking into account the most accurate research available at the time **as well as manufacturer recommendations.**"*

Line 127 - Since eye discharge and respiratory symptoms involved transmissible pathogens, more than just Standard Precautions would apply. Please amend.

- We agree that this could be a possibility and therefore have edited text in multiple sections to reflect this:
  - Lines 47-48: *"Our data highlight several areas of concern in the practice of **Standard or Transmission-based Precautions in the sampled population.**"*
  - Line 127: *"Use of **Standard/Transmission-based Precautions**"*
  - Lines 179-181: *"Two, employees in optometry clinics should be educated and tested/audited on the practice of **Standard Precautions and the early recognition and triaging of patients requiring Transmission-based Precautions.**"*
  - Lines 202-203: *"Our data highlight several areas of concern in the practice of **Standard or Transmission-based Precautions in the sampled population.**"*

References - as mentioned above, the Lian et al 2016 paper should be included as a reference.

- We have cited this reference in the introduction, lines 61-63 and have also added it to the bibliography, lines 238-239:
  - *"**Lian K-Y, Napper G, Stapleton FJ, Kiely PM. Infection Control Guidelines for Optometrists 2016. Clin Exp Optom 2017;100(4):341-56.**"*

Please also use "Title Case" for all journal article titles, as is required by OVS style.

- All journal article titles have been updated in the References section as per the OVS style.

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Upload an interesting/compelling color image of a topic loosely related to your study as a "Synopsis image" file. Examples of previously published OVS Announces images can be found at <https://journals.lww.com/optvissci/pages/default.aspx>.

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- Please see picture below:





1 **Title Page**

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3 **Manuscript title:** Understanding Infection Prevention Practices in Optometry Clinics

4

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## Abstract

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Significance: Los Angeles County Department of Public Health (LAC-DPH) investigated an outbreak of epidemic keratoconjunctivitis secondary to adenovirus linked to a single optometry clinic between June-July 2017. Sub-optimal infection prevention practices were identified in the implicated clinic.

Purpose: To determine infection prevention practices in optometry clinics within Los Angeles County.

Methods: A 17-question survey on infection prevention practices among a sample of optometry providers in the county was conducted by LAC-DPH. The survey was administered via emails sent to a local optometric society's listserv and in-person at a local continuing education event for optometrists. The results were analyzed and are represented as percentages.

Results: There were 42 responses, 20 via the online survey (response rate 15%) and 22 via the in-person survey (response rate 22%). More than half had no written hand-hygiene policy (58.5%, n=24/41), 46.2% (n=18/39) did not wear gloves while examining patients with eye drainage and about half (48.6%, n=18/37) did not use droplet precautions for patients with respiratory symptoms. The vast majority used multi-dose eye-drop vials (92.5%, n=37/40) but 41.6% (n=15/36) did not discard the vial if the tip came into contact with conjunctiva/ skin/ environmental surface. To ensure a clean tonometer for each patient, the majority (68.4%, n=26/38) used 70% isopropyl alcohol, 47.4% (n=18/38) used non-contact tonometers and 23.6% (n=9/38) used disposable tips (answers not mutually exclusive); none used bleach.

Conclusions: Our data highlight several areas of concern in the practice of Standard or Transmission-based Precautions in the sampled population. One, hand hygiene policies are not well-enforced. Two, Personal Protective Equipment are not appropriately used while examining potentially infectious patients. Three, eyedrop vials are not consistently discarded if contaminated with eye secretions. Lastly, a large proportion of surveyed practices use inadequate disinfection techniques of tonometers.

53 **Manuscript**

54 The modern healthcare setting is known to facilitate the growth of resistant microbes. Infections  
55 caused by resistant microbes are difficult to treat, leading to increased morbidity, mortality,  
56 length of stay and healthcare costs for patients.<sup>1</sup> It is therefore important to follow recommended  
57 infection control practices in both inpatient and outpatient healthcare settings.

58  
59 For the purpose of infection control, optometry clinics are considered to provide outpatient care  
60 and the Centers for Disease Control and Prevention (CDC) has issued specific guidelines for  
61 this setting.<sup>2</sup> Additionally, **Optometry Australia** and the American Academy of Ophthalmology  
62 **have** issued infection prevention guidelines for **optometrists**, eye care services and operating  
63 areas.<sup>3,4</sup> Basic infection control practices not only prevent spread of infections between patients  
64 but also keep optometrists and their staff safe. **Optometrists must be aware of Standard**  
65 **Precautions which entails appropriate hand hygiene, use of Personal Protective Equipment**  
66 **(e.g., gloves, masks, gowns), safe injection practices, safe handling of contaminated**  
67 **surfaces/equipment and respiratory hygiene. Outpatient settings are not always well-designed**  
68 **to practice Transmission-based Precautions like Contact Precautions and Airborne Precautions,**  
69 **and therefore staff should be trained to triage patients who may need these precautions early.**

70 The use of instruments like tonometers in optometry clinics highlights the importance of their  
71 appropriate cleaning and disinfection techniques, because many of the bacteria and viruses can  
72 live for days on instrument surfaces.<sup>4</sup> Similarly, the use of multi-dose eye-drop vials have been  
73 associated with epidemic keratoconjunctivitis outbreaks in the past.<sup>5</sup>

74  
75 As with many other outpatient settings, it is difficult to monitor the current state of infection  
76 control practices in optometry clinics until there is an infectious outbreak reported. The Los  
77 Angeles County Department of Public Health investigated an outbreak of epidemic  
78 keratoconjunctivitis between June-July 2017.<sup>6</sup> All cases reported were linked to a single

79 optometry clinic. There were 17 patients who were diagnosed with epidemic keratoconjunctivitis;  
80 15 of whom visited the optometry clinic and two were household contacts of clinic patients. On  
81 laboratory testing, the implicated organism was human adenovirus (HAdV) type D53 (HAdV-53).  
82 The investigation uncovered sub-optimal infection prevention practices in the clinic, particularly  
83 around disinfection of instruments, and eye drop administration, which contributed to the  
84 epidemic keratoconjunctivitis outbreak. In response to this, the Healthcare Outreach Unit within  
85 the Los Angeles County Department of Public Health undertook the task of determining whether  
86 these practices were commonplace within other local optometry clinics. The aim of the study  
87 was to understand infection control practices in optometry clinics in Los Angeles County.  
88 Findings from this study would help inform infection control recommendations made by the Los  
89 Angeles County Department of Public Health to the optometry community.

90

91 Methods:

92 The Los Angeles County Department of Public Health conducted a survey among a sample of  
93 optometry providers in Los Angeles County as part of the investigation of the aforementioned  
94 outbreak. Sample size calculations were deferred since it was determined that any responses  
95 received through the survey would be informational for the outbreak investigation. The identified  
96 sample was one of convenience and not a random sample to allow for an easier data collection.  
97 The Department of Public Health partnered with Los Angeles County Optometric Society to  
98 deliver the survey, where all members of the society and those who attended one of the  
99 continuing education events hosted by the society were given the opportunity to respond to the  
100 survey. While the study team did not collect information on the board certification status of  
101 respondents, it can be assumed that the majority were board-certified based on the  
102 characteristics of the selected sample.

103

104 The survey consisted of multiple-choice questions, none of which asked for identifying  
105 information, and was administered in two formats: online and in-person. The online survey was  
106 distributed to a local optometric society's email listserv via the SurveyMonkey platform. The in-  
107 person survey was conducted at a local continuing education event for optometrists. The survey  
108 had 17 multiple-choice questions related to infection prevention practice (copy of survey  
109 available in Appendix). Results from the survey were aggregated, analyzed and are represented  
110 as percentages.

111

### 112 Results:

113 The Los Angeles County Department of Public Health received a total of 42 survey responses.  
114 There were 20 responses obtained via the online survey out of 135 potential responses, leading  
115 to a response rate of 15%. There were 22 responses obtained via the in-person survey out of  
116 100 potential responses, leading to a response rate of 22%. Not all respondents completed the  
117 survey in its entirety, resulting in a varied number of responses received for each question.

118

119 Setting/Administrative policies: In terms of the workplace setting of the respondents (n=40; non-  
120 mutually exclusive responses), 77.5% worked in an optometry clinic; 15% worked in a  
121 healthcare clinic and 10% worked in optical goods stores (Table 1). The majority of the  
122 respondents 68.3% (n=28/41) either did not have a hand hygiene policy or were unaware of its  
123 presence. Similarly, 53.7% (n=22/41) clinics did not measure employees' adherence to hand-  
124 hygiene. When hand hygiene was measured (n=17), it was most commonly measured through  
125 direct observation 94.1% (n=16), followed by measuring product use 29.4% (n=5).

126

127 Use of Standard/~~Transmission-based~~ Precautions: Soap (either plain or antiseptic) and water  
128 were most frequently used for hand hygiene 59% (n=23/39). A large number of respondents  
129 (46.2%; n=18/39) did not wear gloves while examining patients with eye drainage. Nearly 48.6%



130 (n=18/37) didn't use any precautions when a patient presented with respiratory symptoms.  
131 Isolation of patients with either respiratory or infective eye symptoms was an uncommon  
132 practice and occurred in only 18.4% (n=7/38). Use of multi-dose eye-drop vials was more  
133 popular (92.5%; n=37/40) than single-use eye-drop vials (35.9%; n=14/39) among practices.  
134 However, 41.6% (n=15/36) failed to discard multi-dose drops, when the tip came into contact  
135 with conjunctiva, skin or environmental surfaces.

136  
137 Cleaning/Disinfection techniques: The most popular methods of ensuring clean tonometers for  
138 all patients (non-mutually exclusive responses) were 1) using 70% isopropyl alcohol/alcohol  
139 wipe with air drying (68.4%, n=26/38), 2) using non-contact tonometers (47.4%, n=18/38), and  
140 3) using disposable tips (23.7%, n=9/38). None of the respondents used diluted bleach as a  
141 disinfectant. A third of the respondents, 34.2% (n=13/38), performed tonometry on patients with  
142 conjunctivitis or eye discharge. Among these, 23% (3/13) inappropriately disinfected the  
143 instrument by wiping the tip with 70% isopropyl alcohol/alcohol wipe and air drying.

144  
145 Employee practices: While examining patients with respiratory symptoms, 73% (n=27/37) wore  
146 face masks. The majority were not expected to work if they themselves had symptoms of  
147 conjunctivitis, 76.3% (n=29/38), and were expected to report back only after resolution of  
148 symptoms, 62.1% (n=18/29).

149  
150 Discussion:

151 The objective of this study was to better understand common infection control practices within  
152 optometry clinics in the community with the goal of filling in gaps in knowledge and practice as  
153 needed. The CDC has published an evidence-based guide for infection prevention in the  
154 outpatient settings, which includes optometry clinics.<sup>2</sup> Based on recommendations in the guide,  
155 we identified lapses in several areas through our survey.

156  
157 Investigations of several epidemic keratoconjunctivitis outbreaks from different states have  
158 consistently identified lapses in appropriate infection control methods surrounding hand  
159 hygiene, use of Personal Protective Equipment, use of eyedrop vials and disinfection of  
160 environmental surfaces and instruments.<sup>6,9</sup> Prior evidence has shown sub-optimal hand hygiene  
161 compliance among physicians in an ophthalmology clinic (~74%).<sup>7</sup> Hand hygiene audits with  
162 education have been shown to be effective in improving hand hygiene.<sup>8</sup> Our data showed a  
163 large proportion of respondents (68.3%) did not have a hand-hygiene policy in their  
164 practice/were unaware of its presence, and about half (53.7%) had no hand-hygiene audits  
165 performed, suggesting opportunities for improvement in this practice. Similarly, a large number  
166 (46.2%) did not wear gloves while examining patients with eye discharge, while nearly half  
167 (48.6%) did not follow any precautions while examining patients with respiratory symptoms.  
168 Multi-dose vials were not appropriately discarded, with 41.6% of respondents not discarding the  
169 vials when the tips came into contact with conjunctival, skin or environmental surfaces. Lastly,  
170 disinfection of tonometers was sub-optimal with close to 68.4% of the respondents using 70%  
171 isopropyl alcohol which has shown to be associated with epidemic keratoconjunctivitis  
172 outbreaks in the past. Despite the noted lapses in infection prevention practices, it was  
173 encouraging to see majority of the employees (70-80%) practicing good standard and  
174 respiratory precautions when they themselves had eye or respiratory symptoms.

175  
176 Based on results of the outbreak investigation<sup>6</sup> and this survey study, the Los Angeles County  
177 Department of Public Health makes a few recommendations to the optometry community. One,  
178 individual optometry practices should set aside adequate administrative resources dedicated to  
179 infection prevention and control. Two, employees in optometry clinics should be educated and  
180 tested/audited on the practice of Standard Precautions and the early recognition and triaging of  
181 patients requiring Transmission-based Precautions. Single-dose vials should be used when

182 available. Multi-dose vials should be discarded if they come in contact with the  
183 patient/secretions or if they are beyond the use-date set by the manufacturer. Three, policies on  
184 disinfection of **all** instruments like tonometers should be updated regularly, taking into account  
185 the most accurate research available at the time **as well as manufacturer recommendations**.  
186 Current evidence suggests that using disposable covers or disinfection with 1:10 diluted bleach  
187 (1-15 minutes) are the most effective methods of preventing the spread of common eye  
188 pathogens through tonometers.<sup>4,10</sup> The recommended guidelines and updated research on  
189 infection prevention practices can be better disseminated by partnering with local/state/national  
190 societies during conferences, continuing education events, online modules, etc.

191  
192 There are a few limitations while interpreting results from this study. The **sample was one of**  
193 **convenience and the** response rate was relatively low (~18%), making generalizability of results  
194 difficult. The survey did not collect practice identifiers to avoid untoward implications and  
195 therefore it could be that more than one member from same practice completed the survey. The  
196 **study** only relied on subjective **interpretation of survey questions and therefore some answers**  
197 **may reflect misinterpretation of questions by respondents rather than actual practice. The**  
198 **survey was conducted in the months following the outbreak and results might reflect a**  
199 **heightened awareness of infection control practices.**

200  
201 Conclusions:  
202 **Our data highlight several areas of concern in the practice of Standard or Transmission-based**  
203 **Precautions in the sampled population. One, hand hygiene policies are not well-enforced in**  
204 **surveyed practices. Two, Personal Protective Equipment are not appropriately used while**  
205 **examining potentially infectious patients. Three, eyedrop vials are not consistently discarded if**  
206 **contaminated with eye secretions. Lastly, a large proportion of surveyed practices use**

207 inadequate disinfection techniques of tonometers. Overall, infection prevention practices in  
208 optometry clinics are sub-optimal<sup>2</sup> and must be improved.

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**Tables**

280 Table 1: Consolidated representation of responses to study survey (N=42).

	Number selected response	Number answered question	Percentage (%)
Setting (non-mutually exclusive responses)			
Optometry clinic	31	40	77.5
Healthcare clinic	6	40	15
Optical goods store	4	40	10
Other	5	40	12.5
Administrative policies			
No or unknown hand-hygiene policy/guideline	28	41	68.3
Hand-hygiene audits performed	17	41	41.5
Standard Precautions			
Hand-hygiene with soap and water	23	39	59
Wear gloves to examine patients with eye drainage	21	39	53.8
No precautions to examine patients with respiratory symptoms	18	37	48.6
No isolation of patients with eye or respiratory symptoms	31	38	81.6
Use single-use eye-drop vials	14	39	35.9
Use of multi-dose eye-drop vials	37	40	92.5
Discard multi-use eye-drop vial if tip touches conjunctiva/skin/environmental surface	21	36	58.3
Cleaning/Disinfection techniques			
Use a non-contact tonometer	18	38	47.4
Use a tonometer with disposable tips	9	38	23.7
Wipe instrument with 70% isopropyl alcohol and air dry	26	38	68.4
Perform tonometry on patients with eye discharge	13	38	34.2
Employee practices			
Wear face mask if respiratory symptoms	27	37	73
Time away from work if eye symptoms	29	38	76.3

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## Appendix

### Survey Questions:

- 286 1. Which of the following best describes the setting you work in? (select all that apply)
- 287 a) Optometry clinic
- 288 b) Healthcare clinic
- 289 c) Optical goods stores
- 290 d) Other (please specify)
- 291 2. Is there a written hand-hygiene policy/guideline in place at your clinic?
- 292 a) Yes
- 293 b) No
- 294 c) Unknown
- 295 3. Select which hand hygiene approach is used in your clinic. If your clinic uses multiple
- 296 approaches for hand hygiene, select which approach you used last time you performed
- 297 hand hygiene.
- 298 a) Soap and water
- 299 b) Antiseptic soap and water
- 300 c) Hand sanitizer (alcohol-based)
- 301 d) Other (please specify)
- 302 4. Does your clinic measure employees' adherence to hand-hygiene?
- 303 a) Yes
- 304 b) No
- 305 c) Don't know
- 306 5. If Yes, how is adherence measured (select all that apply)
- 307 a) Direct observation
- 308 b) Measuring product use
- 309 c) Conducting surveys

- 310 d) Other type of measurement (please specify)
- 311 6. Under what circumstances do you wear gloves in clinic? (select all that apply)
- 312 a) While examining every patient
- 313 b) If anticipated contact with conjunctiva
- 314 c) While examining patients with eye drainage
- 315 d) Cleaning environmental surfaces/equipment
- 316 e) Never
- 317 f) Other (please specify)
- 318 7. Do you use single-use eye-drop vials in your clinic?
- 319 a) Yes
- 320 b) No
- 321 8. If Yes, do you discard single-use eye-drop vials after use on one patient?
- 322 a) Yes
- 323 b) No
- 324 9. Do you use multiple-dose eye-drop vials in your clinic?
- 325 a) Yes
- 326 b) No
- 327 10. If Yes, do you discard multiple-dose eye-drop vials? (select all that apply)
- 328 a) Only after date of expiration
- 329 b) If the drops are used on an infectious patient
- 330 c) If the tip comes into contact with conjunctiva/skin/environmental surface
- 331 d) 28 days after opening
- 332 e) None of the above
- 333 f) Other (please specify)
- 334 11. How does your clinic ensure a clean tonometer for every patient? (select all that apply)
- 335 a) Using a non-contact tonometer

- 336 b) Using a tonometer with disposable tips
- 337 c) Wiping the instrument with 70% isopropyl alcohol/alcohol wipe and air drying
- 338 d) Cleaning the instrument by wiping, then disinfecting by immersing for 5-10 minutes in
- 339 dilute bleach (1:10 concentration), washing tip under running/sterile water and air
- 340 drying/wiping with lint-free cloth
- 341 e) Cleaning the instrument by wiping, then disinfecting by immersing for 5-10 minutes in
- 342 70% ethyl alcohol, washing tip under running/sterile water and air drying/wiping with lint-
- 343 free cloth
- 344 f) Use of manufacturer's disinfection instructions
- 345 g) Other process (please specify)

346 12. Is tonometry performed on patients with conjunctivitis or eye discharge?

- 347 a) Yes
- 348 b) No

349 13. What precautions do you use if a patient presents with respiratory symptoms?

- 350 a) Use a face mask
- 351 b) Use a face mask with eye protection
- 352 c) No precautions used
- 353 d) Other (please specify)

354 14. Are patients with respiratory or infective eye symptoms (i.e. discharge, conjunctivitis, etc.)

355 isolated from the rest of the clinic (e.g., separate waiting room)?

- 356 a) Yes
- 357 b) No

358 15. Do you wear a face mask if you have respiratory symptoms and have close contact with

359 patients (within 3-6 feet)?

- 360 a) Yes
- 361 b) No

362 16. Are you expected to work with patients if you have symptoms of conjunctivitis?

363 a) Yes

364 b) No

365 17. If No, when are you expected to report back and work with patients?

366 a) After 72 hours

367 b) After 7 days of symptoms

368 c) After 10-14 days of symptoms

369 d) After resolution of symptoms