Scottish Hospitals Inquiry - Glasgow 4 Part 2
Witness Statement of
Shona Cairns

Personal Details and Professional Background

1. This statement is provided in response to a request made by Counsel to the Scottish Hospitals Inquiry. NHS National Services Scotland (NSS) submitted a closing statement (**A51651537 – NSS Closing Statement**[1]) following the Glasgow III Hearing. Counsel to the Inquiry has invited NSS to provide information relating to a number of areas covered within that closing statement and to provide information on follow up questions to aid the Inquiry.

2. I am Shona Cairns, BSc (Hons), PgDip, MSc. I hold the post of Consultant Healthcare Scientist/Epidemiologist at Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) Scotland and have done so since 2021. I am the Clinical Lead for the Healthcare Associated Infection Surveillance and Epidemiology (HCAISE) programme and I am the Professional Lead for healthcare science in ARHAI Scotland. I am a registered Clinical Scientist with the Health and Care Professions Council and have worked in a national epidemiology role for more than 20 years, focusing on developing epidemiological evidence to reduce the burden of infection and antimicrobial resistance (AMR) in healthcare.

3. I graduated from the University of Strathclyde with a Bachelor of Science (Honours) degree in Immunology and Pharmacology in 1999 followed by a Postgraduate Diploma with Distinction in Information Technology (with Database Development) from the University of Paisley in 2003. I completed a Master of Science in Epidemiology at the London School of Hygiene and Tropical Medicine part-time by distance learning in 2008 whilst employed by NSS .

4. I started my scientific career working as a research assistant in a University of Glasgow laboratory researching links between human genes and diseases. I

[1] Hearing Commencing 19th August 2024 Core Participants' Submissions – Document 8, page 147.

returned to university to develop the data and database experience required to move into epidemiology roles. Following the completion of my Postgraduate Diploma, I was recruited by NSS in November 2003 in what was then called the Scottish Centre for Infection and Environmental Health (SCIEH) and then Health Protection Scotland (HPS). Throughout my NHS career, I have worked in various roles within teams responsible for reducing the burden of healthcare associated infection (HCAI) and AMR. Since June 2021, this has been the remit of ARHAI Scotland as part of NHS Scotland Assure.

5. My first NHS role was as a data manager in the Scottish Healthcare Associated Infection Programme (SSHAIP) when I was recruited in November 2003. This role introduced me to HCAI epidemiology and I was supported by NSS to develop into a healthcare science career as an Epidemiologist, including support to undertake an MSc in Epidemiology. I moved into my first Healthcare Scientist/Epidemiologist role in 2006 and progressed from there to Advanced Healthcare Scientist, Principal Healthcare Scientist, Lead Healthcare Scientist before my current role as Consultant Healthcare Scientist/Epidemiologist.

Experience and Current Role

6. In my current role, I am the Clinical lead for the HCAISE clinical programme and the Data and Intelligence team of healthcare scientists and data/information managers. The team is responsible for providing high-quality epidemiological data analysis using advanced statistical methods and software tools to analyse complex datasets from multiple sources including data provided by NHS Boards and large nationally held datasets. The programme includes the national mandatory healthcare associated infection surveillance programme (*Staphylococcus aureus* bacteraemia, *Escherichia coli* bacteraemia and *Clostridioides difficile* infection); other non-mandatory surveillance programmes (hospital onset respiratory virus surveillance); epidemiological monitoring of outbreaks/incidents reporting via the outbreak reporting tool; epidemiological support to local and national incidents/outbreaks; and is responsible for the scoping and development of novel surveillance systems based on clinical need.

7. I collaborate closely with infection prevention and control (IPC) and public health professionals, clinicians, microbiologists, data analysts, statisticians, and policymakers to ensure the data and intelligence we produce is robust and actionable.

8. As Consultant Healthcare Scientist, I have a national leadership role within the Scottish and UK-wide HCAI and AMR agendas. I am a member of the Scottish One Health AMR Strategic Oversight Group. I work closely with UK partners and I am the Scottish lead for the UK Four Nations HCAI and AMR surveillance group and a member of the UK Government AMR Human Health Delivery Board.

9. I am the professional lead for healthcare science in ARHAI Scotland. The cohort of 35 healthcare scientists develop highly specialised data, intelligence and evidence reviews to provide the evidence base strategies to inform IPC and reduce the burden of healthcare associated infection and AMR.

10. I have a healthcare science workforce education and development leadership role in ARHAI Scotland. I was a core member in several workforce education initiatives including the development of healthcare science career frameworks and competency matrices; and development of a healthcare science epidemiology fellowship training programme. A key aim of the clinical programme I lead in ARHAI Scotland is to develop a competent IPC workforce in epidemiological methods and I have developed and lead facilitated a number of epidemiology training courses for internal and external stakeholders. Most recently, we have delivered 5 training days to nearly 200 Scottish IPC professionals in Surveillance and Epidemiology for IPC.

11. I have led large scale national epidemiological surveys in Scotland. Following contribution to two national point prevalence surveys of healthcare associated infections and antimicrobial use in 2005/2006 and 2011 as an Epidemiologist, I led the Scottish National Point Prevalence Survey of Healthcare Associated Infection and Antimicrobial Use in 2016. Following analysis and interpretation of the epidemiological evidence, I led multi-disciplinary collaboration with clinicians to identify key evidence-based priorities areas for IPC interventions, antimicrobial stewardship initiatives and surveillance activity. The results from the survey

informed the Scottish Government policy and played a key role in local and national IPC and stewardship strategies.

12. I have provided epidemiological expertise to healthcare outbreak investigations, supporting local teams with epidemiological intelligence to inform control measures. This support to NHS Boards can include analysis of data routinely held by ARHAI Scotland to support NHS Boards and may occasionally involve mobilisation of a team of epidemiologists to the NHS Board to undertake review of case notes.

13. During the COVID-19 pandemic, I led a highly skilled team on the development of epidemiological evidence to inform Scottish COVID-19 policy and guidance. I was a member of the Scottish Government Chief Nursing Officer's COVID-19 Nosocomial Review Group and regularly presented epidemiological data to support decision making.

14. I report to Laura Imrie, Clinical Lead, NHS Scotland Assure. She reports to Julie Critchley, Director, NHS Scotland Assure. Julie Critchley reports to Mary Morgan, Chief Executive, NSS.

Comparator data

15. Comparison of patient populations is a complex area of epidemiology. With regard to **A52240258 - Counsel to the Inquiry's Closing Submission**[2] **paragraph 313 of chapter 7**, (page 613), ARHAI Scotland acknowledges the challenges with undertaking comparative analysis between hospitals and/or haematology units. This is a challenge faced when undertaking any epidemiological comparison, due to the epidemiological concept of confounding. Confounding occurs when the difference in the measure being compared across different haemato-oncology populations i.e. the rate of infection is affected by other differences between the populations being compared.

16. There are epidemiological and statistical methods for adjusting comparisons for the

[2] Available on the Inquiry website - Closing Statement by Counsel to the Inquiry - Glasgow 3 | Hospitals Inquiry

effects of confounding, though these require extensive patient level risk factor data and larger datasets. These methods are often used for large scale epidemiological studies where the results are being used to identify risk factors for interventions or to inform policy. They are often a requirement for publishing results in peer-reviewed journals. An example of an analysis undertaken by ARHAI Scotland to adjust for confounding is the comparison of the prevalence of HCAI reported in Scottish National Point Prevalence Surveys of 2011 and 2016. One objective of the survey was to determine whether the prevalence of HCAI had changed in the intervening period, in part to contribute to understanding of whether interventions to reduce HCAI had been successful. As the inpatient population had changed in the intervening period e.g. age, underlying co-morbidities, it was important to account for this when comparing the 2011 HCAI prevalence with the 2016 HCAI prevalence. Statistical modelling was used to compare the prevalence adjusted for differences in the patient population and concluded that the HCAI prevalence was lower in 2016 compared with 2011 after the comparison had been controlled for differences in the two populations.

17. There are information governance considerations when requesting and holding the required granularity of patient data. Ideally, patient level datasets would be available for both populations being compared. The data would include information about factors that can confound the comparison by their uneven distribution across populations, e.g. age, sex, underlying co-morbidities, and treatment regimes, alongside contextual factors such as staffing levels, occupancy on the unit, and facilities available. This level of data was not available to Mr Mookerjee or NSS during the production of their reports as discussed during the Glasgow III Hearing. Without adjustment for confounding, the limitations of the analysis should be acknowledged and conclusions drawn in the context of the limitations.

18. With regard to Counsel to the Inquiry's Closing Submission **paragraph 337 of chapter 7, (page 622)**, these issues were also a limitation in the comparator analyses undertaken by NSS, where the best available data at the time was used and the limitations understood. It is important to note that obtaining comparative data for specialist units in Scotland is challenging, given the size of the population and the fact that many specialist services are delivered via regional/national

centres. There is some merit in undertaking unadjusted comparisons but the limitations of such should be described and conclusions drawn in the context of the limitations.

19. With regard to Counsel to the Inquiry's Closing Submission **paragraph 424 of chapter 7, (page 654)**, it is not commonly recognised that a large sample size will adjust for the effects of bias and confounding. The way to reduce the effects of confounding when comparing data is by design such as selection of similar comparator organisations or units e.g. comparing a Bone Marrow Transplant (BMT) unit with another, or by using analytical techniques such as statistical modelling. Often it is necessary to work with the data available, but ensuring that the limitations, including the potential for confounding, are well described, and that the strength of any conclusions drawn is understood in the context of the data available is essential.

Correlation and causation

20. With regard to Counsel to the Inquiry's Closing Submission **paragraphs 315 to 321 of chapter 7, (pages 614-616)**, NSS acknowledge the challenges faced by Mr Mookerjee in his analysis to determine an association between water positivity and rates of infection. As previously provided in NSS feedback (**A48986808 - NHS National Services Scotland – Response to Expert Report of Sid Mookerjee**[3] and **A49860374 – NHS National Services Scotland – Response to Supplementary Expert Report of Sid Mookerjee**[4]), we considered there to be a number of methodological limitations that should be considered when interpreting the limited data. These included a small number of data points and a small number of water sample results included in some years. Mr Mookerjee stated in his oral evidence that, "I accept the hypothesis that there is a strong association between the exposure variable, which is the water contamination, and the occurrence of infections from environmental bugs in the Schiehallion cohort" (**Transcript – Sid Mookerjee**[5] **– 05.11.2024 - transcript column 132, page 68**). It is my opinion, the

[3] Bundle 21, Volume 3, Document 4, page 15.
[4] Bundle 21, Volume 7, Document 2, page 16.
[5] Available on the Inquiry website - Transcript - Sid Mookerjee - 05.11.2024 | Hospitals Inquiry.

strength of this conclusion should be considered in the context of the limitations of the data available and methods used.

Statistical Process Control (SPC) Charts

21. The selection of a baseline for use in SPC charts can be challenging. The baselines are calculated using available data and there is often more than one option available. The baseline should ideally reflect the “normal” background rate to enable instances outside of normal variation to be identified. With regard to Counsel to the Inquiry’s Closing Submission **paragraph 339 of chapter 7, (pages 622-623)**, NSS was asked to clarify the baseline used in the "Review of NHSGG&C paediatric haemato-oncology data” report of October 2019. The SPC charts used the mean of rates prior to the move to the Royal Hospital for Children (RHC) (July 2013 to May 2015). This choice of baseline has limitations as this assumes that the “normal” background rate in the paediatric haemato-oncology patient population is that observed whilst the population was cared for in Yorkhill Hospital, an older estate rather than the new purpose-built hospital where the risk from the environment may be expected to be lower. Baselines are calculated using retrospective data and if the rates have historically been high, the baseline will be high making it more difficult for the limits in the graph to be breached or other signals to be detected. This baseline was chosen to describe what might normally be expected in this population though the limitations of using a Yorkhill Hospital baseline are acknowledged.

22. SPC charts and analysis can be used both prospectively and retrospectively. Prospective use of SPC charts is common in IPC where IPC Teams (IPCTs) maintain charts for key organisms or infections. As new cases are identified and added to the SPC chart, instances of unusual variation can be identified near real-time to prompt action and further investigations to determine whether there is an outbreak. SPC charts can be used retrospectively to analyse data and identify instances of unusual variation that have occurred historically to support investigations and the Incident Management Team (IMT). This is how SPC charts were used in the HPS reports. It is important to note that the HPS SPC charts were not used in real time and were not used to identify or declare an outbreak.

23. The monthly HPS SPC charts were intended to provide a level of granularity that enables signals in the data to be identified during an incident that progressed over time, with specific points of concern during the year. Annual data may not be granular enough for incident/outbreak management and important points during the outbreak would not have been identified in the data.

24. There are acknowledged limitations to SPC charts and the HPS SPC charts were not intended to be considered in isolation. They were intended to support the IMT and to be considered, with the caveats acknowledged, alongside other information and evidence available to the IMT.

Epidemiology and surveillance

25. There are often several options when selecting a denominator for measuring the incidence of infection. This should be based on the population at risk, though is often driven by the availability of denominator data. Bed day denominators are a better measure of the duration that a patient is at risk in the hospital environment. This measures the time at risk differently based on length of stay. For example, a patient who is admitted to hospital for ten days contributes 10 bed days to the denominator versus a patient who is admitted for one day who will contribute 1 bed day. This better reflects time and population at risk than an admission denominator where both patients, irrespective of the time spent in hospital, contribute 1 to the denominator. Furthermore, a patient with 10 admissions for one day will contribute 10 to an admission denominator versus 1 in a patient with a length of stay of ten days, who is likely to be sicker. Counsel to the Inquiry's Closing Submission **paragraph 355 of chapter 7, (page 629)**, recounts Mr Mookerjee's evidence that there is no evidence that someone who is an inpatient for 10 days is at more (or less) risk than someone who is a day patient on 10 separate days. However, Mr Mookerjee's choice of admissions as the denominator does not reflect this. It is acknowledged that Mr Mookerjee did not have access to the data that would have been required to fully capture the level of time-at risk in the denominator. NSS agree that there is a risk associated with care provided during day case admissions, and that time at risk for all patients receiving treatment (combined for inpatient and day case admissions) would be the most appropriate denominator. However, such a

combined dataset was also not available to Mr Mookerjee. It is important to acknowledge this limitation in the denominator when drawing conclusions.

26. Counsel to the Inquiry's Closing Submission **paragraph 383 of chapter 7, page 639**, recounts Mr Mookerjee's evidence that a child admitted to ward 2A in 2017 had a 16% chance of catching a bloodstream infection. This figure is in fact the observed number of infections per 100 admissions or percentage of admissions resulting in an infection, not the probability or percentage chance of a child in the cohort developing a bloodstream infection. Individual risk or probability of infection developing in an individual is difficult to estimate particularly with a heterogeneous population. Risk of developing a bloodstream infection will be different for each patient in the cohort and will depend on individual factors including underlying conditions and length of stay.

27. ARHAI Scotland has been piloting a methodology for local surveillance of environmental organisms in high-risk units. A key aim of the pilot is to develop candidate triggers that can be incorporated into monitoring systems and that would identify areas for further investigation locally. The first phase of the pilot is complete and a preliminary pilot report was prepared with recommendations for further development (**A52957484 - Environmental Pathogens Surveillance Pilot Report**[6]). Feedback from NHS Boards was positive and suggested triggers were useful for detecting trends and areas of concern for action. Further work is necessary to refine the triggers ensuring there is a balance between the resource implications of multiple triggers and associated investigations alongside identifying potential risk to patients in high-risk units. A second phase of the pilot is planned for financial year 2025/26 and the final report will include recommendations to support NHS Boards in their local monitoring of environmental organisms. The inclusion of flexible alert organism surveillance and triggers to support local investigation are also important considerations for the proposed national IPC e-surveillance solution.

28. The Scottish Government has been leading on the development of an outline

[6] Bundle 44, Volume 2, Document 47, page 709.

business case for a national IPC e-surveillance solution. This was completed in April 2025. It is intended that this system will have local and national functionality. ARHAI Scotland is contributing to the development of the national requirements for this system to ensure that that intelligence on healthcare associated infections, including unusual organisms and those presenting environmental risk, can be captured and integrated consistently and promptly within national datasets. Scottish Government published a Prior Information Notice (PIN) for the National Infection Prevention Control Intelligence Solution in January 2025 which notifies of intention to tender future planned procurements (**A52969637** - **Public Contracts Scotland - National Infection Prevention Control Intelligence Solution**[7]).

HEAT targets for potentially environmentally related HCAI

29. NSS was asked in an email from the Inquiry dated **26 March 2025** to consider whether there should be a HEAT target for potentially environmentally related HCAI. For the purposes of clarity, the Scottish Government system of HEAT targets monitoring is no longer in place. The Scottish Government issued new standards for HAIs on 27 March 2025 (DL(2025)05) - **A52969638** - **Scottish Government - Update on Standards of Healthcare Associated Infections - 27 March 2025**[8]. The new standards are that there should be no increase in the incidence (number of cases) of *Clostridioides difficile* infection (CDI), *Escherichia coli* bacteraemia (ECB), and *Staphylococcus aureus* bacteraemia (SAB) by March 2026 from the 2023/2024 baseline. These infections were selected initially for HEAT targets and subsequently HCAI standards due to their high incidence and endemicity in healthcare settings.

30. There is currently no national surveillance system in place for monitoring HCAI that are potentially linked to the healthcare environment (other than the requirements to report outbreaks or incidents as per Chapter 3 of the National Infection Prevention and Control Manual). In order to develop HCAI standards, a national HCAI surveillance system with baseline HCAI data would be required. For the purposes of surveillance, the designation of an infection as healthcare associated requires a

[7] Bundle 44, Volume 2, Document 91, page 1377.
[8] Bundle 44, Volume 2, Document 90, page 1375.

clear epidemiological definition. There is currently no agreed definition for designating an infection caused by an organism with a potentially environmentally related source as healthcare associated making development of such a surveillance system and HCAI standard challenging. Furthermore, the assessment of the likelihood of the source being the environmental is complex and requires consideration of the multi-factorial nature of these infections.

31. ARHAI Scotland suggest that rather than national surveillance and HCAI standards, the focus should be robust local monitoring of alert organisms and standardised reporting of incidents and outbreaks involving infections with a potentially environmental source to ARHAI Scotland, in line with Chapter 3 of the NIPCM. This focus on local monitoring, assessment/investigation and reporting to ARHAI Scotland will be supported by the development of triggers to support local monitoring and the proposed national IPC e-surveillance solution.

Declaration

I believe that the facts stated in this witness statement are true. I understand that this statement may form part of the evidence before the Inquiry and be published on the Inquiry's website.

Signed: Shona Cairns Print Name: Shona Cairns

The witness was provided the following Scottish Hospitals Inquiry documents for reference when they completed their statement.

Appendix A

Scottish Hospitals Inquiry - Hearing Commencing 19th August 2024 Core Participants' Submissions

A52240258 - Counsel to the Inquiry's Closing Submissions (available on the Inquiry website)

Scottish Hospitals Inquiry - Hearing Commencing 19 August 2024 - Bundle 21 - Volume 3 - Responses to Expert Report of Sid Mookerjee

Scottish Hospitals Inquiry - Hearing Commencing 19 August 2024 - Bundle 21 - Volume 7 - Substantive Core Participant responses to Supplementary Expert Report

of Sid Mookerjee

Scottish Hospitals Inquiry - Hearing Commencing 19 August 2025 - Bundle 44 - Volume 2 - Expert Reports in Response to GGC Expert (HAD) Report and Associated Documentation