Surveillance of conjunctivitis at a school in Kamonyi District, Rwanda, 2024

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ABSTRACT

INTRODUCTION: Conjunctivitis, a highly contagious eye condition, can significantly impact public health, especially in close-contact settings like schools. This study investigated a conjunctivitis attack at ECOSE Saint Kizito Musambira Boarding School in Rwanda.
METHODS: This surveillance study examined 577 students and 26 staff members through clinical examinations, health records, and demographic data collection from March 12-20, 2024.
RESULTS: The conjunctivitis primarily affected female students (77%), with symptoms including itchy eyes (80.9%) and foreign body sensation (96.7%). The high attack rate suggested a highly contagious agent. Treatment included ciprofloxacin, ibuprofen, and tetracycline pomade. Close living conditions and bed-sharing were more common behaviors among the students.
CONCLUSION: This conjunctivitis attack highlights the importance of rapid detection and response to infectious diseases in schools. While antibiotic therapy was the main management approach, the specific etiology remains uncertain without diagnostic tests. Future prevention strategies should focus on hygiene measures, early case identification, isolation, and enhanced laboratory testing to manage school outbreaks effectively.

INTRODUCTION

Conjunctivitis, commonly known as "pink eye," is one of the most frequent eye conditions worldwide [1]. It affects people of all ages and demographics, with an estimated 6 million cases reported annually in the United States alone [1]. Globally, the prevalence of conjunctivitis varies, but it remains a significant public health concern due to its highly contagious nature and potential for outbreaks in close-contact settings such as schools and daycare centers [2].
The World Health Organization (WHO) recognizes conjunctivitis as a common cause of eye morbidity, particularly in developing countries where access to healthcare and proper hygiene practices may be limited [3]. The global burden of conjunctivitis is difficult to quantify precisely due to underreporting and varying surveillance systems across countries. However, studies suggest that viral conjunctivitis accounts for up to 80% of all acute cases globally [4].

In Africa, eye diseases, including conjunctivitis, pose a significant health challenge. The continent bears a disproportionate burden of eye conditions

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due to factors such as limited access to healthcare, poor sanitation, and high prevalence of infectious diseases [5]. A systematic review of eye diseases in Africa found that conjunctivitis was among the top three most common ocular surface disorders across the continent [6]. In Ethiopia, a study found that conjunctivitis accounted for 29% of all eye diseases in a rural district [7]. In Nigeria, research indicated that conjunctivitis was responsible for 32.9% of childhood eye disorders in a tertiary hospital [8].

East Africa, which includes Rwanda, has shown similar patterns of conjunctivitis prevalence and impact. The East African region faces unique challenges in eye health due to its tropical climate, which can facilitate the spread of certain pathogens associated with conjunctivitis [9]. In Uganda, a neighboring country to Rwanda, a study conducted in primary schools found that 11.8% of children had conjunctivitis [10]. This high prevalence in a school setting underscores the potential for rapid transmission in such environments. In a study of ocular pathology among children aged less than 16 years in the Democratic Republic of Congo, allergic conjunctivitis was the most common pathology, affecting 56.2% of children [11]. The Rwanda Ministry of Health has identified eye health as a priority area in its national health strategy, recognizing the impact of conditions like conjunctivitis on public health and education [12]. Acute infectious conjunctivitis is a common ocular condition with major public health consequences [13].

Conjunctivitis patients are often contagious, and outbreaks of this infectious condition can cause significant morbidity and may jeopardize military readiness [14]. Clinical manifestations of acute conjunctivitis include tearing, foreign body sensation, redness, and pain, and examination of the infected eye may reveal eyelid edema, discharge and/or tears [14–17]. Viral conjunctivitis, particularly that caused by adenoviruses, is highly contagious and can spread rapidly in close-contact environments such as schools [17]. While usually self-limiting, outbreaks can cause significant disruption to educational activities and may lead to broader community transmission if not properly managed [18]. Studies indicate that timely detection and response to outbreaks are crucial to prevent further spread, minimize health impacts, and inform appropriate control measures [19–21].

METHODS

Setting

This survellience study was conducted at the ECOSE Saint Kito Musambira, which experienced conjunctivitis attack among students between March 12th 2024 and March 24th, 2024. ECOSE Saint Kito Musambira, is a private secondary school located in Kamonyi District, Musambira Sector, Karengera Cell, Nyarutovu Village. The school had a total population of 603 people, comprising 577 students (284 females, 293 males) and 26 staff members (12 females, 14 males).

Control of transmission

Like other boarding schools, ECOSE Saint Kito Musambira was an environment that presented a unique challenge for disease control due to the close living quarters and shared facilities. A comprehensive set of immediate interventions was rapidly implemented to contain the spread of infections and manage the affected individuals. Rapid case detection and response are key to ending a disease outbreak through efficient surveillance and laboratory work, effective coordination, and a strong workforce [19–21]. The primary action involved the awareness of conjunctivitis, enforcement of hand hygiene and school treatment of initial cases, and restricting students' movement beyond school boundaries during the outbreak, effectively limiting potential transmission within the school environment and the surrounding community. Simultaneously, a thorough screening process was initiated to identify additional cases, enabling prompt intervention and preventing further spread.

Medical treatment was promptly administered to affected individuals, encompassing a multi-faceted approach with antibiotics to combat potential secondary bacterial infections, anti-inflammatory drugs to reduce eye inflammation and discomfort, and analgesics to alleviate both associated pain and fever [22]. Additionally, a robust information, education, and communication (IEC) strategy was deployed, focusing on educating the school community about the modes of transmission, recognizing symptoms, and implementing effective prevention methods.

This multi-pronged approach aimed to not only treat existing cases but also empower the broader school population with knowledge to

mitigate the further spread of the eye disease. The implementation of this surveillance system holds paramount importance in managing and preventing disease within the school setting. Its multifaceted value lies in its capacity for early detection and rapid response to potential outbreaks, allowing for swift containment measures. By facilitating the identification of the causative agent and mode of transmission, it enables a more precise and effective response strategy [23]. The system plays a crucial role in guiding targeted interventions and optimizing resource allocation, ensuring that efforts are focused where they are most needed [24]. Furthermore, it provides a mechanism for continuously monitoring the effectiveness of implemented control measures, allowing for real-time adjustments and improvements [24].

The data and insights gathered through this surveillance system contributed to the development of informed, long-term prevention strategies tailored to the unique challenges of the school environment. This comprehensive approach not only addresses immediate health concerns but also fortifies the institution's capacity to prevent and manage future similar issues, thereby safeguarding the health and well-being of the entire school community. By systematically collecting and analyzing data on this outbreak, we aimed to minimize its impact, prevent future occurrences, and contribute to the broader understanding of managing infectious eye diseases in educational institutions.

Case definition and data collection

A case was defined as signs or symptoms of conjunctivitis in a student with onset between March 12th 2024, and March 24th, 2024. The health event was defined as suspected viral or adenoviral conjunctivitis, characterized by specific symptoms and clinical presentations including itchy eye, foreign body sensation in the eye, fever, headache, watery discharge, and redness of the eye as observed in the disease's occurrence. This surveillance on conjunctivitis at ECOSE Saint Kizito Musambira involved regular data collection, analysis, and reporting. Data sources included schools' records, direct clinical examinations, and demographic information from the school administration, providing a thorough distribution of the population by age, sex, sharing bed status, and either living inside or outside of the school and classroom students attend. Data was collected among 152 students suspected of having conjunctivitis. Data collection instruments included standardized clinical assessment forms, and demographic questionnaires, capturing variables such as symptom onset, clinical signs, treatment received, and patient demographics. A multidisciplinary team consisting of ophthalmology clinical officers, medical doctors, laboratory technicians, environmental health officer, the hospital's Integrated disease surveillance and response (IDSR) focal person's public health practitioners, and community health workers conducted the screening from March 12th to 20th, 2024, ensuring a thorough and expert-led investigation.

Statistical analysis

The database was meticulously cleaned and coded, with variables appropriately categorized to ensure data integrity and accuracy. Statistical analysis was performed using Excel and SPSS version 25, employing descriptive statistics to summarize the disease characteristics and identify trends. This rigorous methodology enabled a comprehensive understanding of the disease dynamics, facilitating decision-making for control and prevention strategies.

Ethical Considerations

The study team secured permission from the management of Remera Rukoma Hospital, which oversees healthcare services in the area. Additionally, approval was granted by the management of ECOSE St Kizito Musambira School, where the disease occurred, ensuring proper access to the affected population and cooperation from school officials. Furthermore, the ethics committee of Remera Rukoma Hospital reviewed and approved the surveillance protocol, ensuring that the study adhered to ethical standards for public health investigations involving human subjects.

This multi-layered approval process demonstrates the study's commitment to ethical conduct and respect for institutional and community stakeholders. Consent was not applicable was this surveillance of conjunctivitis at ECOSE St Kizito Musambira does not contain any individual person's data in any form (including individual details, images or videos), and all data used in the analysis were aggregated and anonymized.

RESULT

General characteristics of the participants

The mean student age was 16.6 years old (± 2.2 years), with a median age of 16 years. The age range among students is 11 years, from a minimum of 13 years old to a maximum of 24 years old. The majority of the participants (77%) were female students. Almost all students (88%) shared beds with others, with two-thirds (67%) reporting that their bedmate was sick (Table 1).

Table 1: *Characteristics of the 152 participants*

Characteristics	N (%)
Gender	
Male	35 (23.0)
Female	117 (77.0)
Sharing bed status	
Yes	134 (88.2)
No	18 (11.8)
Sickness status of who he/she is sharing a bed with	
Yes	102 (67.1)
No	50 (32.9)
Living out of school	
Yes	0 (0.0)
No	152 (100.0)

No students lived outside the school. These findings suggest that close contact among students may be a contributing factor to the spread of conjunctivitis.

The magnitude of the disease

Figure 1 illustrates the daily number of students who developed signs and symptoms of illness compared to those who sought hospital consultation from March 12th to March 20th, 2024. The peak of the conjunctivitis occurred on March 15, with 34 students consulting the hospital, while 29 exhibited signs and symptoms. Following this, there was a gradual decline in both the number of affected students and those who sought hospital care. Notably, on March 18, 29 students consulted the hospital despite only 19 showing symptoms, indicating heightened concern during this period. Overall, the trend suggests that more students sought hospital care than exhibited symptoms, reflecting the perceived severity of the conjunctivitis.

Symptoms of conjunctivitis among the 152 participants

The surveillance data in Table 2 indicates that itchy eyes and foreign body sensations were the most common symptoms among students with

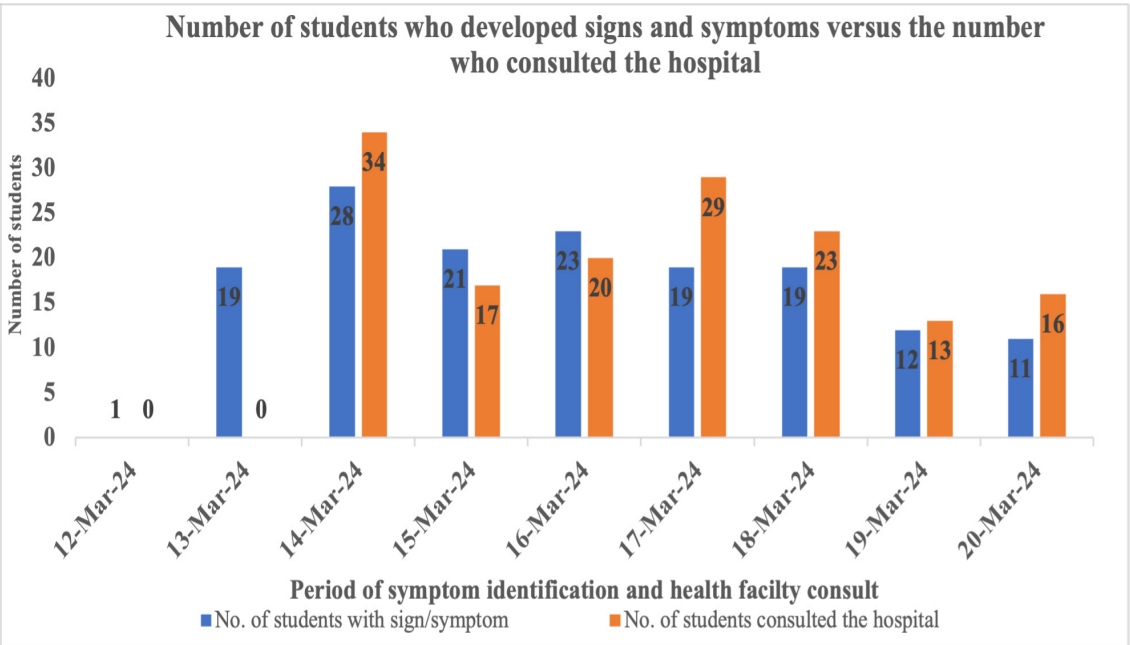

Figure 2: *Symptoms of conjunctivitis and healthcare consults camong the 152 participants*

conjunctivitis at ECOSE St Kizito Musambira, affecting 80.9% and 96.7% of students, respectively. Fever and headache were less prevalent, each occurring in approximately 17.8% of cases.

Table 2: *Symptoms experienced by the participants*

Symptoms	N (%)
Fever	
Yes	27(17.8)
No	125(82.2)
Headache	
Yes	27(17.8)
No	125(82.2)
Itchy eye	
Yes	123(80.9)
No	29(19.1)
Foreign body sensation	
Yes	147(96.7)
No	5(3.3)

Clinical manifestations

The surveillance data reveals a high prevalence of conjunctivitis signs among students at ECOSE St Kizito Musambira. Nearly all participants experienced redness of the eye, painful eyes, lid swelling, watery discharge, sticky discharge, and conjunctival injections. Ecchymosis was also observed in almost all cases. While conjunctival hemorrhage was less common, affecting approximately 73.7% of students, the overall presentation indicates a severe conjunctival infection within the school population (Table 3).

Pharmaceutical management

As shown in Table 4, most students with conjunctivitis at ECOSE St Kizito Musambira, were prescribed ciprofloxacin tablets (100%), focusing on bacterial conjunctivitis management. Ibuprofen was also commonly prescribed to manage associated pain and inflammation (89.5%). While paracetamol was administered to a smaller proportion of students (12.5%), the use of tetracycline pomade (15.1%) suggests a combination approach targeting both bacterial conjunctivitis, although the latter was not specifically tested for in this study.

Table 3: *Clinical signs of conjunctivitis among 152 participants*

Signs of conjunctivitis experienced	N (%)
Watery discharge	
Yes	147(96.7)
No	5(3.3)
Lids swelling	
Yes	147(96.7)
No	5(3.3)
Painful eyes	
Yes	152(100)
No	0(0)
Redness of eye	
Yes	152(100)
No	0(0)
Sticky discharge	
Yes	152(100)
No	0(0)
Conjunctival hemorrhage	
Yes	112(73.7)
No	40(26.3)
Conjunctival injections	
Yes	152(100)
No	0(0)
Ecchymosis	
Yes	149(98.0)
No	0(0.0)

Table 4: *Medications prescribed to participants with signs/symptoms of conjunctivitis*

Medication prescribed	N (%)
Ciprofloxacin tablets	
Yes	152(100)
No	0(0)
Ibuprofen 400mg	
Yes	136(89.5)
No	16(10.5)
Paracetamol 500mg	
Yes	19(12.5)
No	133(87.5)
Tetracycline pomade	
Yes	23(15.1)
No	129(84.9)

DISCUSSION

The current study aimed to describe the epidemiological characteristics of conjunctivitis among students at ECOSE Musambira Boarding School during a conjunctivitis disease attack. The findings revealed a high prevalence of conjunctivitis among the student population, with a majority being female students. Conjunctivitis affected 41.2% of females and 11.9% of males. This finding is different from the outbreak that occurred in Germany, where there was no sex disproportion [25]. The close living conditions, as evidenced by the high proportion of students sharing beds with sick roommates, likely contributed to the rapid spread of the infection. Thus, the studies also show that isolation and closing the school prevent person-to-person transmission and spread in the outer communities [26].

The clinical presentation was characterized by a constellation of symptoms and signs, including itchy eyes, foreign body sensation, redness, pain, lid swelling, and discharge, as found in other similar outbreaks [27–30]. The high prevalence of these symptoms and signs suggests a severe conjunctival infection within the school population. The management of the conjunctivitis attack primarily relied on antibiotic therapy, with ciprofloxacin being the first-line treatment. While this approach is commonly used for bacterial conjunctivitis, it is important to note that the etiology of the disease was not definitively established, and the use of tetracycline pomade might suggest a consideration of chlamydial conjunctivitis. However, the absence of specific diagnostic tests for chlamydia limits the ability to confirm this hypothesis.

The high attack rate and rapid onset of symptoms suggest a highly contagious agent, likely a viral pathogen. However, the possibility of a viral etiology cannot be excluded as the studies indicate that viral conjunctivitis is the most common infectious conjunctivitis [1]. Implementing strict hygiene measures, such as handwashing and proper disposal of eye secretions, is crucial to prevent future attacks. Early detection and isolation of cases also helped to contain the spread of the infection. Similar efforts have been claimed to control this kind of infection [31].

This conjunctivitis attack emphasized the need for robust surveillance systems to detect disease increases early and implement timely interventions. The high incidence of conjunctivitis underscores the significance of promoting good hygiene practices, such as handwashing and avoiding sharing personal items, among students. Additionally, the study revealed the challenges associated with diagnosing the specific etiology of conjunctivitis in resource-limited settings, emphasizing the need for improved laboratory capacity. The conjunctivitis attack also highlighted the importance of involving the entire school community, including students, staff, and parents, in prevention and control efforts.

CONCLUSION

These surveillance findings underscore the challenges and necessities of managing infectious diseases in resource-limited settings. The high attack rate and rapid symptom onset suggest a highly contagious agent, possibly bacterial, though the viral etiology could not be excluded without specific diagnostic tests. Measures to prevent future health crises in schools should include enhancing hygiene practices, conducting regular health education, improving laboratory capacities for precise etiological diagnosis, and conducting studies to identify the factors associated with conjunctivitis in school settings.

Declarations

It is important to note that this article is not an official report of health event investigations but rather an independent analysis and interpretation based on the authors' expertise and understanding of the situation. The views expressed herein represent the personal opinions of the authors and may not reflect the official stance or recommendations of the involved organizations or authorities. Readers should exercise caution in generalizing these findings to similar events without considering local guidelines and validated procedures.

Availability of data and material

The datasets generated and analyzed during the surveillance of conjunctivitis at ECOSE St Kizito School Musambira are available from the corresponding author upon reasonable request, as they contain no individual personal data, consist only of aggregated statistics, and are anonymized.

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REFERENCES

[1] A. A. Azari and N. P. Barney, "Conjunctivitis: A Systematic Review of Diagnosis and Treatment," JAMA J. Am. Med. Assoc., vol. 310, no. 16, p. 1721, Oct. 2013, doi: 10.1001/jama.2013.280318.

[2] Y. Madurapandian et al., "Case report: An outbreak of viral conjunctivitis among the students and staff of visually impaired school, Tamil Nadu, India, 2020," Front. Public Health, vol. 10, p. 978200, Aug. 2022, doi: 10.3389/fpubh.2022.978200.

[3] WHO, "Universal eye health: a global action plan 2014–2019." Accessed: Sep. 25, 2024. [Online]. Available: https://www.who.int/publications/i/item/universal-eye-health-a-global-action-plan-2014-2019

[4] V. Jhanji, T. C. Y. Chan, E. Y. M. Li, K. Agarwal, and R. B. Vajpayee, "Adenoviral keratoconjunctivitis," Surv. Ophthalmol., vol. 60, no. 5, pp. 435–443, Sep. 2015, doi: 10.1016/j.survophthal.2015.04.001.

[5] S. Resnikoff et al., "Global data on visual impairment in the year 2002," Bull. World Health Organ., vol. 82, no. 11, pp. 844–851, Nov. 2004.

[6] A. Bastawrous, P. I. Burgess, A. M. Mahdi, F. Kyari, M. J. Burton, and H. Kuper, "Posterior segment eye disease in sub-Saharan Africa: review of recent population-based studies," Trop. Med. Int. Health, vol. 19, no. 5, pp. 600–609, May 2014, doi: 10.1111/tmi.12276.

[7] W. Alemayehu, R. Tekle-Haimanot, L. Forsgren, and J. Erkstedt, "Causes of visual impairment in central Ethiopia," Ethiop. Med. J., vol. 33, no. 3, pp. 163–174, Jul. 1995.

[8] A. I. Ajaiyeoba, M. A. Isawumi, A. O. Adeoye, and T. S. Oluleye, "Pattern of eye diseases and visual impairment among students in southwestern Nigeria," Int. Ophthalmol., vol. 27, no. 5, pp. 287–292, Oct. 2007, doi: 10.1007/s10792-007-9056-7.

[9] P. Courtright and S. K. West, "Contribution of Sex-linked Biology and Gender Roles to Disparities with Trachoma1," Emerg. Infect. Dis., vol. 10, no. 11, pp. 2012–2016, Nov. 2004, doi: 10.3201/eid1011.040353.

[10] M. Kawuma and R. Mayeku, "A survey of the prevalence of refractive errors among children in lower primary schools in Kampala district," Afr. Health Sci., vol. 2, no. 2, pp. 69–72, Aug. 2002.

[11] N. Nsiangani Lusambo et al., "Prevalence and patterns of childhood ocular morbidity in Kinshasa. A population-based study," Glob. Epidemiol., vol. 3, p. 100054, May 2021, doi: 10.1016/j.gloepi.2021.100054.

[12] MOH, Rwanda, "Health Sector Policy 2015." Accessed: Sep. 25, 2024. [Online]. Available: https://www.moh.gov.rw/news-detail/health-sector-policy-2015

[13] E. Tsui et al., "Pathogen Surveillance for Acute Infectious Conjunctivitis," JAMA Ophthalmol., vol. 141, no. 12, pp. 1140–1144, Dec. 2023, doi: 10.1001/jamaophthalmol.2023.4785.

[14] O. Efros, A. Zahavi, H. Levine, and M. Hartal, "Clinical and public health management of conjunctivitis in the Israel Defense Forces," Disaster Mil. Med., vol. 1, p. 12, May 2015, doi: 10.1186/s40696-015-0002-3.

[15] T. Muto, S. Imaizumi, and K. Kamoi, "Viral Conjunctivitis," Viruses, vol. 15, no. 3, p. 676, Mar. 2023, doi: 10.3390/v15030676.

[16] B. Ghebremedhin, "Human adenovirus: Viral pathogen with increasing importance," Eur. J. Microbiol. Immunol., vol. 4, no. 1, pp. 26–33, Mar. 2014, doi: 10.1556/EuJMI.4.2014.1.2.

[17] D. Solano, L. Fu, and C. N. Czyz, "Viral Conjunctivitis," in StatPearls, Treasure Island (FL): StatPearls Publishing, 2024. Accessed: Jul. 29, 2024. [Online]. Available: http://www.ncbi.nlm.nih.gov/books/NBK470271/

[18] D. Kneale, A. O'Mara-Eves, R. Rees, and J. Thomas, "School closure in response to epidemic outbreaks: Systems-based logic model of downstream impacts," F1000Research, vol. 9, p. 352, May 2020, doi: 10.12688/f1000research.23631.1.

[19] R. A. Fowler, D. C. Scales, and R. Ilan, "Evidence of airborne transmission of SARS," N. Engl. J. Med., vol. 351, no. 6, pp. 609–611; author reply 609-611, Aug. 2004.

[20] "Strengthening Outbreak Management and Emergency Response Systems - Global Health Risk Framework - NCBI Bookshelf." Accessed: Jul. 29, 2024. [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK367950/

[21] "Preparing for Ebola Virus Disease in West African countries not yet affected: perspectives

from Ghanaian health professionals | Globalization and Health | Full Text." Accessed: Jul. 29, 2024. [Online]. Available: https://globalizationandhealth.biomedcentral.com/articles/10.1186/s12992-015-0094-z

[22] J. Wei, J. Mu, Y. Tang, D. Qin, J. Duan, and A. Wu, "Next-generation nanomaterials: advancing ocular anti-inflammatory drug therapy," J. Nanobiotechnology, vol. 21, p. 282, Aug. 2023, doi: 10.1186/s12951-023-01974-4.

[23] J. M. van Seventer and N. S. Hochberg, "Principles of Infectious Diseases: Transmission, Diagnosis, Prevention, and Control," Int. Encycl. Public Health, pp. 22–39, 2017, doi: 10.1016/B978-0-12-803678-5.00516-6.

[24] A. Alshehri, B. Balkhi, G. Gleeson, and E. Atassi, "Efficiency and Resource Allocation in Government Hospitals in Saudi Arabi: A Casemix Index Approach," Healthcare, vol. 11, no. 18, p. 2513, Sep. 2023, doi: 10.3390/healthcare11182513.

[25] C. Adlhoch, I. Schöneberg, G. Fell, D. Brandau, and J. Benzler, "Increasing case numbers of adenovirus conjunctivitis in Germany, 2010," Eurosurveillance, vol. 15, no. 45, p. 19707, Nov. 2010, doi: 10.2807/ese.15.45.19707-en.

[26] S. L. Chen, R. C. Liu, F. M. Chen, X. X. Zhang, J. Zhao, and T. M. Chen, "Dynamic modelling of strategies for the control of acute haemorrhagic conjunctivitis outbreaks in schools in Changsha, China (2004–2015)," Epidemiol. Infect., vol. 145, no. 2, pp. 368–378, Jan. 2017, doi: 10.1017/S0950268816002338.

[27] D. L. Wen Xu, "An outbreak of epidemic keratoconjunctivitis caused by human adenovirus type 8 in primary school, southwest China | BMC Infectious Diseases | Full Text," BMC Infectious Diseases. Accessed: Aug. 06, 2024. [Online]. Available: https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-019-4232-8

[28] M. A, S. S, and Z. W, "The Rising Challenge: Addressing the Pink Eye (Acute Conjunctivitis) Outbreak in Pakistan," Arch. Iran. Med., vol. 27, no. 7, Jul. 2024, doi: 10.34172/aim.28619.

[29] E. Yeu and S. Hauswirth, " A Review of the Differential Diagnosis of Acute Infectious Conjunctivitis: Implications for Treatment and Management ," Clin. Ophthalmol., vol. 14, pp. 805–813, Mar. 2020, doi: 10.2147/OPTH.S236571.

[30] M. M. J. Moghadam, M. M. Yari, F. A. Jalilian, R. Amini, and N. Bazzazi, " Epidemiology and molecular diagnosis of acute conjunctivitis in patients attending Hamadan, west Iran ophthalmology clinics 2016–2017 ," Clin. Optom., vol. 11, pp. 105–111, Oct. 2019, doi: 10.2147/OPTO.S217722.

[31] F.J. Muñoz-Negrete, "Adenoviral keratoconjunctivitis: An update - ScienceDirect," Science direct. Accessed: Aug. 06, 2024. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S2173579413000492?via%3Dihub