



# International Journal of Ophthalmology & Vision Research

## Research Article

# Virucidal Activity of Hand Sanitizer against Ocular Isolates of Adenovirus -

**Jason G Hooton<sup>1</sup>, Kathleen A Yates<sup>2</sup>, Eric G Romanowski<sup>2</sup> and Regis P Kowalski<sup>2\*</sup>**

<sup>1</sup>University of Pittsburgh, Kellogg Eye Center, University of Michigan

<sup>2</sup>University of Pittsburgh

**\*Address for Correspondence:** Regis P Kowalski, University of Pittsburgh, the Eye & Ear Institute, Pittsburgh, Tel: +412-647-7211; ORCID: 0000-0002-8558-0782; E-mail: kowalskirp@upmc.edu

**Submitted: 23 August 2018; Approved: 11 September 2018; Published: 17 September 2018**

**Cite this article:** Hooton JG, Yates KA, Romanowski EG, Kowalski RP. Virucidal Activity of Hand Sanitizer against Ocular Isolates of Adenovirus. Int J Ophthal Vision Res. 2018;2(1): 011-013.

**Copyright:** © 2018 Kowalski RP, et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Purpose:** Since the H1N1 Influenza Pandemic of 2009, increasing attention has been paid to the use of alcohol-based hand sanitizers. Significant research has been conducted regarding the formulation, use, and effectiveness against various types of bacteria and viruses. Adenovirus ocular infections such as Epidemic Keratoconjunctivitis, follicular conjunctivitis (EKC), and pharyngeal conjunctival fever are common ocular viral infections that present a unique challenge to the ophthalmological community because of their hardiness and lack of effective treatment options. Prior research on the use of alcohol-based hand sanitizers to combat viral strains associated with EKC has either been limited in its scope or suffered from inadequate inactivation of antivirals during the testing phase. This study evaluated the virucidal activity of Purell Hand Sanitizer against adenovirus in vitro.

**Methods:** Log reduction, direct incubation antiviral assays were performed with both Purell Gel Hand Sanitizer and PBS control using stocks of Adenovirus 3, 4, 5, 7a, 8, 19, and 37. Samples were inactivated and serially diluted at 10 seconds, 2 minutes, and 5 minutes and plated. Assays were done in duplicate.

**Results:** The hand sanitizer reached a 3-log<sub>10</sub> decrease in viral titers at 10 seconds of exposure with adenovirus types 3, 5, 19, and 37. Two minutes of exposure was required to achieve similar results with 4 and 7a. Sufficient decrease was never achieved with type 8 despite 5 minutes of exposure.

**Conclusion:** Purell Gel Hand Sanitizer effectiveness is inconsistent across viral types typically associated with EKC and can potentially still be transmitted to other vectors.

## INTRODUCTION

Since the H1N1 Influenza Pandemic of 2009, increasing attention has been paid to the use of Alcohol-Based Hand Sanitizers (ABHS) as a simple, flexible, and inexpensive means to help individuals maintain adequate hand hygiene and stop the spread of pathogens especially in the setting of a hospital or clinic. Significant research has been conducted regarding the proper formulation and use of these products and their effectiveness against various types of bacteria. Less attention has been paid to their effectiveness against viruses that infect the eye such as the adenovirus.

Adenovirus ocular infections such as Epidemic Keratoconjunctivitis (EKC), follicular conjunctivitis, and pharyngeal conjunctival fever are common ocular viral infections that present a unique challenge to the ophthalmological community because of their hardiness [1] and lack of effective treatment options once infection has occurred. EKC is the most common adenoviral illness found in nosocomial outbreaks and is usually caused by types 8, 19, 37, or 54. EKC can be severe with pseudomembrane formation (Figure 1). Research has demonstrated the importance of properly sanitizing clinic equipment and other fomites that have been linked to outbreaks of EKC [2]. Person to person transmission continues to be a significant concern which provides justification for further exploring effective ways to stop its spread.

Prior research on the use of alcohol-based hand sanitizers has either been limited in its scope (only a few viral strains) or suffered from inadequate inactivation of antivirals during the testing phase [3,4]. Proprietary research would advocate that formulation of products is most important, while other papers such as those conducted by Steinmann et al. [4] argue that alcohol concentration is the most important factor in virucidal activity. Even then, evidence on optimal concentration of alcohol varies along with time of exposure needed to produce adequate activity reduction of the virus [3]. It was the aim of this project to understand the effectiveness of the product used at our facility, which by itself is part of one of the largest hospital systems in the country.

## METHODS

We tested seven types of adenovirus including those most closely associated with EKC and follicular conjunctivitis. Log reduction,

direct incubation antiviral assays based on protocol established by Romanowski et al. [5] were performed with both Purell Advanced Instant Hand Sanitizer Foam (GOJO Industries Inc., Akron, Ohio) and PBS control using stocks of adenovirus 3, 4, 5, 7a, 8, 19 and 37. This hand sanitizer is used throughout our ophthalmology department and the University of Pittsburgh Medical Center, Pittsburgh, PA. Samples were inactivated and serially diluted at 10 seconds, 2 minutes, and 5 minutes and then plated. Assays were done in duplicate and then the entire experiment was repeated 3 times.

## RESULTS

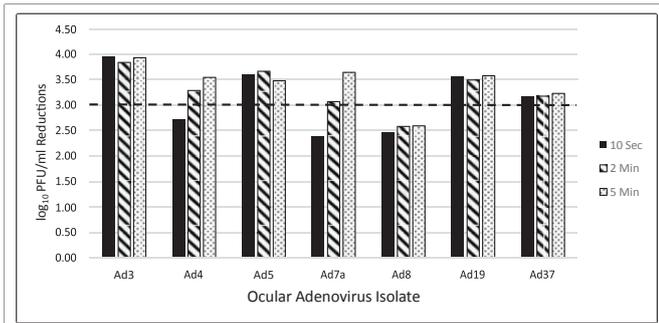
The hand sanitizer demonstrated a 3-log<sub>10</sub> decrease in viral titers at 10 seconds of exposure with adenovirus types 3, 5, 19, and 37 (Figure 2). Two minutes of exposure was required to achieve similar results with type 4 and 7a. A 3-log<sub>10</sub> decrease in viral titers was never achieved with type 8 despite 5 minutes of exposure.

## DISCUSSION

Purell Gel Hand Sanitizer is effective across the majority of adenoviral types typically associated with EKC. It should be noted that the insufficient decrease with type 8 was most likely due to its difficulty with viral culture and not the effectiveness of the hand sanitizer. While we demonstrate robust effectiveness of this ethyl-alcohol based solution, it is important to remember that previous



**Figure 1:** An adenovirus patient with epidemic keratoconjunctivitis and severe pseudomembrane formation indicated with fluorescein orange staining of the palpebral conjunctiva.



**Figure 2:** The log<sub>10</sub> decrease of ocular isolates of adenovirus (Ad) serotypes to an ethyl-alcohol based hand sanitizer. A 3-log<sub>10</sub> decrease denotes a virucidal effect (horizontal line at 3.00).

work has shown that even though 70% isopropyl alcohol is routinely used to wipe down equipment, it has poor virucidal activity for strains most commonly associated with EKC [6]. While our experiment was limited to just one product, it does provide some reassurance that ethyl-alcohol based hand sanitizers are helping decrease the spread of EKC in our clinics. However, Purell Gel Hand Sanitizer effectiveness is inconsistent across viral serotypes typically associated with EKC and can potentially still be transmitted to other vectors.

## REFERENCES

- Gordon YJ, Gordon RY, Romanowski E, Araullo Cruz TP. Prolonged recovery of desiccated adenoviral serotypes 5, 8, and 19 from plastic and metal surfaces in vitro. *Ophthalmology*. 1993; 100: 1835-1839. <https://goo.gl/4rkgva>
- Dart JK, El Amir AN, Maddison T, Desai P, Verma S, Hughes A, et al. Identification and control of nosocomial adenovirus keratoconjunctivitis in an ophthalmic department. *Br J Ophthalmol*. 2009; 93: 18-20. <https://goo.gl/noVkg6>
- Sally F Bloomfield, Allison E Aiello, Barry Cookson, Carol O'Boyle, Elaine L Larson. The effectiveness of hand hygiene procedures in reducing the risks of infections in home and community settings including handwashing and alcohol-based hand sanitizers. *American Journal of Infection Control*. 2007; 35: 27 - 64. <https://goo.gl/p13vsU>
- Steinmann J, Becker B, Bischoff B, Magulski T, Steinmann E. Virucidal activity of Formulation I of the World Health Organization's alcohol-based handrubs: impact of changes in key ingredient levels and test parameters. *Antimicrob Resist Infect Control*. 2013; 2: 34. <https://goo.gl/xkV3KJ>
- Romanowski EG, Yates KA, Teuchner B, Nagl M, Irschick EU, Gordon YJ. N-chlorotaurine is an effective antiviral agent against adenovirus in vitro and in the Ad5/NZW rabbit ocular model. *Invest Ophthalmol Vis Sci*. 2006; 47: 2021-2026. <https://goo.gl/Vju1WV>
- Rutala WA, Peacock JE, Gergen MF, Sobsey MD, Weber DJ. Efficacy of hospital germicides against adenovirus 8, a common cause of epidemic keratoconjunctivitis in health care facilities. *Antimicrob Agents Chemother*. 2006; 50: 1419-1424. <https://goo.gl/cj1K3>