The ROYAL COLLEGE of OPHTHALMOLOGISTS

www.nature.com/eye

BRIEF COMMUNICATION OPEN

Check for updates

Microbiological profile of infectious keratitis in the Newcastle and Gateshead region: a 10-year analysis

Nikolaos Tzoumas [1,2]✉, Ana Luiza Mylla Boso [3], Melissa Gough [1,3], Jaswant Sandhu [3] and Manjusha Narayanan [4]✉

Eye (2024) 38:813–814; https://doi.org/10.1038/s41433-023-02763-x

INTRODUCTION

Infectious keratitis is a leading cause of blindness and hospitalisation worldwide, incurring £2,855 per admission [1]. Causative organisms demonstrate marked geographical and temporal variation, and there are limited epidemiological data necessary to establish disease trends [2]. We analysed infectious keratitis patterns and trends in a regional context, informing prevention and management strategies.

METHODS

We audited corneal scrapes from a major UK NHS trust, serving Newcastle and Gateshead's densely populated and deprived areas (population: 556,181) [3], from January 2012 to 2023. Sight-threatening corneal ulcers meeting local criteria underwent urgent investigation. Cultures were incubated for at least a week, longer for suspected *Acanthamoeba*. Microbial trends were analysed using age-adjusted Poisson regression. We considered only the first non-commensal microbial agent each admission (±30 days) to avoid duplications.

RESULTS

We found 600 culture-positive cases involving 72 species and 31 genera; 10% were repeat cases. Bacteria comprised 88.8%, fungi 7.0%, and *Acanthamoeba* 4.2%. Positive scrape yield averaged 37.9% per admission. Median age was 59 (IQR 42–75) years, stable throughout.

The commonest genera were *Staphylococcus* (25%), *Pseudomonas* (22%), *Streptococcus* (12%), and *Moraxella* (10%). Gram-positive and negative representation was equal (44%, 43%). Although *Staphylococcus* cases remained stable (0% annual change, $P = 0.99$), *Pseudomonas* cases rose significantly (+7%, $P = 0.003$), establishing it as the predominant infectious agent over the past four years (Fig. 1). *Pseudomonas* keratitis peaked

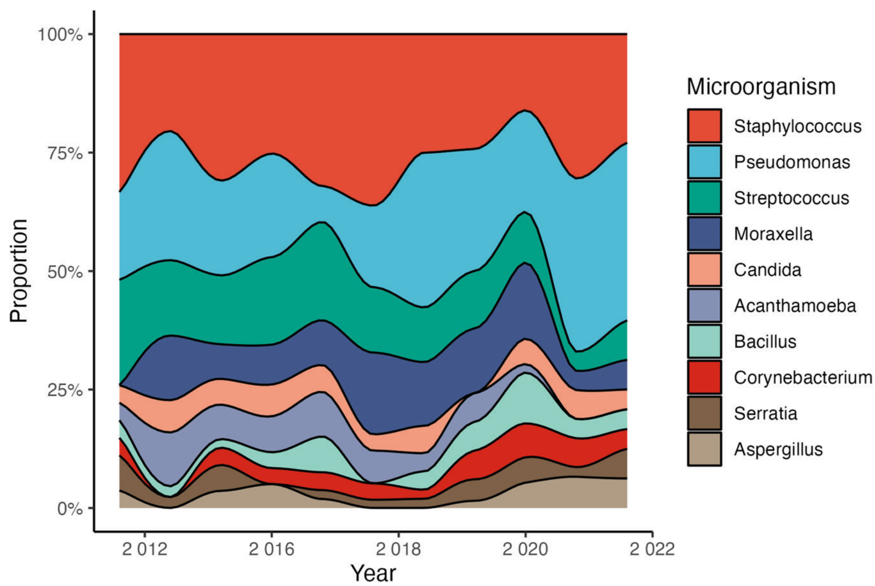

Fig. 1 Area plot showing the trends of the most prevalent infectious keratitis pathogens over the past decade. Each line represents the cumulative proportion of culture-positive cases for that year. The relative incidence of *Staphylococcus* has remained stable, while *Pseudomonas* has shown an upward trend in recent years.

[1]Biosciences Institute, Newcastle University, Newcastle upon Tyne, UK. [2]Sunderland Eye Infirmary, Sunderland, UK. [3]Newcastle Eye Centre, Royal Victoria Infirmary, Newcastle upon Tyne, UK. [4]Microbiology and Virology Services, Royal Victoria Infirmary, Newcastle upon Tyne, UK. ✉email: nik.tzoumas@newcastle.ac.uk; Manjusha.narayanan@nhs.net

Received: 7 August 2023 Revised: 1 September 2023 Accepted: 15 September 2023
Published online: 17 October 2023

July to November (27–42%) *vs*. rest of year (5–20%). There were no consistent changes in other pathogens' rates, including *Acanthamoeba* (−8%, $P = 0.34$; Supplementals).

Peak months were May, July, August, September, and October (9–10% each). The busiest period was the last week of June and the first week of July (Supplementals). Gram-positive pathogens prevailed in May (57%) and January (55%), while Gram-negative pathogens predominated in November (58%) and August (55%). On weekdays, most samples were processed Tuesdays (21%) and Saturdays (18%). These timings do not consider potential delays in sample handling.

DISCUSSION

We reveal a sustained increase in *Pseudomonas*-related keratitis rates across Northern England, recently surpassing *Staphylococcus* cases (Fig. 1). This aligns with other UK regions' trend of declining Gram-positive infections, favouring Gram-negative pathogens like *Pseudomonas* [4, 5]. This shift may reflect changing contact lens use behaviours, a recognised risk for Gram-negative infections. However, it remains unclear why this practice would not have led to a similar trend in *Acanthamoeba* keratitis – this disparity could stem from softer water compared to the South [6].

We also confirm bacteria as the main cause of infectious keratitis, comprising 89% of culture-positive cases (previously reported: 91–93%) [2]. *Staphylococcus* and *Pseudomonas* dominated our sample (25%, 22%), surpassing rates in other UK areas like neighbouring Sunderland (14%, 12%) [2]. Non-bacterial keratitis rates were comparable [2], hinting at limited microbial diversity possibly due to elevated antibiotic use [7]. Additionally, we confirmed increased culture-positive cases in warmer months [5], and identified increased rates on Tuesdays and Saturdays, likely due to higher patient visits to our Eye Casualty the previous day [3].

Further epidemiological study is urgently needed to establish UK-wide infectious keratitis trends and identify preventable causal relationships.

DATA AVAILABILITY

Summative data generated or analysed during this study are included in this published article and its supplementary information. Further data available on request.

REFERENCES

1. Moussa G, Hodson J, Gooch N, Virdee J, Penaloza C, Kigozi J, et al. Calculating the economic burden of presumed microbial keratitis admissions at a tertiary referral centre in the UK. Eye. 2021;35:2146–54.
2. Stapleton F. The epidemiology of infectious keratitis. Ocul Surf. 2023;28:351–63.
3. De Silva I, Thomas MG, Shirodkar A-l, Kuht HJ, Ku JY, Chaturvedi R, et al. Patterns of attendances to the hospital emergency eye care service: a multicentre study in England. Eye. 2022;36:2304–11.
4. Moledina M, Roberts HW, Mukherjee A, Spokes D, Pimenides D, Stephenson C, et al. Analysis of microbial keratitis incidence, isolates and in-vitro antimicrobial susceptibility in the East of England: a 6-year study. Eye. 2023;37:2716–22.
5. Ting DSJ, Ho CS, Cairns J, Gopal BP, Elsahn A, Al-Aqaba M, et al. Seasonal patterns of incidence, demographic factors and microbiological profiles of infectious keratitis: the Nottingham Infectious Keratitis Study. Eye. 2021;35:2543–9.
6. Radford CF, Minassian DC, Dart JK. Acanthamoeba keratitis in England and Wales: incidence, outcome, and risk factors. Br J Ophthalmol. 2002;86:536–42.
7. Shallcross LJ, Davies DSC. Antibiotic overuse: a key driver of antimicrobial resistance. Br J Gen Pract. 2014;64:604–5.

ACKNOWLEDGEMENTS

NT was supported by a National Institute for Health and Care Research (NIHR) Academic Clinical Fellowship (ACF-2021-01-008) and his research was funded in whole, or in part, by the Wellcome Trust (R127002). For the purpose of open access, the author has applied a CC BY public copyright licence to any Author Accepted Manuscript version arising from this submission.

AUTHOR CONTRIBUTIONS

NT and ALMB conceived of the presented idea. MN and JS were involved in planning and supervised the work. MN worked out the technical details and provided the data. NT analysed the data. NT and MG took the lead in drafting the article. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s41433-023-02763-x.

Correspondence and requests for materials should be addressed to Nikolaos Tzoumas or Manjusha Narayanan.