SCOTTISH HOSPITALS INQUIRY

Hearings Commencing
19 August 2025

Day 2
Wednesday, 20 August 2025
Ms Shona Cairns
Dr Dominique Chaput

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10.03

THE CHAIR: Good morning. Before I invite Mr Mackintosh to lead-- I think Ms Cairns is the witness this morning----

MR MACKINTOSH: (Inaudible 10:03:53).

THE CHAIR: -- can I say something about Direction 11? Now, Direction 11 proposed a change in timetable in relation in particular to the submission of closing statements. Now, the intention was to provide legal representatives with further time, but I immediately accept that that failed to take into account counsel's other professional commitments.

Now, I understand informal representations have been made to Counsel to the Inquiry, which he has passed on to me. I see the force of these representations immediately, and what we will do is to revert to the previous timetable which counsel will quite reasonably have constructed their, as I say, professional commitments around.

Direction 11 is no longer on the website and matters will be formalised probably in a further direction, but I regret any concerns that may have been raised by that. The purpose was a good purpose but, as with many good purposes, they have other consequences. So the short point is: we will revert to the timetable set out in Direction 10, although that will be stated more formally probably in a further direction. Now, can I turn to Mr Mackintosh and invite him to lead Ms Cairns as our witness this morning?

MR MACKINTOSH: Thank you, my Lord.

THE CHAIR: Good morning, Ms Cairns.

THE WITNESS: Good morning.

THE CHAIR: Now, I understand you're prepared to affirm. Sitting where you are, can I ask you to repeat these words after me?

Ms SHONA CAIRNS

Affirmed

THE CHAIR: Thank you very much, Ms Cairns. I don't know how long your evidence will take. It's scheduled for the morning. It may or may not take the whole morning. We usually have a coffee break at about half past eleven. If, for any reason, you want to take a break, just give me an indication and we will take a break.

Can I encourage you perhaps to speak a little louder than you would in normal conversation? The room's quite large, you have the microphones, but particularly with detailed evidence it's very important that we hear exactly what

you have to say. So, if I could ask you, as I say, maybe just to project a little more than you would in normal conversation. Now, Mr Mackintosh.

Questioned by Mr MACKINTOSH

Q Thank you, my Lord. Ms Cairns, I wonder if I can take your full name.

A Shona Cairns.

Q You produced a statement.

A I did.

Q Are you willing to adopt it as part of your evidence?

A I am.

Q Thank you. Now, what I first want to do is just to look at your statement, on page 10 of the statement bundle, and just discuss your professional qualifications. We can clearly read them in full, but you describe yourself as a "Consultant Healthcare Scientist/Epidemiologist".

A That's correct.

Q So, how did you come to become one of those? What's the career path to get to be----

A So I've actually worked for the previous guises of ARHAI Scotland for 22 years. So I started-- So I'm a scientist by background; I've got a degree in immunology and pharmacology. So I first started in ARHAI as a data manager, and whilst I was working in ARHAI, they supported me to undertake a Master's in epidemiology, so I have a Master's in epidemiology. We've got a really good career framework pathway within ARHAI Scotland where you can progress through the various-- the various roles, so now I'm a consultant healthcare scientist.

To be able to do that, I had to undertake clinical science registration, so I'm a registered healthcare scientist with the Health and Care Professions Council, which is a similar council to the GMC and NMC. So, I'm bound by the-- the sort of areas of practice and ethics around that, so that's-- that's how I've got to consultant healthcare scientist.

Q Now, you mentioned that you were the clinical lead within ARHAI for, it says in your statement, the HCAISE clinical programme and data intelligence team.

A Yes.

Q We've obviously dealt with a lot of ARHAI documentation in this Inquiry. Could you give us a broad understanding of what that team does? As we go through, I may well ask you, "Is your team, in a sense, corporately responsible for this document or that document?"

A Yeah. So there's two aspects to it. So the clinical programme, which is called the Healthcare Associated

Infection Surveillance and Epidemiology programme, that programme is responsible for producing national level epidemiological evidence. The purpose of that is to reduce healthcare associated infections and to support Infection Prevention and Control, so we produce lots of epidemiological evidence.

We also support boards with epidemiology as well. So if there are outbreaks, we would then support boards with some of the epidemiological work that needs to happen there, and we're responsible for the National Mandatory Surveillance Programme as well. So that all sits within the clinical programme. The Data and Intelligence team is----

Q So, just before we go a bit further, the National Mandatory Reporting Programme----

A Yeah.

Q Now, I may have got the numbers slightly wrong, but there was a point when that was four particular micro-organisms.

A It is currently three organisms----

Q Three? And what are the three that are currently in the----

A So, Staphylococcus Aureus Bacteraemia, we have E. Coli Bacteraemia, and C. Difficile Infection. I should mention actually that surgical site infection surveillance was part of that programme, but that was paused during the pandemic to support the pandemic response. The programme at the moment is under review. We're----

Q Before we go into that, just one thing: you're a fast talker.

A Sorry.

Q Speaking as a fast talker, I'm conscious that his Lordship has to take notes and there's someone doing a transcript out there, and so if you can just slow it down a little bit, then it will make everyone able to understand more. So you were telling me about it being under review.

A Yes. So we're undertaking a national review of surveillance at the moment. That's a request from Scottish Government as part of their Healthcare Associated Infection Strategy. So we are revisiting what's included in the National Mandatory Surveillance Programme to make sure that the surveillance that we have in place is focused in the right areas.

So we're prioritising what we want to look at. So that's under review at the moment and surgical site infection is part of that review to determine what we need to do in terms re-implementing that, if that's where we want to put the surveillance resource.

Q Okay. Now, before I pulled you off to the three micro-organisms

being nationally reported, you were about to turn to the Data and Intelligence Team, what they did. So what do they do?

A So the Data and Intelligence Team are a team of epidemiologists, healthcare scientists, and data managers. So they are the engine, really, for producing the evidence. They undertake the analysis, so they support both the Healthcare Associated Infection Surveillance and Epidemiology programme, but they also support an AMR, Antimicrobial Resistance and Use programme as well. So they're the service that provides the data and intelligence.

Q So when we've been asking, say, Ms Imrie or Ms Rankin about reports they were involved in producing, whilst they might well have been involved in defining the scope and understanding the outcomes, the actual engine of the calculations is run by that team.

A It is, yeah.

Q Right.

A Yeah.

Q Now, you produced three reports for this Inquiry at our request, for which we're grateful. I think it's important that we just identify them formally. So the first one, if we just have the front pages, is bundle 44, volume 2, document 45, page 685. This is a report by you produced at the request of the Inquiry commenting on the HAD report.

A Yeah.

Q Are you willing to adopt that as part of your evidence?

A Yes.

Q Yes. The next one was a supplementary report on Aspergillus calculations, and that's in bundle 44, volume 3, document 5, at page 222. That might have been the right volume. Yes, page 222. Yes. So this was produced by you on 20 June 2025, and you're willing to adopt that as part of your evidence.

A Yes.

Q We'll come back to it, don't worry. Then, finally, you produced a response to a series of questions we asked you to calculate, which is bundle 44, volume 8, document 1, page 3. This was a result-- a request actually drafted by me for a particular bit of information on 1 August. Now, I appreciate that that request was made by us, and I will ask you about interpretation because, obviously, we didn't ask you interpretation questions in it. Are you willing to adopt the calculations as part of your evidence?

A Yes.

Q Thank you. What I want to do is just-- I think we've already almost answered this, but we're going to go back to a particular document. Last year we looked at the October 2019 review of infection rates in paediatric haemato-

oncology, which is bundle 7, document 6, page 214. Now, this is the draft version, and we took most of the evidence about what happened in it from Ms Imrie in the Glasgow 3 hearing. What involvement did you and your team have in producing this?

A So, the Data and Intelligence team produced the report. At that time, Laura Imrie was the clinical lead for the program that I am now the clinical lead for. I was on the periphery of this report. I was involved towards the end because of the very short turnaround to produce the report, so I wasn't involved all the way through, but I was involved towards the end. I'm now the clinical lead for the programme, and the team that produced the report have advised me all the way through the Public Inquiry to make sure I'm cited on it.

Q In the closing statement from NSS in the Glasgow 3 hearing, a misunderstanding that I am told I have made-- I was corrected on something, and I want to explore it with you to make sure I really understand it properly. It relates to the average line on these charts. If we could go to page 229 and, in fact, look at-- I'll go to 230 and look at the top half of the page, Figure 6. I'm not going to ask you to interpret this, but this is a chart, seemingly a "SPC chart using the environmental including enteric case group definition from HPS data from July 2013 to September ['18 (sic)]."

Now, the light blue line that appears towards the bottom of the chart, just above "2" on the label on the left-hand side, is described as "average", I think, on the right-hand side. Is that how I should read it?

A Yes.

Q Now, I want to make sure I really understand how that average line is calculated. Is it, as I thought when we finished the hearing, calculated as an average of all the data points on that chart, or is it, as I am told by NSS's counsel, calculated by an average-- if I understood her correctly, of the average of everything, as it were, before the move to the new hospital?

A That's correct. The average of the rate in Yorkhill before the move.

Q Right. So, I'm not going to ask you what the meaning of "breaching an upper warning limit" because I had that from Ms Imrie, but just to put it into context, that upper warning limit line is driven to some degree by that average. Have I understood that correctly?

A That's correct, yeah.

Q Right, okay. That's helpful.

THE CHAIR: Can I just make sure that I've got this, because I was looking at something else? The upper warning-- Right, maybe two steps. The line which

is an average is the-- is that the count, the sort of----

A It's the rate per thousand bed days.

THE CHAIR: Sorry, can you just give me that again?

A The rate per thousand bed days.

MR MACKINTOSH: So, it is at around about 2.6 or something on that chart.

A Yeah. So, the-- the blue line is the average rate per thousand bed days in Yorkhill before the move.

THE CHAIR: Right, and that's parallel with the X-axis?

A Yes.

THE CHAIR: Right, and the upper warning limit is the orange line?

A That's correct.

THE CHAIR: Right. Sorry, Mr Mackintosh, I was just a little bit behind you----

MR MACKINTOSH: Just for completeness, what, as it were, mathematically drives the upper warning limit in any particular point?

A Yeah, the upper warning limit is two standard deviations from the mean, and that will vary because the bed days vary.

Q Right, so if the bed days were consistent, the upper warning limit would be a straight line?

A That's correct.

Q Because they vary slightly, the upper warning limit varies slightly?

A Yes.

Q Right, thank you.

THE CHAIR: Let's take that again. The upper warning line is two deviation points----

A Yeah.

THE CHAIR: -- from-- two standard deviation points----

A Yes.

MR MACKINTOSH: And then we----

THE CHAIR: -- from----

MR MACKINTOSH: Sorry, my Lord.

THE CHAIR: Sorry. From the average?

A Yeah.

THE CHAIR: Right.

A Yeah, from the Yorkhill average.

THE CHAIR: Yes, and the reason why it varies is reflecting bed days.

A Yes.

THE CHAIR: Right. It may be that I ask these rather pedestrian questions, but I'm quite keen to get the exact answer.

MR MACKINTOSH: Now, it's worth, just for completeness, what is the method of calculating the upper-- is it upper clearance limit or the upper----?

A Upper control limit.

Q Control limit. What----

A That's three standard deviations from the mean.

Q Now, I'm going to come back, as we go through all these documents I put to you this morning, about different methods of understandings of statistical significance. Now, I wonder if you can explain to us why measuring two or indeed three standard deviations is a useful thing to do.

A So, whenever you measure anything, any data, there is inherent variation, random variation in-- in anything that you measure. The standard deviations, the-- the upper warning and the upper control limit, allow you to consider your data alongside that variation. So, if you have a point, for example, outside of a control limit or a warning limit, that is outside what you would expect whilst accounting for random variation.

So it allows you, when your numbers are small, to be able to take-- because when-- when your numbers-- when your data is a small data set, you have more random variation built into that. So the control limits and the warning limits allow you to account for random variation in that, so if you have a point that's outside of the line, then you're seeing something different. It's-- it's, for example, a higher rate than you would expect based on random variation.

THE CHAIR: Is that derived from a statistical principle, or is it a question of policy?

A It's a statistical principle.

THE CHAIR: Right. Thank you.

MR MACKINTOSH: Okay. Now, we're going to come to other methods of measuring statistical significance as we go, and what I will ask you as we go is to discuss the differences and the merits of each one because, unhelpfully, people have picked different tools to measure this, but what, if anything-- No, I've asked, specifically, this question already, so I'll move on.

I'd like to discuss, before you move on to the substance of this, and I-- take it off the screen, please. What sort of knowledge do you feel you have about issues around where the patients were placed in the Queen Elizabeth and Children's Hospital in '15 to '20, how the water system was or indeed wasn't managed, what the reaction was to the water-- How much context do you feel you have, in case I'm going to ask you questions that require context?

A Yeah, I have-- I have context. I'm aware of the various controls that were put in place. I might not be able to rhyme off all of the dates, but I think it's important to acknowledge that the HPS

reports were written for the IMTs, so all of the epidemiology within the HPS reports were considered in the context of the controls and the changes over time. It wasn't looked at in isolation.

Q Thank you. Now, I'd like to discuss a sort of slightly odd topic that-- it's been-- I think been confusing me, is there have been a number of different studies done, and these include, at the time, Ms Harvey-Wood and Dr Peters, Dr Kennedy in '18 and '19, at least I think three different HPS exercises in '18 and '19.

Then comes Mr Mookerjee, and now we have the HAD team and Dr Drumright. I think a lot of the questions that I've been asked to ask all these people along the way involve a discussion of the detailed merits and demerits of individual decisions they took in choosing case definitions, choosing denominators, choosing numerators, deduplicating, and at one level it's quite hard to know where to react.

I suppose it occurs to me there might be two ways to react to all this information. It might be that some of these criticisms are so fundamental as to render a particular piece of work entirely useless to us, but some of the criticisms might be such as to just make us need to think about it a bit more, or take it against something else, or take account of a particular weakness.

Now, in that context, we'll come to the HAD report in detail in a moment, but just looking back, when you look at Ms Harvey-Wood and Dr Peter's work, and Dr Kennedy's work, do you see them as slightly different from the HPS approach but worth looking at, or something that's got a fundamental flaw?

A I don't think there are fundamental flaws. I think they have just done something slightly different to the HPS report.

Q We've obviously got NSS's submissions about Mr Mookerjee's comparator exercise, which I have been heard to say is, "NSS didn't feel it could be done. He's done it, and you've pointed out the reasons why you probably shouldn't have tried," in essence. What do we do with something like Mr Mookerjee's exercise given the flaws that you and your team have identified in it? Do we put it to one side or do we use it in a particular way? How should we react to this submission from your organisation?

A So, I think there are elements of the report that have fundamental issues. I think particularly the-- the correlation. I think the---

Q So that's the correlation with the water testing result?

A I think so. I think there are-- I think there are a lot of limitations around

that analysis that perhaps weren't acknowledged.

THE CHAIR: Right. Again, I'd like to take this particularly slowly. This is the water positivity, right?

A Yes.

THE CHAIR: So could I just ask you to repeat that? I apologise in advance. I'm going, possibly, to continue to make these interventions, but it's in an effort, really, to understand what you were saying. Could I just ask you to repeat what you said about the water positivity?

A Yeah, I think there are fundamental issues with-- with that. I think the-- I think the availability of data----

MR MACKINTOSH: So is this the number of water tests, effectively?

A Yes. The-- the number of water tests, the-- Yeah, certainly early in the exercise, there were a very small number of-- of water tests. I appreciate the-- the data sets were particularly challenging to work with, I think-- the water results, as I understand it. I think the-- the final graph is really helpful. I think that-- that----

Q That was the one that was produced at the hearing day?

A Yeah.

Q So, I'm going to just confirm it because I don't want to get confused. Can I ask my colleague who has had no warning of this to look at bundle 27, volume 18, I think page 3. Is that the one you mean?

A Yes, yeah.

Q Yes. So, what's helpful or not helpful about this?

A So, I think the combined rate for Schiehallion overall per thousand admissions, so the-- the pink line----

Q That's one towards the bottom of the screen?

A Yeah, I mean, I think the 2A and 6A infection rates are-- are quite difficult, and I know that there's been a lot of discussion around whether that was the right thing to do. I don't think the comparison between----

Q Sorry, before we go on, so what should we do, from your point of view, with the pink line by itself?

A I think we should use that as----

Q Right, okay. So, you were about to move on to something else?

A Yeah, so----

THE CHAIR: Sorry, can you clarify for me that point?

MR MACKINTOSH: So this is the overall Schiehallion rate line per thousand admissions. What are you saying that we do or don't do with that particular information, Ms Cairns?

A The overall Schiehallion, I

think, is probably a more robust measure of the incidence.

Q Okay.

THE CHAIR: Right, and when we're talking about the overall Schiehallion rate, that is what, at least on my screen, is purple rather than----

MR MACKINTOSH: I've been calling it mauve, my Lord, but----

THE CHAIR: Well, mauve is entirely acceptable, but it's the line that includes "25.70".

MR MACKINTOSH: Yes. I think Ms Cairns is nodding----

A Yeah. Correct, yeah.

THE CHAIR: Yes.

MR MACKINTOSH: Now, you were moving onto something else, and that's why I stopped you. So, are you about to say something else about another part of this chart?

A Yeah, I mean, I-- I think the benefit of the overall Schiehallion rate is the consistency around-- around that measure. So, whilst there may be some challenges around interpretation of the rate numbers, I think it's more about the trend. And, similarly, with the overall comparator institution rate, we have had questions about how comparable they were, and I think probably comparing the actual rate between the comparator and Schiehallion is problematic for that reason.

Q So, again, I'm going to unpack that. So, comparing the overall Schiehallion rate, the mauve line, with what? What's the one you've----

A The orange dashed line, "Overall"----

Q Yes, so it's the average that you think is the problem, comparing it with the average. Would you compare it with them all separately?

A No, I-- I think the actual-- the-- the absolute rate number. So, for example, in 2017 comparing 25.7 with 10.21 is problematic----

Q Right.

A -- because I think where we got to with the freedom of information requests is that there maybe was some inconsistency around how the institutions had responded, but what I think is important here is looking at the trend over time. So, within the comparator institution, there's a fairly stable trend. In the Schiehallion unit, we see an increase with a peak in 2017, and then a downward trend.

Q Could this be you're saying that you're not-- you're worried about using the numbers, but you're interested in using the shapes?

A Yes.

Q Right. Whilst we're talking about this chart-- We'll take the chart off the table because this is a more

philosophical question off the screen. I don't think I really appreciated the task in understanding these big databases. It wasn't until-- and this is not intended as a particular dig at Dr Drumright.

It wasn't until she explained in her answer a stage she hadn't done when she produced one of our tables that it occurred to me that, actually, it is quite a process to understand a big database. Now, you're nodding. There's a nice transcriber who can't hear that. What is the process that you do within ARHAI faced with a 200,000 row spreadsheet of bloodstream infection results. So what do you do in order to get the output that might produce, as it were, a nice chart?

A So, we have a-- we have a team of really skilled data managers, and that's their bread and butter. So they would have-- for example, we use ECOSS. They have access to the ECOSS----

THE CHAIR: They use?

A The ECOSS national database of----

THE CHAIR: Right, yes.

A So, that would be where we would get the-- the data about----

MR MACKINTOSH: That's coming in from laboratories around Scotland?

A Yeah, that's right. So it's a-- it's a national database, and they have feeds in from the diagnostic laboratories and reference laboratories. So that all sits within a database in Public Health Scotland. We have access to that database, so our data managers are able to go in and get an extract of the data for whatever piece of work that we are working on. They would bring that into whatever data management or statistical package they're using.

They would write code, and we have standard code now for bloodstream infections because we use the same 14-day case definition, and they would run that so that the-- the system would automatically identify the-- the bloodstream infections that need to be included in the analysis.

Q So, in terms of truism, the code you write, to some degree, defines the output you get.

A Exactly.

Q If another person or unit wrote code to identify cases and deduplicate, or the other way around, one would hope they would produce the same answer, but they might produce a different answer.

A If you had two people working on the same data set with the same case definitions, the same 14-day definition, they should come up with the-- the same answer.

Q Yes. The way that the data is coded in the database, if it wasn't something they were familiar with, would

that cause them any problems, because I noticed that in the data set, which I now have the-- I've now looked at, there's a column, Column L, I think, where multiple positive results are listed in the same field?

So you get a four-digit, five-digit code for a particular microids, and then a comma, and then another one, and then another one, another one. Does that ever cause any difficulty to your team, in extracting data from in there, to make sure you've counted the right ones?

A That-- That is not how the data comes through from ECOSS. If that were the data that the-- the team were working with, they would very easily be able to separate those into individual species-level data to be able to do the----

Q But they would have to know how it came?

A Yeah, they would have to know how it came, but that's the first step with data management, is you look at your data and you work through what you need to do, you plan what you're going to do with it, you write your-- you can write your code in advance, you would write a plan of analysis, and your first step within that is-- is data management, and you would understand the underlying data.

Q Now, I can't put the data sets into a bundle because the first column is everyone's CHI number, but if I'm right that this column lists multiple organisms in the same field, are you saying that that's not how ARHAI receives it? You get it in a different way?

A We get one row per organism, but you can very easily take that row-- from what we've seen from the-- the data that's been submitted as part of this, you can very easily separate those, for example, three organisms in one row into three rows, and that would be how we would manage it if that were the data that we had received.

Q Can you think of a reason why the data provided to Dr Drumright and the data provided to Mr Mookerjee by NHS Greater Glasgow was provided in a polymicrobial way with multiple codes in a single row as opposed to the way you get it?

A I-- I'm not sure how the data come into ECOSS from the laboratories. There's a-- a big team within Public Health Scotland, an IT team, that maintain the ECOSS database. They may well get the data in that format, but they would do the work in the background.

Q I see, okay.

THE CHAIR: Can I-- This is me being slow. What you're asking Ms Cairns to consider is a method of presenting raw data of infections in the form of a spreadsheet.

MR MACKINTOSH: Yes.

THE CHAIR: You're asking her to consider a spreadsheet which has one row, representing, presumably, one episode----

MR MACKINTOSH: One blood test.

THE CHAIR: One blood test, I beg your pardon. In the event of that one blood test revealing, let us say, three infections, so it's polymicrobial, or three organisms, that is presented as a spreadsheet with one row but three separate infection codes?

MR MACKINTOSH: All in one field in the spreadsheet.

THE CHAIR: All in one field, and when you talk about "a field", and I apologise for my slowness on this, you're talking about cell----

MR MACKINTOSH: A cell in Excel, yes.

THE CHAIR: -- one cell in a spreadsheet, and Ms Cairns is saying, well, that is not the way it comes from ECOSS.

A Correct.

MR MACKINTOSH: But it might be the way it comes to ECOSS. She doesn't know.

A It might be.

THE CHAIR: Yes, right. Again, apologies to everyone for being pedestrian, but if I'm not pedestrian I don't necessarily follow it.

MR MACKINTOSH: (To the witness) You mentioned that ARHAI now has a standard code. When did you bring that in?

A Yeah. I think we've-- I think we've probably always had it because we've always done the same thing, but when we're doing analysis now, we are better at sharing code between different projects. Anything that's a-- a bacteraemia or a bloodstream infection analysis, we use that code.

Q Because----

A It's a line of code, I suppose, rather than a-- an actual package of code.

Q So, this question is one you haven't had notice of, and if you want to look at me blankly and go, "I can't possibly answer it," you're more than entitled to go away and think about it and send us in a note. I have a recollection – which might well be wrong, but I'm sitting here now – that some of the charts between the three different HPS infections had slightly different shapes of their lines for the same notional groups of bugs. Is that something that rings a bell with you?

A I-- I suppose one of the things, and I can't quite remember, for the reports that are not the haemato-oncology October 2019 report-- So, that

report has in it groups of organisms.

Q It does.

A So the report-- The-- The measures within the graphs are not species-level; they're groups of organisms. So, they have been deduplicated at group level so that we were-- for example, the environmental organism SPC chart, we had one environmental organism within the 14-day period rather than multiple, and the reason that we did that was because there were patients with polymicrobial episodes, so we used a grouped----

Q I think we can see that in-- back to bundle 7. If one goes to page 255, I think we have the definitions there. Is that what you're meaning, "the groups"?

A Yes.

Q And I think, in the earlier report that was done, I think with the role for Ms Rankin in it, we heard about it yesterday from her, we see that on the same bundle, page 205 and over the pages. Are those the groups you're talking about?

A Yes. The haemato-oncology report had an additional category added.

Q It does. It does, yes, the one that's called "environmental and enteric", I think.

A Mm-hmm, yeah, but that organism list is different, actually, as well, between situational assessment and the haemato-oncology report.

Q Right, okay. Well, then, I think I'm going to ask you a much broader question. To what extent should this Inquiry worry about small differences between the definitions of these groups, given that the CNR has got a different list and Dr Mumford has a different list and Professor Hawkey has a different list?

THE CHAIR: These are groups of organisms?

MR MACKINTOSH: Groups of organisms.

A I think, internally within the reports, it is not a problem. I think if you were trying to compare the number of infections between the reports – that's total number of infections between the reports – that-- that would be an issue with comparability. The organism lists are-- have evolved and they continue to evolve, and the more data you look at, the more environmental organisms you identify, so the list-- the list grows.

When you pull an extract of data from ECOSS or from another laboratory system, there isn't a nice master list that covers all organisms in the world. You will find ones that don't fit nicely into the categories that we've got listed here, and you have to look at that organism and say, "It should live in gram-positive," for example, or you might want to consider

whether it's an environmental-- or an organism with a potentially environmental source, in which case you would need to have a look at the literature.

I would talk to consulting microbiologists or Infection Control doctor, and we would say, "Okay, we think that needs to live in the environmental organism list going forward."

Q So, the question that comes to me is that, ultimately, I've got to make sense of all these different charts, and if we just recap, Dr Kennedy gave evidence that the original list he had – I won't take you to it – came from Dr Inkster and it was linked to the 2018 case definition for the water incident. You recollect that?

A Yes.

Q Yes, and then we've just looked at the situational awareness list, which is on page 205 of bundle 7 – no need to put it on the screen – and we've just looked at the list from the October 2019 report, and they're a wee bit different.

The list in the mycobacterium SBAR is also different as well. Then we've got Dr Mumford's list from the Inquiry's report, and although no one produced a chart from it, we've also got the CNR's case definition. You're nodding your head. Then we finally got Professor Hawkey's list which underlines-- "environmentally relevant", he calls it.

A Mm-hmm, yeah.

Q Now, if we go to-- same bundle 7, if we go back to page-- I think it's 219 again. I'm sure colleague counsel will correct me in submissions that I've got this wrong, but I got the impression from the evidence of a number of witnesses including Dr Mumford that the environmental including enteric group was the group that came closest to her list and the Case Note Review's list. Now, is that something you recollect being evidence, or are you just taking it on trust from me at this point that's a statement of what someone else said?

A No, I-- I would agree with that, and I think the environmental enteric list is also most aligned with the HAD report as well.

Q Right. To what extent and what constraints am I under if one wants to compare----

THE CHAIR: Sorry, Mr Mackintosh, it's just my failure in noting. We're talking about how close lists are, and the environmental including enteric list comes closest to the----

MR MACKINTOSH: HAD report?

A Yes.

Q And Dr Mumford?

THE CHAIR: And Dr Mumford.

A I would need to look it up, yeah.

MR MACKINTOSH: No, okay, fair enough. I'm not going to push you on it. What about Dr Kennedy?

A Quite different from Dr Kennedy.

Q Quite different from Dr Kennedy. What about CNR?

A I-- Yeah, it would be closer to the CNR because that was gram-negatives.

Q Okay. So, the reason that I'm asking that question is, at some point, I've got to make a submission to his Lordship about how to use all these charts, and let's imagine that I hear from sufficient people with expertise that one can see a comparison between some of these groups and the environmental including enteric group in the October 2019 paper. How do I compare the charts? Do I look at actual numbers, or do I look at trends? What's the thing that you think is the point where you look at them and think, "Oh, these are interestingly different or similar?"

A It has-- It has to be trends.

Q Right.

A The-- The numbers and rates will be different if the organism lists are different, so the trends are-- is the important bit if you want to look across the reports.

Q Right, and when we say "trends", is that, for example, best exhibited by a best-fit line, whether linear or smooth, that's significant, or step changes in rates around events that seem important?

A I think it's probably important to look at-- to look at both. I think there's quite a lot of limitations with the modelled lines.

THE CHAIR: Sorry, give me that again, "Limitations with"----?

A Limitations with the modelled lines. So, there's, I think, two or three different types of models that have been created to describe the trends.

MR MACKINTOSH: We're going to come to those after the coffee break.

A Yeah.

Q Right, but you were-- I think you're about to go on.

THE CHAIR: Sorry, sorry, we interrupted you.

A Yeah. Yeah, I think-- I think both. I think the modelled lines are interesting if you interpret them in the context of the limitations, but I think looking at the data as well, but also looking at all of this in the context of what we know about the clinical situation and the environmental situation.

So these graphs are really just one piece of the jigsaw, as-- as far as I'm concerned. If you're looking at the graphs, you have to understand the wider context. The HPS reports and graphs

went to the IMTs, so they were discussed with the clinicians, they were discussed with the other experts on the IMT. The graphs with the modelled lines are mainly being looked at in isolation, and I think that's-- that's challenging with epidemiology.

MR MACKINTOSH: So you need to have the context is your effective core point?

A Absolutely.

THE CHAIR: Can I just take the opportunity to get a definition that I can understand of modelled lines? My understanding is that it's an attempt, with the assistance of software, to represent trends in a smoother and more visually accessible way than what would be the alternative. So, maybe I need to know what the alternative would be.

A So, the-- the models that are being created are trying to describe the trend using maths in a way that is taking away some of the, sort of, dispersion of all of the different rates. It's trying to say that, "This is the"-- "This is the best maths for me to describe what's happening with the data." I don't think that's answered that, sorry. Your question----

THE CHAIR: Right, okay. So it's----

MR MACKINTOSH: My Lord, might we come back to this when we're looking at the chart?

THE CHAIR: Certainly, certainly.

MR MACKINTOSH: It might be more use----

THE CHAIR: I didn't want to leave the expression "modelled"----

MR MACKINTOSH: No, I think we're going to have to discuss it, but it might be easier to do it with the charts in front of us and then discuss them.

THE CHAIR: Okay, yes.

A Yeah.

MR MACKINTOSH: I'd like to just talk for a moment about numerators and denominators. You've obviously produced the reports, we've read the reports. I wonder if we can go to bundle 44, volume 2, your report, page 691.

Now, you've given a lot of thought into the choice of enumerators and denominators in the HAD report. By way of context, when we're asking detailed questions, what's your primary concern or concerns about the way that the HAD report have approached the selection of numerators and denominators for adult patients?

A So, for adult patients, the way that the infections and activity have been identified is based on the-- the consultant and sector. So, as I understand it from the raw data that were provided by Glasgow, Dr Drumright was provided with inpatient-- inpatient stays, and when you look at underneath that, the infections

and-- So the numerator and the denominator have been extracted based on the consultant of the patient.

Now, that doesn't account for the location of the patient. So, we know from-- particularly from the adult data, some of the infections were identified in locations outside of haemato-oncology, both in Queen Elizabeth and in other hospitals as well. So the denominator is not representing haemato-oncology location necessarily.

Q So, there's a particular issue that I think you set up in paragraph 3.2.5.3, which is on page 694. Top of that page, 694, you at 3.2.5.2, you point out that, in this paper, a lot of the results have a location of "General outpatients Queen Elizabeth". Then you express a concern in 3.2.5.3. Was this an issue that was then resolved by the HAD in their response, or have I misunderstood?

A 3.2.5.2 was resolved. I think Dr Drumright acknowledged that, so I think that one we resolved.

Q So, when you say-- Does it mean that you're wrong or she realises it's true? What do you mean by "acknowledged"?

A I can't quite remember if that's the one where she had said that I was mistaken. It could be that one.

Q Well, her response is in 44, volume 5, page 32, and it's paragraph 2B.4.

THE CHAIR: Could you give me that volume again, Mr----

MR MACKINTOSH: 44, 5, my Lord, page 32, paragraph 2B.4. (To the witness) So, I think this may be a suggestion from Dr Drumright that you were mistaken.

A Yes. So, Dr. Drumright confirmed the data set that had the correct data in it. The problem that I had was there were two other data sets listed in her response to one of the documents.

Q Yes, we asked her some questions about what data she used and she responded.

A Yeah, yeah. So, there were-- there were three data sets listed there that talked about denominators, and in one of them it had the correct assignment of the BMT patients and two were, as far as I could see it, they-- they weren't correct, but Dr Drumright confirmed that she had used the data set that was correct, so----

Q Can we take that off the screen? Am I right to understand that what she has done and what this conversation has clarified is that they picked the patients based on the identity of the consultant, which sector they were in, and they picked the occupied bed days for the identity of the consultant and

which sector they were in?

A Yes.

Q So the two match?

A This particular issue was that some of the bed days in 2016 and ’17 had been assigned to Queen Elizabeth when those patients, the BMT patients, were not in Queen Elizabeth. It was a very specific issue that----

Q So that has been resolved?

A That has been resolved.

Q Are you still concerned that by picking consultant and sector, you will have bed patients having infections when they’re not actually in the Haematology ward?

A Correct.

Q Correct? Right.

A Similar with the activity. Some of the activity will be bed days that are outside of haemato-oncology.

Q Right. Does this have echoes of the difficulties that Mr Mookerjee was having identifying where the paediatric patients were in his exercise? If I recollect, he had patients who he didn’t realise that the Clinical Decision unit had been used for a short period, and he had patients who should have been in 2A but were elsewhere in the building. Is this the same sort of territory of confusion, or are we talking about something else?

A It probably is. I think the-- I think the challenge has been-- for both Dr Drumright and Mr Mookerjee, is that the information that they have, and I think Dr Drumright talked about, she had been advised that ward level data wasn’t robust. So, I’m not entirely sure, because I haven’t seen Mr Mookerjee’s data that he used, but if he had the same data set, he may have the same issue. So, the data set from Glasgow that Dr Drumright used had a row in it for every inpatient stay, and within that it had the admission ward and the discharge ward.

Q I mean, a column rather.

A Yeah, a column for admission ward and discharge ward, and also the length of stay for the entire stay. So that was where I had noticed that some of the admission wards were not in haemato-oncology and some of the discharge wards were not----

Q I think I can suggest to you what happened with Mr Mookerjee’s, and I’ll work out a way of getting him to explain that in evidence. He had a bloodstream results database of 215,000 rows, but that contained no admissions information.

He had an entirely separate document provided by the Health Board which reported the number of admissions and occupied bed days in each ward. So what he attempted to do is to match bloodstream infections in, effectively, 2A with the bed day and admission data he

was being given for 2A.

A Yeah.

Q That's a rather different approach to what Drumright's done.

A Yes, very different.

Q Yes, and it ended up having its own problems, but maybe we won't go into those now. Staying with Dr Drumright, to what extent does this issue about the matching of activity and infections-- which seemingly also applies to some extent in the paediatrics, how does that impact, to go back to our original question, the value of the exercise that Dr Drumright has carried out?

A So I think she's actually measuring something different. So based on the information that she provided subsequently, I think it was confirmed that the denominator and numerator were both based on consultant. So what is actually being measured here is the incidence of infection for haemato-oncology patients with a haemato-oncology consultant.

Q Not patients in a particular ward?

A Exactly, yeah.

Q Now, going back to the category I sort of imposed on you of things that are problematic that you probably shouldn't use, or things that you should use with acknowledgement to

what their weaknesses are, where does this put her work for adults?

A I don't think it's hugely problematic as long as we understand the impact of undertaking the analysis that way. I wasn't able to determine from the raw data how much of that activity and how many of those infections were outside of haemato-oncology locations. I think the problem with the analysis is, if the hypothesis is about the location, you're not actually describing the infection rates in the location.

Q In respect to the adult patients, what do you think the hypothesis was in HAD?

A I think they were trying to look to see whether there was an association between the bloodstream infections and contaminated water system.

Q Would it matter to the usefulness of the-- I mean, they had North Sector, South Sector and BMT, and North Sector was clearly never in the hospital, so I would imagine it's a control of some sort. I'll ask Professor Hawkey about that, and you're nodding.

A Yeah.

Q And South Sector was in the hospital, so again that doesn't-- That's not my question about that. The question is about BMT. Would it matter that, as far as the Inquiry understands, apart from those five weeks in the summer of 2015,

the BMT patients, adults, didn't go into the hospital until after the filters were on the taps? Would that affect the value of that hypothesis, the test? Because they weren't exposed to the water system in the same way.

A Yeah, I think-- I think that is problematic, because they-- Yeah, so their time at the hospital was after the-- it was two months, I think, June and July 2015, when they were in Queen Elizabeth----

Q Yes.

A -- and then after-- they moved back was after the environmental controls had been put in place. So, yeah, I don't think the BMT patients are going to be a good way to look at whether there's some sort of association between water and infection rates.

Q But the South Sector patients were exposed to the water system from the moving?

A Yes.

Q Yes. Right. This is probably a good point to stop, my Lord, for a coffee break, because I was going to move on to----

THE CHAIR: Yes----

MR MACKINTOSH: Is it a bit early, or----?

THE CHAIR: If the clock is correct, it's quite an early----

MR MACKINTOSH: No, no. I'll go on for another 15 minutes. I've just got a big chunk. We'll do the big chunk and then we'll stop, but I'm just sort of----

THE CHAIR: Right. I mean, I'm in your hands, Mr Mackintosh, but let's see what we can do.

MR MACKINTOSH: Let's move on to paediatric data.

THE CHAIR: Just on the BMT point, I'll try to maybe just summarise to make sure that I've understood it. As we understand things, the adult BMT patients were in the Queen Elizabeth for about, as Mr Mackintosh has said, five weeks in June and July of 2015.

They then went back to the Beatson and were not exposed to whatever the conditions in the Queen Elizabeth were. They came back to the Queen Elizabeth in June 2018, after which GGC had taken certain measures to change the conditions. So other than the five weeks, they were never exposed to the unchanged conditions. Yes?

A Yeah. So if you want to look at the-- the association between an exposure and infection rate, you can't only look at an exposed time period.

THE CHAIR: Mm-hmm. Yes.

MR MACKINTOSH: So the South Sector have the potential to be a useful comparator, because they have before '15 in the Beatson and then after '15 in the hospital.

A Yeah, potentially. Yeah.

Q Would you look the whole period they were in the new hospital----

THE CHAIR: Mr Mackintosh, can I look for help? You use the expression "South Sector" because that's the HAD----

MR MACKINTOSH: I mean 4C, my Lord.

THE CHAIR: Ward 4C, yes.

MR MACKINTOSH: So when I say "South Sector", I mean adult haematology not in the BMT, were in 4C, but at the very beginning there was talk of them being in 4B, but they are a 4C group?

THE CHAIR: Yes.

A Yes.

MR MACKINTOSH: For the purposes of just connecting our memory, our principal witness amongst the consultants is Dr Hart, who has given written statements.

Now, those patients were exposed to whatever was going on in the water from the move, so it has a comparison with the period before the move. Is that something that you----

A Yes.

Q Now, this is the first point I get to ask you about comparisons just between two hospitals. Is it legitimate to compare the rate of infections that the 4C patients in South Sector haematology, who are exposed in the new hospital, with their experience in a different hospital with a different water system? Is that a legitimate comparison to take?

A I think it's-- I think it's difficult, and I think it's probably a similar issue to Yorkhill and RHC. So you're comparing an older estate with a new, state-of-the-art facility, so you're immediately-- Yeah, I think-- Yeah, there are some challenges with that. There's other-- There's other problems along the way as well in terms of, is the patient population comparable over time too?

Q So if you assume that it is----

A Yeah.

Q -- on the basis of, no one told it isn't, but no one checked either, and you have a different water system, you've still got the comparison issue between the two hospitals you just mentioned.

Now, when Mr Mookerjee tried this with the English comparators, he was criticised on the basis that they were all different. So that Cardiff and Vale lots were small, Great Ormond Street had a different age profile, and only Leeds was comparable. I think this was Professor Stevens' evidence. Does that same issue apply here or not?

A Not as much, because the patient population, as you say, is more likely to be similar between before and after. At the simplest level, if you're interested in a potential contamination in

the water system in-- in one hospital versus the other, then, you know, you can make-- you can make that comparison, but there are limitations around that as well that you would need to understand. Again, it's about the clinical context and the environmental context as well, and that information being interpreted together.

Q What about using the hospital, the Queen Elizabeth, at its own control? So rather than worrying about what happened before the move, you simply compare the rates before the water interventions with the rates after the water interventions and see if there's a difference. Would that have any merits or demerits?

A Yeah, absolutely. I think it's-- You're effectively doing a before and after study. There's an intervention that's put in place. That's something that we frequently do with-- with epidemiology.

Q Now----

THE CHAIR: Yes, can I just essentially ask you to confirm that? Comparing events, outputs, before an intervention and after an intervention is a classical question for an epidemiologist?

A Yes, yeah.

THE CHAIR: Yes.

MR MACKINTOSH: Now, if we move to paediatrics, there are two issues I want to pick up with you, one of which is

the actual occupied bed day data that was used, but before we get to that, which you've raised in your-- after we asked you some questions in your final, third report, but just staying at sort of a higher level, what are your concerns, if any, about the choice of numerator and denominator in the paediatric part of the HAD report?

A Similar issue.

Q To the adults?

A To the adults, yeah. They-- I had a question and Dr Drumright confirmed that actually a consultant had been used for both the denominator and the numerator, so that concern that had been in my report had been resolved, so she confirmed that both----

Q This is for the paediatrics?

A For the paediatrics, yeah. It's a similar issue. There were infections that were in other locations, not in haemato-oncology, and also some of the activity was for other locations as well. So again, it's not describing the infection rate in the haemato-oncology location, it's describing the infection rate in patients with a haemato-oncology consultant.

Q If we go to the HAD report, and we go to bundle 44, volume 1 – and I use a sort of visual aid of looking at a table just to illustrate the question I'm asking – and we go to page 97, we see this table which appears in the report which lists all

the infections that, subject to that caveat with Dr Drumright, we discussed about the actual data she used in de-duplication. Do we see here that for example if on the "Wards" column there are some locations that are not in Yorkhill, Schiehallion ward, and for the Queen Elizabeth there are some locations that are not in Wards 2A or 6A or 4B, depending on time?

A Yes.

Q Now, I've not counted them, but I get the impression it's not a high proportion. So my question is, does this problem matter?

A I think it would need to be quantified. I don't know from-- from that, but it does look slightly different from the raw data. I have to say, there were more-- I haven't scanned through that recently, but there seem to be more infections outside of haemato-oncology than even just looking at that one table. So I think it would be important to understand the impact of-- of that.

What I did notice is that, unlike the Adults, all of the bed days and infections were in either Yorkhill or RHC. There weren't hospitals outside of those hospitals that had bed days or infections, so it's less of an issue with the children than the adults, where the adults-- there were hospitals outside of-- So, for example, the Royal Alexandra Hospital had infections or activity as well, so it's not such an issue with the paediatrics, but it is still not describing the location.

Q Because one of the things that occurred to me is that this Inquiry has become used to the idea of where patients were placed in the new hospital, because not only have we heard evidence about the decant, we've also heard evidence from individual patients about being moved to different wards at various points, and eventually we got the admission day data and occupied bed day data broken down by ward so we could see that there were relatively significant numbers of paediatric patients in different wards. Do you have any knowledge about where patients were placed at Yorkhill?

A No.

Q No? But if we look at the denominator data-- You can take that off the screen. I need to explain why I asked you a question, because I asked you the question and you might think it's an illegitimate question to ask, so I want to give you the opportunity to say so. Can we look, please, at bundle 7, document 7, which is the October 2019 report? Sorry, document 6, rather, and we go to page 226. Now, is this a graphical description of the occupied bed day data used by the HPS team who wrote this report?

A Yes.

Q Yes. So, did we ask you to extract the actual data, the numbers that underlie this?

A Yes.

Q Yes. You, I think, addressed that in your third document, which is at bundle 44, volume 8, document 1, page 3, and if we go to page 20-- Really hope I've got this bit right. No, I've got entirely the wrong place. Let me just find it. Can we go to page 14?

THE CHAIR: Sorry, could you give me the volume again?

MR MACKINTOSH: Are we in volume 8?

THE CHAIR: Thank you.

MR MACKINTOSH: Let's go to volume 6. I think it might work better. So, bundle 44, volume 6, document 1, page 3. Page 4? Yes. No. Page 14. Well, after that confusion of numbers, my Lord, what we have is bundle 44, volume 6, page 14.

THE CHAIR: Thank you.

MR MACKINTOSH: (To the witness) So this paper you wrote in response to our questions. In fact, you helpfully put our questions into the document, and then at the end, if you go to page 18, you plotted a chart which we see might have a relationship to those previous charts that we've just looked at.

A Yes.

Q This is the two added together.

A That's the combined.

Q Yes. You then created a table on page 24. Can you explain the table and, if you consider it matters, what's going on and why it matters?

A Yeah. So this is the bed days that we have from the HAD report. We've got the bed days for haematology and oncology from HPS and then the combined. So, haematology and oncology are from the original graph, and then the combined is from the new graph.

Then I have-- or the team have worked out the difference between the bed days used by Dr Drumright and the HPS bed days, and there are some quite large differences. There are some small differences, but also some large differences as well, and I think that reflects the different sources of the data.

Q But why would there be a different source? So, what's the source of the data that you used in the October 2019 report?

A So, we use the-- it's called an ISD(S)1 data set. It's another national activity data set used by-- held by Public Health Scotland. Those data are submitted by health boards at specialty level, not at ward level, so specialty-- so haemato-oncology specialty. As far as I understand it, the bed days used by Dr Drumright were from Glasgow's Trakcare system. I don't-- I don't know why the

bed days that we used were not provided to Dr Drumright.

The data that goes into ISD1 is also held by NHSGGC, so when I looked at the data that Dr Kennedy had used, it looks like it's the same-- it looks like it's the same data that we used, and he said it had come from his acute services information systems. I think he had--a team had provided it. So he looked like he was using the same bed days as us. When we did the comparison between the bed days being used by Glasgow alongside the HPS bed days in the October report----

Q If we go back to bundle 7, page 226, we can see there's little differences----

A Yeah.

Q -- in the orange, where there are slight difference.

A Yeah, and ISD(S)1 is a live database, so it might be that there's, you know, differences that happen. So that-- I think the-- I think the differences between what Glasgow were using back for IMT for Dr Kennedy is almost identical to-- to what-- what we were using, but Dr Drumright's are quite different, and some of those bed days will be from other specialties like we've talked about in the denominator, because the activity had been extracted based on the consultant rather than location, whereas the ISD(S)1 is based on location.

Q So----

A So that explains why there might be more bed days in Dr Drumright's, but it doesn't explain why there might be less.

THE CHAIR: Right. I don't think I got all the steps there.

MR MACKINTOSH: Just to recap, if we go back to volume 8 of bundle 44, this table has-- after the years and the month, it has a column from the HAD bed day database, which you've had access to and, in fact, it's in one of the bundles.

A Yes.

Q Yes. So that's the number of bed days that Dr Drumright worked with. The bits in blue are the data that was supplied to the HPS team for the October 2019 report----

A Yes.

Q -- and that comes from a national source that Glasgow had fed into.

A Yes.

Q Part of that comparison was to compare what Glasgow was feeding in with what you got out, and there's a very small difference.

A Not what they were feeding in, but what they were using in their analysis.

Q Right, just to see whether there's a difference, and it's slight.

A Yeah.

Q Then there is a, however, difference between what you were getting from the national database, which Glasgow had fed into, and what HAD are using.

A Yes.

Q This is this right-hand column, which has a huge range of different scales of the difference.

A Yes.

Q Now, there's two questions about this. One is, "Does it matter?" and I'll come to that in a moment. The other is, "How might it happen?" Can you help us on how might this happen, other than the idea that they're picking up consultant activity elsewhere in the hospital?

A I-- I don't have an answer for that, other than for perhaps the additional bed days or from other-- other locations outside of haemato-oncology, but I-- I can't explain the other differences.

Q Right, but in terms of, "Does it matter?" why might it matter, if it matters at all?

A I-- I mean, what-- what Dr Drumright has used is-- is perhaps consistent, but there are quite-- there's quite a lot of variation in the differences as well, so that would-- that would concern me a bit more in terms of whether-- whether there is a consistency around these bed days.

Q Because if we go back to bundle 7, page 226, I get the impression, and tell me I'm wrong, that in oncology there's a broadly flattish sort of rate, and in haematology it's broadly flattish until, some point in '17, it goes up. Is that sort of roughly what you see there, or am I being too clever and reading stuff I can't see?

A No, I think-- I think it's clear that there was an increase in activity in haematology, but that-- that would need-- that would need clinicians to----

Q To tell you----

A -- tell us whether-- there might have been a change in-- in the way that care was being delivered and they decided to do more inpatient than day case, because these-- this is only inpatient activity in this graph.

Q Okay, well, I'm going to ask a couple more questions about bed days, and then I'm going to ask you an overall question, like I did for the adults, of what we should do with this calculation. So, what I'd like to do is to go to the HAD report itself, so that's at bundle 44, volume 1, and to-- I think it's Figure 5, which is on-- In fact, no, not Figure 5; it's Table 4 on page 71. Now, do you see how there are some months which-- there's one month there in 2020 which is red----

A Yes.

Q -- and over the page for South

Sector, there's lots of months that have some numbers that are red.

A Yes.

Q Then over on page 73, in a discussion about bacteraemia in adult patients in the final paragraph, there's noticing some spikes in a chart, and this is-- the chart itself is over the page, but it says at the bottom:

"When we adjust for unrealistically small denominators [over the page], predominantly from South Sector which moved to QEUH in May 2015 (Figure 6), we see a dampening effect in the spikes..."

Now, what view do you have about the legitimacy of deciding to average out the unrealistically small denominators for a certain month?

A I don't-- I don't think it's unreasonable to do, but I think you would need to have a bit more background about whether that was the true activity, or whether there was a-- an artifact or problem in the data. The-- the other point with this is I think there were months where there seemed to be an unreasonably high denominator, but that was not adjusted.

So I think the only denominators that were adjusted here were the ones that were low and were increasing the rate. But, again, it's-- I think it's a difficult situation when you have just the data and you don't have the opportunity to say to clinicians, or the-- the bed days experts, you know, "Is there a reason for this?"

Q Which organisation would have access to that information?

A NHSGGC.

Q Right, and the next thing I want to look at is in Dr Drumright's response on volume 5, and it's on page 32. So it's paragraph 2B.5. Now, have you read this paragraph before about the 2005-2007 data?

A Yes.

Q So, what is it that Dr Drumright is describing she did-- or they did. It's all three of them?

A So, at a very high level, there were no bed days for 2005 to 2007.

Q This is for the paediatric patients?

A Yes, yeah, and Dr Drumright has made an assumption about that and has calculated bed days based on other data----

Q That's the rest of the period at the hospital?

A I think it was 2008 to 2014, so, yeah.

Q Yes. Do you have any views on whether that's an appropriate approach to take?

A I think it's quite a big assumption, and I also question whether it was necessary to do, whether 2008 to

2014 would have been enough data without having to-- to add some additional years data into the analysis. 2008 to 2014's quite a wide range. So 2014's nine years from the beginning of the estimated bed days, 2005. A lot-- a lot can change, I'm sure, in the way that care's delivered in haemato-oncology in that time period. Again, it's probably conversations around whether that's appropriate with clinicians to understand whether that is an acceptable way to do it.

Q Is there any particular reason to do it, though?

A I assume the reason to do it was to increase the amount of data in the longer time period.

Q I don't know whether there was less or more activity in that period, and it seems quite clear from the consequential witness statements, and-- I think Professor Gibson and Dr Rankin, that people don't remember very much about that back then, and there are no minutes of the Acute Invention Control Committee before 2009. If in doing that your estimate was-- your assumption was wrong, would that have the effect of sort of skewing one end of the trend, either up or down?

A Yes.

Q So when the Inquiry looks at the trend in Yorkhill – and I recognise "trend" is a very soft word, and we'll come back to what it means after the coffee break – would we be advised to look at the whole period or to limit ourselves to '8 to '14-- to '15?

A I think-- I think '8-- 2008 to 2014 is probably the most appropriate to look at, but I don't know if it-- there was a trend line for 2008 to 2014.

Q I think there is in the latest material----

A Oh, okay, okay.

Q -- but----

A Yeah.

Q I'm just going to double check, my Lord. I think this might be a better place to stop.

THE CHAIR: Right. Well, as I said, Ms Cairns, we usually take a coffee break, so can I ask you to be back for quarter to twelve?

A Yes, thank you.

(<u>Short break</u>)

THE CHAIR: Mr Mackintosh.

MR MACKINTOSH: Thank you, my Lord. Now, what I'd like to do now, Ms Cairns, is to talk about what you might call general analytical statistical methods by reference to the charts. Now, you've actually given a page and a half of discussion, which is in your first report, so that's volume 2, page 695 and over the

page. I'm not going to go through it in the order in your report because we can read that. What I'd like to do is discuss it by reference to the charts that you refer to there and the ones that come along.

So let's go to the HAD report itself, Figure 22, which is bundle 44, volume 1, document 1, page 118. So, what do you understand this chart, Figure 22 – if we could zoom in to the top half of the page, please – to be in the HAD report?

A So, this is the infection rate over time per 1,000 bed days from 2005 to 2022. The data has been segmented at-- at the time of move, so we've got the red----

Q This is for paediatric haemato-oncology patients?

A This is paediatric, yeah. So, the red line is for Yorkhill and the-- the blue line is for RHC Queen Elizabeth.

Q Now, in your paper, I think at 3.3.6 paragraph, you discuss some questions or concerns you have about this chart and its use of statistical methods and trend lines. What's your point?

A So, the main point for me was for the-- the blue part of the graph. So, a-- a straight line has been fitted over that time period, and I think there's too much variation within that time period to have a straight line on there.

Q Is there a way of measuring whether a straight line is an appropriate fit to a particular set of data?

A There-- There is. So, I have worked with Professor Kim Kavanagh on some of these interpretations as well and I had asked her that very question, and she said it's actually slightly more complicated than describing when-- just to have some numbers that say whether the line fits well or not. There's nothing mathematically wrong with the line, but, at the same time, it's not describing the variation over that time period well.

Q Because I've read in various reports, and indeed you mentioned it in your report, concepts of p-values.

A Yes.

Q Are we talking about the same area of study? Is that relevant in this context?

A So, the-- the p-value tells you whether that line is a significant trend down.

Q Right.

A As far as I remember, I don't know for this graph, but there were some of the graphs where Dr Drumright talked about a decrease or----

Q So, there is, on the next page----

A Yeah.

Q -- at the top of the page, second bullet point, a discussion of a two-fold decrease across the whole period,

but there's no discussion of p-values in HAD report against its figures.

A There's-- It's best practice to include p-values.

Q Right. So, what----

THE CHAIR: Sorry. Have you used the expression "p-value"?

MR MACKINTOSH: P-value, yes. I was about to ask-- Ms Cairns, you're going to have to explain, what is a p-value, why is it useful, and when does it tell you something?

A So, it-- it comes-- it comes back to this issue of random variation whenever you measure data. So, the p-value gives you a measure of whether things are different whilst accounting for that variation. So, if you have a p-value of 0-- sorry, less than 0.05, then you would say something was significantly different, and that takes into account that-- that variation around a-- an estimate.

Q So, if you had a truly random result and you tried to fit a trend line to it, it would have a p-value well out of that range?

A The p-value is for the slope of the trend.

Q Right.

A You-- You can fit a line to any data, really----

Q Anything?

A Yeah. There-- There are ways to measure the residuals, the distance of the points from the line. There-- There is a way to do that, but it's more complicated than that because there are lots of things that affect where those infection rates sit in the line, so it's not quite as simple as saying the line fits well or doesn't fit well.

Q So that brings us to the topic of confidence intervals, and I want to look at a chart in the HAD response document.

THE CHAIR: Right. Before we before we leave 22, and it's my fault----

MR MACKINTOSH: Page 118.

THE CHAIR: Was your question directed at both trend lines?

MR MACKINTOSH: (To the witness) Do you have the same issue with the other trend line?

A No. Without having any sort of statistical background to it, that-- that line, to me, doesn't appear to have as much variation as-- as the blue line. There's a period, sort of mid-2016 to, you know, the mid-2019, end of 2019, where it looks to me like there's a period of an increased incidence of infection.

Q I can't remember which page you did this, but at some point you made the observation that there are no zero values in the period between '16 and '20.

A Yeah.

Q What's the point you're making there?

A So, if you look at the red line,

there's much more movement around the line, equal movement around the line, I would say, so-- and you're seeing zeros there and you're seeing higher values. So, actually, that, to me, looks more like random variation.

Q Right.

A You would expect random variation, and, actually, some of the numbers of infections in each of these data points is quite small, and when the numbers are small you would expect to see quite a lot of random variation in the infection rates. On the right-hand side, to me, there is a long period where there are-- there are always infections, there are-- there's-- it doesn't have the same random variation up-and-down pattern. It's a different pattern from-- from Yorkhill.

Q Okay. Now, I'd like to put a chart that was produced by the HAD authors in their response document, and that's in 44, volume 5, document 2, page 50. Now, I think – and I will check with Dr Drumright tomorrow – this is broadly the same data as the Figure 22 we just looked at. Now, if we, again, zoom in the top half of the screen, I'm not going to ask you to-- Well, first, let's look at this. What do you understand to be the purpose of the shading on this chart?

A So, the shading is confidence intervals, I would assume.

Q So, how does this confidence interval, as far as the report describes it, appear to work? What's it telling you?

A It's just-- It's a range of values, really. So, it gives you a range around each point on the line. Again, that, sort of, gives a bit of accounting for the variation that you see in data.

Q Is it to some degree saying that the reality at any particular point will be somewhere in that shaded area?

A Yes.

Q Does that have a connection to the concept of statistical value or reliability?

A Yeah, yeah. So, a 95 per cent confidence interval is sort of equivalent to a p-value of less than 0.05.

Q So, in this case, if we take the blue line, for example, the linear line, the person who's produced this graph is effectively saying, if the linear line is right, then, at any point in time, the infection rate was inside the blue shaded area, and if the linear plus smooth line is right, then, at any point in time, the infection rate was inside the pink shaded area?

A Yeah, give-- Yeah, give or take, yeah.

Q Give or take.

A It is a range, yeah.

Q Yes. Now, this would therefore be the first chart we see that actually has confidence intervals on it. You've looked at this. Does this tell us

anything new that we didn't see previously in Figure 22?

A Yes.

Q What's that?

A It accounts for the variation within the data, so the red line-- the red line is a better fit for the data.

Q How is the red line calculated?

A So, the red-- the generalised additive models include a factor in there that looks at variation in the data rather than trying to fit this straight line. It will look for non-- non-linear dynamics in the data.

Q So it's hunting for trends, in a sense?

A It's-- It's looking-- Yeah, I think what happens is it moves along each point and then decides whether it needs to change the line or not, is my understanding.

Q Is it effectively looking ahead of itself as it goes along?

A I'm not sure if it's looking ahead of itself, but I think what it's doing is trying to find the-- the best way to describe the data.

Q Okay. So, this may be an area which you don't want to go to because of your background, so I want you to tell me if it is.

A So, I'm not a modeller. My job is more about interpreting what I see, so I-- I'm not the right person to talk about-- too much about the methodology.

Q Well, let me ask you a question, and then you decide whether it's (inaudible 12:00:52). If we were to zoom in, because I've arranged this for my colleague, to the period between '14 and '18, roughly-- this-- just there, we have a dip in the pink shaded area and the red line, which Dr Drumright and Professor Hawkey and Dr Agrawal discuss in their commentary. Do you have a view, or do you feel you have sufficient expertise to have a view, on what that dip is reflecting in the real world, in the real data?

A I think it's important to think about it in the context of some of the other data that's been presented as well. I mean, we've-- we've seen this effect-- perhaps not at the same points in time, but we have seen the effect in multiple other reports where the infection rate decreased after the move to RHC, followed by an increase from mid-2016. I think there's quite a few other reports that have-- have shown that.

The-- The timelines around this are slightly different. I think Dr Drumright talked about the decrease starting quite a bit earlier than some of the other reports have identified, and then I think the increase had started earlier as well, but I think, for these models, it's important to acknowledge that they're very simple. All

that's been modelled here is infection rate over time. I think we've talked quite a lot about confounding and comparability.

So, each of these data points is a population and there will be differences at-- at points in time. You can create more complicated models that includes factors that might be changing the relationship over time, but that's quite complicated and you need to have a lot more data than Dr Drumright had available to her. So, the models are simple, they don't----

Q The question I want to ask Dr Drumright – and she knows I'm going to ask it to her, but I haven't got her answer yet; I figured I should do that in the hearing – is to what extent is the line starting in early '14 speaking about something real that's actually happening in the world or the line attempting to get down low enough to meet the zero results which exist in late '15/early '16? Is it a creature of the model, or is it a real thing? Can you answer that question?

A I think that the models are too simple, that any specific dates are very approximate. I don't-- I don't think there's enough-- I don't think the model's complicated enough for us to take the dates as-- as the point where rates were increasing and decreasing.

Q So, is this effectively back to where you were with Mr Mookerjee, it's the shape that matters here?

A Yeah, I think it's the shape that matters. I think the-- the smooth line fits the data much better than-- than the linear, and I think that-- that there was a decrease and there was an increase, but I don't think we can put too much on the specific dates of when the increase and decrease happened.

Q Right. Now, what then happened is that I asked Dr Drumright and Mr Mookerjee to attempt to agree charts for three discrete periods; that is '8 to '15 in Yorkhill, '15 move to the day of the decant in RHC, and then the decant to the move back into Ward 2A.

Now, I haven't yet asked them their opinions about whether that was a good idea or what it means, I'm leaving that for the evidence. So, I feel I should ask you first, do you have any problem with looking at charts for those periods? Do you think that's a valuable exercise, or is there some flaw in taking that approach of cutting it up into sections?

A I don't there's any flaw in taking-- in that approach. I think it makes sense to look at the data in that way because we-- we have a specific clinical understanding of changes that happened in the time period. The one issue with cutting the time periods is that you do reduce the power of the models a little bit.

Q Because the period gets shorter?

A Because it's less data in the model, so, yeah, the period is shorter. So that-- that can be an issue, it makes it a little bit more difficult to see a significant result if there is one there.

Q Now, the other thing I asked-- Well, before we get to that, do you have any views about whether the decant day is a good boundary point to look at, or whether there would have been better ones given your knowledge of what happened in the reaction to the water incident?

A I think it's-- I think it's probably quite difficult, but it's not unusual in this type of analysis, because, within IPC, nothing ever all happens at the same time. So, we know that, between, I think, May and September, we had filters, there were drains cleaned, there were-- and then there was a decant, so there were-- there was multiple interventions happening at the same time. So I don't think the decant is-- is too problematic, but I think it's probably understanding that, immediately prior to that, there were other controls being put in place.

Q Right. What I want to do, then, is-- is to look at four charts and some rates, and I'll just explain-- Well, let's do the charts first. I'm not going to ask you to give an opinion on anything other than, sort of, statistics of what you see until the end. So, if we look at page 57 of bundle 44, volume 7, this is Dr Drumright's work. Now, she hasn't given a commentary on whether she thinks this is either valid or what it means beyond the p-value she has calculated.

So, if you go to page 56, you see I asked her a question, and she, at the bottom of the page, calculates a rate for the period at Yorkhill from '8 to '15 of 4.02 and something per 1,000 bed days. Then, over the page on 57, she plots a chart with a single-- well, actually, there's two lines in there, but they're effectively the same shape, of a GAM fit. Above it, in paragraph 2.3.2, she discusses the p-value for that line. Now, what do you take that she's saying in paragraph 2.3.2?

A So, the p-value for the smooth line means that there isn't a non-linear trend within the data.

Q Right, so it's a linear trend if there's anything?

A Yes, yeah, the line of-- the linear line and the smooth line are the same.

Q Is there a trend in the linear trend?

A No.

Q No. So there's no trend at all, then?

A There's no trend.

Q No trend, okay. If we then go over onto page 58, the question is at the top, the period is June ’15 to September ’18, the value she’s calculated is 4.76 and a bit per 1,000 bed days in that period, and then there’s a chart with a linear line which is blue and a linear plus smooth which is red. Then, there’s discussion above. What do you take from paragraph 2.4.2?

A So, the linear trend is-- is significant-- significantly increasing, but because the smooth p-value is less 0.05, that means that there is a significant non-linear trend, so we would choose-- we would choose the smooth line over the-- over the blue, and what that tells us in terms of the non-linear dynamics is that there was a-- a steeper increase to begin with, but a continuing increase after that.

Q So, it started-- We all remember being taught charts back in the pandemic. This is not an exponential growth.

A No.

Q No, this is sort of, in a sense, the opposite; it’s a steep increase at the beginning and then a slower increase after that.

A Yeah.

THE CHAIR: Again, just so that I’m following: if one considers the blue line without the commentary, that is my understanding of an exponential curve, although, when you were differentiating it from the red line, you described it, if I followed you correctly, as linear, and if we go to the commentary, because of the p-value, the linear, the blue line, you can’t have confidence in that and therefore the red line is preferable?

A Yeah. Because the-- Because the line has a p-value of less than 0.05, it fits the data.

THE CHAIR: Right.

A So that-- You would-- You would choose the the smooth line over the-- over the blue.

THE CHAIR: Right, and the smooth line is the red line?

A The red line, yeah.

MR MACKINTOSH: So, can you use words to describe-- I accept we’ll interpret what it means, but what is the red line, the linear smooth, telling us happened in that period if this has any validity?

A So, the-- the red line, there is an increase which-- a modelled increase, which looks to begin almost immediately after the move, but quite slowly. I would say, then, by sort of early/mid-2016 that that line is a steeper increase, and then by 2017 it slows down a bit.

Q Right.

A But what I should say, again, is that these models are simple.

Q They are, yes.

A Yeah, so I wouldn't take too much with looking at dates as to when things increase and decrease.

Q Well, I wanted to show you two more charts and then ask you a question about these models. If we go on to the next page, page 59, the period has now changed June '15 to-- sorry, 2.5, it's from October '18 to February '22, and this is the chart below, Figure 2.6. A rate has been calculated at 2.88 per 1,000 bed days. Is this similar to, in a sense, the first chart at Yorkhill? There's not a trend here?

A Yes.

Q Right. Now, just for completeness, on page 60, Dr Drumright has calculated the whole of the new hospital period from the move to the opening of the new Ward 2A, and she's calculated the rate of 3.97. Does her model have anything that is significant in it?

A Yes. So, the smoothed-- the smooth line, the red line, is telling us that there is a significant non-linear trend.

Q Which is----?

A Which is to increase and decrease.

Q And the peak-ish is somewhere in the end of '17/'18?

A Yes.

Q And that's your core point, "Don't look at the dates too carefully"?

A I-- I think it's probably approximate.

Q Now, before we go and look at Mr Mookerjee's attempts, can you just summarise for us what areas of value you see in these charts and what areas of concern you have in using them? Obviously the (inaudible 12:13:04) concerns or we don't look at the dates too closely, but what are the other concerns you have?

A So, I think the smooth-- the-- I think these models are better than the originals. I think-- I think these represent the data better. I think there is quite a small amount of data in these models, which affects-- first of all, affects whether you see a trend or not. If-- If you have a small amount of data, it makes it more difficult for something to be identified as significant, because, if you're thinking about it from a confidence interval perspective, that will be very wide, and I think, again, the dates are-- they need to be considered approximate.

Q In terms of what's useful in these charts?

A I think it's useful to see the trends interpreted in the context of the limitations. I think it's useful. I think the trend-- There was one of the trends that was a significantly increasing trend, even though the power had been reduced by the size of the model. I think it was the

period from the move to the decant.

Q Well, it's page 58? This one?

A Yes.

Q Yes.

THE CHAIR: Sorry, could I just take that point again? Looking at the chart on page 58, Ms Cairns, the point you make is?

A So that-- Despite being cut down and there being less data within the model, which reduces the power of the model, we are still seeing a significant, increasing non-linear trend in the data, but there are limitations with that that I've talked about, and it is a very simple model.

MR MACKINTOSH: Now, I want just to show you Mr Mookerjee's attempt to answer the same questions, which are in the same bundle. There was a the chart presented on page 47. If we zoom the top half of the page and ignore the "Python Code". Now, he's sought to fit straight trend lines, and on the previous page he discusses the significance of them, so if we just look at that for a moment to see what we can see and then step back to the top half of page 46. He has calculated rates that aren't that dissimilar from Dr Drumright's, but he has a different view of significance.

He seems to think that both of the two rate trends he's calculated in Children's Hospital are significant, which is not quite the way Dr Drumright came out with it. Now, if we go back to page 47, do you have any, as it were, things we find useful in this attempt – Figure 2 on page 47 – and things that we should be wary about?

A So I think one of the differences here is that the change points have been selected by Mr Mookerjee.

Q No, no, the change points have been selected by me. These are the same change points as Dr Drumright.

A Oh, I see. Ah, in terms of-- Yes, I'm getting----

Q He just stuck them all together in one chart.

A Yeah. I'm getting them-- the other change point analysis-- Dr Drumright lets the----

Q Yes, but that's a different one----

A Yeah, okay.

Q -- which I'll come back to, but----

A Yeah.

Q -- Mr Mookerjee, if I understand correctly, is simply putting the three charts together.

A Yeah.

Q So what's the positives and negatives in terms of value here?

A Yes. I suppose the-- the negatives is that this is linear lines, whereas Dr Drumright has got the

smooth effects included in her-- included in her model. There might be a benefit, in that it depends on how Mr Mookerjee has done this, but there's a way that you can include all of the data in the model and then segment it, and you don't lose the power in the same way that Dr Drumright will have done by having three separate models, but I think that might be a question for Mr Mookerjee.

Q Well, yes. What I might ask you to do is, after today, if you would speak to the NSS legal team, and they will send me a rule line question based on what you think would be the good question.

A Okay.

Q So what's the advantages and disadvantages? Disadvantage is it's straight lines. Advantages are? If any?

A I think the advantages are the fact it's been segmented at those points in time where-- where we have an interest.

Q Okay. What I want to do is go back to the chart you thought that you might be looking at, which was on Dr Drumright's-- the HAD response document, volume 5 of bundle 44, page 52. Yes. So Dr Drumright can explain this in greater detail, and she, of course, is giving evidence tomorrow, but as I understand it, she has sought to let the maths work out where the change points are, in very simple terms. Do you understand what she's trying to do?

A Yeah, I think she's let the-- the statistical package decide where things need to change in terms of the-- in terms of the model. The-- The rates that have been calculated, again this is based on an assumption of no trend within those individual segments, so the rates along the top are the average rate across that period without any sort of accounting for whether there's any trends within that.

Q Again, what value is in this sort of exercise and what things should we be careful about?

A I mean, I think it's helpful-- I think it's helpful to see one of-- Again, I think picking-- allowing the stats package to decide doesn't really tell you about the points in time that we're interested in. I think it's interesting that there's an increase in the rate around about the time that the clinicians are telling us that there's been----

Q So, would that be late '17 when we move from the green to the blue?

A Yeah, yeah.

Q The final thing is that when you did that analysis of the bed day data, you also calculated, at my request-- and I want to see whether you think it was useful – You also calculated-- This is volume 8 of bundle 44. No, it's not. It's

volume 8, document 1, page 3. I've done this again. Sorry, it's not there at all. It's volume 7. Volume 6. 44, volume 6, page 14. Yes.

So if we go to page 20. Now, I asked you to see if you would use the October 2019 report data and create calculations of rates between periods, and I think you actually picked other periods from the ones that we put in the original note. I wonder if you can talk us through this table. Would it be all right to focus on environmental enteric? Would that be a reasonable thing to do to compare it with Dr Drumright?

A Yeah, I think so, because----

Q Right. Could you talk us through that column, which is the second from the right combined column?

A So, the initial period that we were interested in was all of the-- all of the time within Yorkhill, and the rate there was 2.55 per 1,000 bed days.

Q Should we worry that it's only a year, or not even a year? Two years rather, sorry.

A No, I don't think so. I think it's-- I think it's actually helpful, maybe, that it's a shorter period, because there would be less variation within there.

Q Okay.

A Then we have the period from the move until the decant, and we've got a rate of 3.05, and then after that time we have from the decant until the end of the period, which was----

Q So that's only the year until the September IMTs of 2019?

A Yeah. So 2.94 for that one, and then the additional point that I thought would be helpful to include, because the period from the move until the decant-- there was quite a lot of variation in the time period, and I thought that that was perhaps masked in the 3.05.

Q So this is the period from the year after the move?

A Yeah, yeah. So the rate then was 0.91, but I suppose it's just worth recognising that for some of some of these points, there were quite a small number of cases, so----

Q Yes. From HAD data, we've got Figure 22, we've got the recalculated F2/F3 chart with the smooth, best fit line that has the dip before the move and then the peak in 18, and then we've got the segmented piece of work that I asked Dr Drumright and Mr Mookerjee to do, and then using your data, we have this table.

Do you have a view about what these two pieces of data are telling us about whether there was-- Or how would you describe the number of infections in these groups of organisms in Yorkhill and the Children's Hospital over the whole period of time? If you were summarising

up in an elevator pitch, how would you describe what happened using the data?

A Yeah. So, not just looking at these data, but also looking at some of the other reports that have been produced where we see the rates in Yorkhill at a specific point in time, and then a period in the first year after the move where there was a lower infection rate followed by this period from, I think, mid-2016 to maybe 2019 where there was this period of an increased rate of infection followed by a decrease after that, and I think some of that is-- In this table, you can see some of that.

THE CHAIR: So I'm going to ask you, how confident are you in that assumption, in that analysis?

A I'm-- I'm confident in that because of consistency across various different reports.

MR MACKINTOSH: All right. The next question I wanted to ask you about this particular issue of paediatric bloodstream infections is about what they're consistent with. So there were various different ways you could-- Witnesses have summarised what they think happened, and they relate to different periods in time, and I'm going to ask you whether you see these what you might call hypotheses as consistent or inconsistent with the HAD data. So put aside your chart, so just the HAD data.

Now, for example, there was a-- In the HAD report itself, if we go back to page 119, I think, of volume 1-- 119, please. The second bullet point. Is the statement in the second bullet point consistent with what we have now analysed through the HAD response document and Dr Drumright and Mr Mookerjee's further analysis of the data?

A No.

Q Why?

A Because when you segment this, you see a different picture. I think if you look at the data overall-- In fact, though, I think that statement might be based on case numbers with different follow-up periods, so I think that two-fold decrease is problematic just by itself as well, but if we look at the-- if we look at the segmented analysis, that is-- that's not what that data looks like.

Q There's been a view expressed that there was an excess in infections in what Professor Hawkey has listed as environmentally relevant organisms, or HPS listed as environmental enteric organisms, in the Children's Hospital from some point in mid-'16 until some point in 2019-ish. That's an exceedance of what you would have expected and more than-- an exceedance of what you expected. Is that consistent with what you've seen in the data?

A An exceedance of infections----

Q Yes.

A -- during that time period? Yes.

Q And why do you say that?

A From-- From the data, from data we've looked at in the HPS reports, I think that point in the middle of the change point analysis shows that there was something different during that time period.

Q Then, if you recollect, in the late summer of 2019, there was a disagreement amongst those participating in the IMT whether rates had returned to what was referred to by some people as normal rates of infection. Firstly, is that idea that there was a return to normal rates of infection consistent with the HAD data now analysed?

A With the HAD data----

Q With the HAD data.

A I think that final segment, the rate was stable rather than decreasing. I think Mr Mookerjee's final segment had a significant decrease, but not in the-- in the HAD.

Q If you recollect that Dr Drumright calculated a rate for '19 to '22 of 2.8 and 4.8 for the period from the move to the decant-- No, it wasn't 4.8, it was-- My Lord, let's go and find it: bundle 44, volume 7, page 58, 4.7. Then on the

previous page, page 56, a rate of 4.02 at Yorkhill. Can we compare the rate at Yorkhill of 4.02 with the rate after the decant of 2.8, and learn anything useful from that comparison?

A I think it's probably a bit of a stretch.

Q Why?

A There's-- There will be other changes that might impact on infection risk during that time period: changes in the patient population, changes in treatment, the way care is delivered. It seems-- It would be unusual, I think, to compare Yorkhill with a period of time after-- after the move. I think it's also-- Yeah, I think in terms of comparisons, you're comparing-- you're competing one hospital with-- Yeah, I'm not sure about that comparison, actually.

Q Can we derive any value from comparing the 4.7 rate in HAD data between move and decant with the 2.8 in the years after decant? Does that have any value to us in understanding what happened?

A So from move to decant and after the decant?

Q Yes.

A Yeah, I think so.

Q Why is that?

A Because there's a specific intervention between the two time periods. So you would be looking--

you're looking at the infection rate before and after the decant. You could use that – I mean, with a lot of limitations and caveats – to look at whether the decant had had an impact on infection rate.

Q Now, if we turn to the adult patients in the HAD report-- I know you've had some concerns about that as an exercise. Other than those spikes we talked about in the South Sector haematology patients, can you see any other pieces of data that suggest that there was any form of exceedance of infections in the adult patients?

A I don't think that there's anything from these models or from these data that necessarily say that's the case.

Q What about those two spikes that we were looking at before when we were talking about the removal of the low levels of occupied bed days? That's on bundle 44, volume 1, at page-- (After a pause) It's Figure 6, so it's on page 74. There are more spikes on 74, and then they remove-- average out, and there's only one left. What do we do with that information? What do those spikes tell us, if anything?

A So I think again it comes back down to the clinical interpretation. I think if you were using these graphs as part of an incident management, you would immediately be thinking-- If I saw these graphs, I'd be thinking first of all, is there

maybe an artifact in the data? That's the-- That's the first thing you would do, looking at this.

Q Yes.

A You would want to understand, is there maybe something going on with the data? Could there be something with the numerator or the denominator? And then after that I think you would be asking questions around how many infections were in those spikes and what-- what the situation was at that point in time. It's clinical interpretation again I think that would be needed.

Q So, if we go to page 75, where one spike remains in late 2017, we would need to know how many infections are in that spike and then talk to clinicians in there.

A Yeah, I would want to understand clinically what----

Q I haven't actually checked, and I will do so: what weight should we give to the views of the clinicians who've already given the statements about their experience? If they say something was happening, would that mean one thing? If they said nothing happened, would that mean another thing?

A I think their views and the epidemiology are all part of a jigsaw that need to go together.

Q What I want to do now briefly is just to talk about the Aspergillus

exercise carried out by Dr Agrawal, I understand. I'm not going to go over the points you make about de-duplication, or the point you make about-- Well, there's one point I wanted to take to you. So that's volume 2, page 702. It's at 4.4. Sorry, next page, 4.5. It's the smallness of the cases. You discuss root cause analysis. Are you effectively saying that what this Aspergillus data needs is sort of a mini root cause analysis/case notes review to really understand it?

A I would say when the numbers are this small, then that-- that would be helpful. I think one of the differences with aspergillus as well is that the latency period is long. These analyses are based on the location of where the sample's been taken, and the latency for aspergillus can be from days, to weeks, to months even, so we're only describing where the patient has-- is when they have had their sample taken. It doesn't tell you anything about prior exposure----

Q So they could have been exposed at home.

A At home, in another ward.

Q Yes.

A The root cause analysis is-- so the benefit of doing that type of work is that you can really dig into all of these different aspects.

Q Now, I'm conscious that time is short, and Dr Drumright and the HAD team produced similar charts for aspergillus, the conclusion of which appears to be nothing significant happens over the rate.

Mr Mookerjee has produced a chart in which he asserts that something has happened, and I really welcome your thoughts on it. It's on bundle 44, volume 7, page 42, Figure 1. So, if I understand correctly, this is a chart of the infection rates for aspergillus using monthly data, and of course most months there's no infections. Firstly, is there any problem with using monthly data when there's no infections in most months?

A I think, yes, for a linear regression there is an issue with the zeroes. So, I discussed this with Professor Kavanagh and, if a negative binomial regression had been undertaken, then it wouldn't have been such an issue, but I think with a linear regression that can be problematic with all of the zeros.

Q Okay, because, if I understand it, Mr Mookerjee is suggesting that the confidence intervals don't really overlap, and therefore that this might be a significant change in infections. What do you have in terms of whether we think that's something we should rely on, or we think that's something that's problematic?

A I think we would need to see more data on that, because I think that

the confidence intervals look like they're overlapping.

Q Right. So, if I was to go and ask Mr Mookerjee to carry out a negative binomial on the monthly data, do you think that might be more useful?

A I think it-- I think it's-- Well, yeah, my understanding is that that would have been better for-- over time with lots of zero cases.

Q I'll see how he's doing. Okay. Do you see anything-- in the text that's on the screen, anything in terms of the aspergillus rates that shows change or trend, given, for example, the original chart in the HAD report in volume 1, page 128 for the children.

A I had a-- I think I had a similar view on that as I had had to the-- the bloodstream infection data, is that it does look like to me-- without trends or analysis, it does look like there's a period where there was an increased incidence.

Q So, what do we do if we are faced with a situation where this chart sits there and people, not only one, look at that and think, "Is there something going on after the move? and yet we don't have statistical significance in our trends or charts, potentially because the data is so small." What do we do as a decision-maker trying to understand? I mean, do we just ignore this and think, "There's nothing going on here," or do we do something else?

A So I think-- I think the difficulty of this is always going to be that there's no opportunity to discuss what might be going on with these data. So, in an-- in an IMT, if this graph were presented, there would be lots of discussion about why this might be the case, so I think it needs to be taken in the wider context of all of the other information that's available.

As I say, it is-- it's one piece-- it's one piece of a jigsaw. It would be helpful to understand if the clinicians had views around this graph. I think, like, we've got with the much more clinical insight with the bacteraemia data than we do with the aspergillus data.

Q Okay. Now, I'd like to go back to your statement to page 18. I've got two more topics to do. So if we go to page 18 of your statement, paragraph 27. You raise in this, and completely changed the topic, the carrying out of Environmental Pathogens Surveillance Pilot. What was the purpose of this pilot?

A So, the purpose of the pilot is to support the development of a local surveillance system for environmental organisms and high-risk units, so this isn't about us developing a national surveillance system; it's about us trying to work through the way that you would set up a local surveillance system. So, as

part of that, we have a number of candidate triggers in the data – there's seven – and we're piloting those at the moment, and they are triggers that would help local teams identify trends in their data or areas for concern. So at the moment----

Q Can we just put them on the screen so we can connect the two together? This is bundle 44, volume 2, page 716.

A So there-- there isn't a lot of evidence around what these types of triggers for environmental organisms might be, so there are some organisms that are listed in Appendix 13, but there are some others that we've identified along the way. So, boards have asked us previously, "How do we identify when we've-- when we've hit a sort of a trigger point in terms of environmental organisms?"

Q But these were candidate ones.

A Yeah, these are candidate ones.

Q Just to make the-- connect the evidence, the question I was really asking is, if we turn off the screen, to what extent is these relevant to the work of the Inquiry? Is this in some sense a reaction to the Queen Elizabeth events?

A Yes, mm-hmm. This was-- this was a request as-- as part-- I think it was

from the Oversight Board, actually.

Q Now, I want to show you a comment in a supplementary statement from Ms Devine. So this is a hearing-- this hearing. She's one of the consequential witnesses. We asked her about her experience at Yorkhill under the opportunity to ask some further questions, and this is on page 13 of the third volume of this hearing bundle.

Now, I think the issue here relates to the impact of a particular SOP that GGC have – and I'll ask Ms Imrie about that – but since this is about the pilot, I'd like to ask you to respond, if you wish, to paragraph 2 of Ms Devine's statement where she appears to be suggesting-- Well, what is she suggesting?

A So I-- reading this, I think Ms Devine has read the report and has noticed that there were 60 triggers identified in the-- so we had two boards and three pilot sites and, at that point, we had tried to look to see how many of those triggers had been reported via the outbreak reporting tool.

Q That's the red, amber, green system?

A Yeah, yeah. So-- and in line with Chapter 3 of the National Manual. So, I think what she is saying is that the-- the pilot boards are also identifying-- there are also-- there are situations in the-- in the pilot boards that have not

been reported to ARHAI and I think that's maybe the point that she's trying to make, and she's suggesting that there were 60 of these situations and only 14 reports to ARHAI.

But I think what we need to understand about the triggers is they're not mutually exclusive. So, of those seven triggers that are there, a single incident can meet multiple triggers during-- during the course of the pilot. So it's not a-- a one-to-one relationship. The-- the triggers are not mutually exclusive of each other.

Q So one of those 14 could have met other triggers as well?

A Yeah, multiple.

Q Right. Okay, thank you.

A Yeah.

Q If we could turn off the screen-- in fact, sorry, put it back on the screen and go to page 31, the final paragraph of your statement. (After a pause) That's entirely the wrong place. Go to paragraph 31, page 20. You're suggesting that there should be-- What's the point you're making about the importance of local reporting here?

A So I think this was in relation to the question about whether there should be similar targets or standards for environmental infections like we have for staph aureus bacteraemia, E. coli bacteraemia, and C. difficile infection. I think that was the question that had been posed to me, and we--

So my-- my response to that is that those infection types that currently have targets associated with them are endemic, so we do want to have targets to reduce, whereas these environmental infections are not endemic and we need to-- there shouldn't be a baseline for us to try and have a target to reduce them.

Q Yes.

A So, a better way for us to receive information about these types of alert organisms is via the outbreak reporting tool. That-- that would be the right way in order to report these into the national organisation and, as part of that, we are then able to take the learning from it. We get a lot of information in the outbreak reporting tool. We can use that information to collate national intelligence and then share that with boards so that there's shared learning.

Q As a data person, as it were, what do you see as the value of reporting by boards?

A The value of reporting by boards is to enable us-- from my perspective, from an epidemiological perspective, we're able to describe outbreak epidemiology. We can, you know, look at trends; we can work out whether there's commonality across the different health boards.

From an IPC perspective, there's a lot of information that comes in about the management of the incident and, also, lessons learned, and that, as an organisation, is our responsibility to bring that together and make sure that the lessons learned are-- are shared. That's really important.

Q Thank you, Ms Cairns. My Lord, I've asked all questions I was planning to ask, but I think it'd be necessary to see if there're any questions in the room and on video from those whose instructing solicitors are outside the building.

THE CHAIR: Right. Ms Cairns, as you've heard Mr Mackintosh explain, he wants to check if there's any other questions which should be asked. Could I ask you to go back to the witness room? I would anticipate that process might take 10 minutes.

A Okay, thank you.

(<u>Short break</u>)

THE CHAIR: Mr Mackintosh.

MR MACKINTOSH: I just have one question for the witness.

THE CHAIR: I understand. (To the witness) One more question.

MR MACKINTOSH: (To the witness) So, returning to the Environmental Pathogens Surveillance Pilot's report, are you able to give us any indication of what the feedback was from those boards that took part in the Pilot about what they felt was the value of it?

A Yeah. So, they felt that it was really useful. It helped them identify areas within their-- their unit-- What I should say is that two of the boards that participated were actually supporting an incident, an outbreak, in those boards as well, so a lot of the information that we were providing to them they were-- they were already aware of because they were investigating incidence in the units. So, on top of what they already knew, they felt that this information was additionally helpful to them.

Some of the triggers they felt were maybe a little bit sensitive, and that's one of the things that we're looking at as part of the next pilot, is we have to get the balance right between the number of triggers that are coming up versus the resource that's available for investigation, because that-- that needs to be balanced. So, there's a bit of work around refining some of these triggers.

Q Is there any-- This is probably just from me. Is there any issue with having environmental triggers that you need to change them as time passes in order to deal with the-- unlike the standard three or standard four where you know what they are, is any difficulty

that you actually have to be flexible to have these sort of triggers and therefore having a policy makes that harder?

A Absolutely. I mean, the-- all of these triggers are really just to, sort of, prompt investigation rather than being anything other than that. There's lots of reasons why we might need to change the triggers: the size of the unit is one thing; the organism list might change where there might be other environmental organisms; boards might decide that they want to-- to change, you know, what we are recommending as well based on their own local epidemiology. So these are just a guide, the triggers, they're not-- they're not about, "Immediately there's a trigger, you have to report to ARHAI." It's-- It's the different types of triggers.

Q Is this effectively more a tool than a reporting mechanism?

A Yes, I would say so, yeah.

Q Thank you very much, Ms Cairns.

THE CHAIR: Ms Cairns, thank you very much. That is now the end of your evidence and you're free to go, but, before you do, can I thank you for your attendance this morning, but also for the quite considerable amount of work that you have clearly done in not only preparing for your evidence today, but providing responses to the Inquiry to questions directed to NSS. So, you're free to go, but you go with my thanks.

A Thank you, thank you.

THE CHAIR: Thank you.

(<u>The witness withdrew</u>)

THE CHAIR: Well, we'll sit again at two o'clock when I think Mr Connal will be taking the evidence of Dr Chaput.

MR MACKINTOSH: Dr Chaput, yes, at two o'clock, yes.

THE CHAIR: All right.

(<u>Adjourned for a short time</u>)

THE CHAIR: Good afternoon, Mr Connal. Now, we're ready to proceed with Dr Chaput?

MR CONNAL: We are, my Lord.

THE CHAIR: (After a pause) Good afternoon, Dr Chaput. Now I understand you're willing to affirm?

THE WITNESS: Yes.

<u>Dr DOMINIQUE CHAPUT</u>

<u>Affirmed</u>

THE CHAIR: Thank you, Dr Chaput.

THE WITNESS: Thank you.

THE CHAIR: Now, we've scheduled you for the afternoon. I don't know how long your evidence will take, but should you wish to take a break at

any time, please just give me an indication and we can take a break. Feel that you're, as it were, in control of the situation.

Can I ask you to bear in mind that the whole room needs to hear you? The microphones are there, they should help, but perhaps if you speak a little louder, project a little more, possibly even a little more slowly than you would normally speak. Thank you.

THE WITNESS: That's fine.

THE CHAIR: Now, Mr Connal.

Questioned by Mr CONNAL

Q Yes, good afternoon, Dr Chaput.

A Hello.

Q I'm going to ask you one or two introductory questions, but, first of all, although your name appears on various documents, I'm conscious that you do have a witness statement among them, and I'll therefore ask you the formal question I ask everybody, which is are you prepared to adopt that witness statement as part of your evidence?

A Yes.

Q Thank you. Could you just confirm the date you first joined NHS GGC?

A It was at the end of May 2021, I believe the 31st, the very end.

Q Yes, thank you. Partly because your name appears on lots of different documents, can I ask you this, how would you describe your specialism?

A That's a good question. My background is a bit unusual for someone, perhaps, who's now working in a-- in a healthcare scientist role, so my background is in environmental microbiology. That has given me some experience and skills that have proven helpful in several different aspects of both the reference laboratories where I am based and on the Infection Control team.

So perhaps experience or skills that are relevant to the work that I've done for the Inquiry would be in analysis of large data sets, interpretation of environmental microbiology, and data presentation, visualisation and communication for diverse audiences, and I believe that's perhaps why I have found myself involved more than I perhaps would have predicted at the beginning of my career in GGC.

Q So if I said to you, are you a microbiologist----

A Yes.

Q Are you an epidemiologist?

A Hmm, that-- Not strictly, no, but then epidemiologist is not a protected title, and it-- people can be different types of epidemiologists, but, no, I have not

considered myself an epidemiologist, strictly.

Q Well, as you'll probably have guessed by now, I thought I was calling you in order to talk about your reports on water, and we'll turn to them shortly, but I need to ask you about some other matters as well.

First, could I ask you about a document that you drew, sort of incidentally, to our attention in the course of last week, which is an article that has been published. The bundle reference is bundle 44, volume 8, at page 141. Now, we can immediately see, of course, that the list of authors includes names familiar to this Inquiry.

A I think you've probably heard from many of them.

Q Well, certainly Kerr Clarkson, Dennis Kelly, David Watson, Tom Steele, and Alistair Leanord.

A Yeah.

Q Not sure we've heard from Dr Bagrade or Dr Marek, but anyway, their names are well known to us. For my purposes as Counsel to the Inquiry, I'm probably more interested in the factual material that is contained within the article, i.e. the events, rather than the views and so forth----

A Of course.

Q -- which I've associated with it. The topic, and please correct me if at any point I summarise incorrectly, but I would summarise it as indicating that the issue discussed in the article is a-- let me call it a significant challenge encountered. Are you happy with the phrase----

A Absolutely, I think that's a-- an accurate description.

Q A significant challenge encountered at the point when the refurbished Ward 2A was to be returned to practical use.

A Yes, that's correct.

Q That challenge was, and again, I'm reading a lot of technical matters very short, but essentially a heavy load of microbiological proliferation found in the water system, perhaps unexpectedly. Is that fair?

"Unexpected", that's-- that's-- that would be fair. "Heavy load" is-- is a relative term. We have strict microbiological thresholds for water, and after the reconstruction of that ward was completed, despite best efforts, the threshold-- the-- the microbial counts in the ward, that had been closed for three years at this point, were above what was acceptable to us, yeah.

Yes. I'm happy----

A This is----

Q -- not to get into debate with you about the precise meaning of "heavy".

A No, no, of course. But yes,

that's the-- that's the situation we were facing. That will also be reflected in the other-- some of the other material you've seen.

Q What the article goes on to discuss is what had been done during the period when the ward was closed, and then what was done to try to resolve the issue that you'd----

A Yeah, precisely.

Q -- unexpectedly encountered. Now, the material within the article, and I won't always say that because it will become very laborious-- this material is perhaps, I would suggest to you, potentially relevant to the Inquiry in a number of respects, and I'll just run through these briefly and see whether you agree.

A Yeah.

Q First of all, one of the Inquiry's questions is, is everything safe now?

A Of course, yeah.

Q At least in principle, the material discussed here is relevant to that question.

A Yes.

Q It may be relevant to the Inquiry's consideration of microbial biofilms, which it's had at various points. Would you agree?

A Yes.

THE CHAIR: To the challenge, which we've discussed in other contexts, of keeping unoccupied, non-operational areas safe in terms of water system?

A Yes.

MR CONNAL: To the efficacy or otherwise of carbon dioxide dosing as a method of----

THE CHAIR: Mr Connal, sorry, did you say carbon dioxide?

MR CONNAL: Carbon dioxide.

A Chlorine dioxide?

Q Chlorine----

THE CHAIR: Chlorine dioxide.

MR CONNAL: Chlorine dioxide dosing. Yes, my fault entirely. Chlorine dioxide dosing, and perhaps finally to the-- and I'll just use this in a non-technical sense, the vulnerabilities of thermal mixing taps?

A Yeah, that would be accurate.

Q Yes. I suppose the next question I'm bound to ask you, I'm afraid, is the fact of the significant challenge and the issues that arose around it. Are you able to help us at all as to why the Inquiry wasn't aware of this before you incidentally referenced this material last week?

A Aware of this exact publication?

Q No, of the problem that had arisen back in 2021-22.

A I don't believe this is the-- There are certainly other documents that refer to this. The-- If I refer to, actually

from my bundle, all the presentations I prepared, that would have been in February/March 2022, there's a list of presentations from that time, and this-- these all detail the process that we went through to recommission that ward. I could give you some document numbers if that would help.

Q Well, I have all your presentations, and I'll go through them----

A Yeah, so all those documents-- This-- This process has been referred to, I believe, in Dr Walker's material at great length, and I-- I did not intend to surprise the Inquiry with this. I-- This-- This occurred in 2021, 2022, and we recommissioned the ward with oversight or assistance from NHS Assure, the Scottish government was involved. There will be a lot of documentation around this process, and so the intention in publishing a paper about it-- We did not publish this paper for the Inquiry.

Q No.

A This is because we were facing a tricky situation, but not one that I believe is unique to this hospital. It's a challenge that other teams and other health boards may face, and I found that our approach ultimately proved successful. We learned a lot during it.

Let me also say: this was-- this was very much a multidisciplinary team effort, as you can see by the author list. I'm

only the first on the list because I led on the writing up of the paper, but this was very much a team effort. The amount of data that we gathered through that process is extremely valuable, because it can-- it adds to the evidence base for how one manages water systems under different challenges.

So this paper-- this paper-- I realise it was published, I think, in May of this year, but to get to that point, that manuscript we submitted in-- I believe it was December 2024. It's gone through a fairly extensive peer review. This is a fairly high impact journal, which means it's quite difficult to get a paper into one of these, and the-- the peer review is extensive, and these were international peer reviewers.

So we wanted to accomplish a few things: we wanted to share lessons learned, we wanted to be open about our data and our processes, and we wanted to, specifically with this work, seek international reviewers to confirm our belief that we are working to an extremely high standard amongst this team.

Q Well, so I'm absolutely clear, I make no criticism of you for preparing the article. I make no----

A No, no, of course.

Q -- suggestion that you personally were trying to ambush us with something by footnoting it in something

else you sent us. It may be entirely my fault, but I hadn't been aware that there was this significant challenge encountered that had given rise to such quite difficult issues which you had to spend a lot of time resolving.

A It was a significant challenge, but I also don't want to overstate the severity of the situation we were facing. I mean, yes, we had-- we had high counts that were above our thresholds, and therefore for us within GGC, we could not reopen that ward, but context is important here.

So the counts we are talking about at the-- at the worst point, which was when it was handed back over to us and we did that initial sweep in September 2021, elsewhere, especially the TVC counts-- There are no strict thresholds for TVC. It's a monitoring tool. So it's not that we had dramatic, uncontrolled overgrowth in that system.

Actually, I would say that, given it had been closed for three years, it wasn't entirely unexpected. I think that one of the points that I do make in this paper is that we adhered and in fact exceeded the guidance in place. As you can imagine, there was a lot of scrutiny on everyone involved in this work. So, of course, we did everything not only by the book but, as I explain in the paper, we exceeded-- we took every measure that we could think of to protect that water system.

So if there was some proliferation in it, I say in this paper, given it was closed for three years – this isn't a three-week closure; this is a three-year closure – the advice-- or the-- from our experience, other health boards facing a similar situation might want to anticipate needing a recommissioning period like this. That just flushing once or twice a week, according to guidance, may not be sufficient.

Q I understand all of that. Thank you. In this forum, I don't think it's going to be helpful for me to try to go through the entire paper because we'll be here long after we're meant to be somewhere else.

I just want to try and make sure I'm picking up correctly some of the key points. Now, one of them is, in a sense, the point that you've just made: that there is guidance for what you're meant to do when you have a-- I mean, just call it an "unoccupied" area for whatever reason, and you point out that once or twice a week flushing is what is suggested, and you did it once a day, as I understand it.

A We did, and we ramped that up.

Q In addition, just so I'm getting it all correctly, you also make the point that, at the same time, this particular hospital system was subject to the chlorine

dioxide dosing.

A It was.

Q Which not all systems will have, for whatever----

A Correct.

Q -- reason, because that had been introduced, as we know, after the water incident in 2018. So you've got both the chlorine dioxide continuing and a regime which exceeds guidance, but nevertheless you encountered this issue, challenge.

A Some-- some proliferation.

Q I just want to try and make sure we have, at least for present purposes – as it were, for the record – some dates. The construction work finished in September 2021?

A That's correct.

Q Secondly – and this is just because we've become obsessed with something called Horne taps in this Inquiry – these were not Horne taps?

A No, there were no Horne taps.

Q These were Armitage Shanks Markwik----

A Markwik 21+----

Q -- taps.

A -- I believe. Yeah.

Q They were the thermostatic mixer----

A They were, yeah.

Q -- taps? Now, what you ultimately did – and again, same point, if I summarise incorrectly, just stop me – was you took, apart from the general question of ramping up the use of the water systems in the ward to more closely mimic an operational ward, in terms of specific interventions, if I can call them that, you did three things.

A That's correct.

Q One, you did chlorine dioxide dosing at a level which you would use to disinfect a new system.

A So this-- Yes, and if I could just correct, it was chlorine dosing rather than chlorine dioxide, so it was sodium hypochlorite, and I did get that-- Some of my slides from years ago might have mixed up the two as well, so if there's any confusion, I may be partly responsible, but no, it was sodium hypochlorite. So that's chlorine, and it was a treatment level dose, not a maintenance dose.

Q Yes. So this is different from the ongoing----

A Oh, yes.

Q -- chlorine dioxide dosing that was in the system more widely in the hospital?

A Yes, because ongoing chlorine dioxide is at a relatively low level because that water is being used.

Q Yes. The second step you took was a----

A A different disinfectant. It was----

Q -- a different disinfectant.

A Yeah. It was hydrogen peroxide.

Q Yes. Which you describe in the paper as typical to what someone would call a shock disinfection.

A That's correct.

Q Sometimes used when an incident has occurred.

A These are terms I've learned from the water engineers that we've-- that I've worked with, but yes, it's been described as a-- a shock dosing. So a higher level to recover an unfavourable situation.

Q Yes. Then the third thing was you changed all the taps.

A That was the final intervention. That was in January-- early January 2022.

Q As I understand it, that was because the chlorine intervention didn't seem in and of itself to fix the problem. Is that correct?

A Correct. The way we were able to show that was through systematic sampling before and after and, for context, on the floors above and below which had remained operational throughout.

Q Then you used the hydrogen peroxide shock dosing which, again using non-technical terms, made quite a bit of improvement----

A It did.

Q -- but didn't entirely resolve everything you wanted resolved.

A Precisely.

Q And then finally you changed the taps.

A We did.

Q You're very careful to say in the papers I recall that while the tap change seemed to lead to a solution, you're not suggesting that it of itself without other things would have solved it, because they would simply have become re-colonised?

A That was a concern. You need to make sure, if you're dealing with a situation like this, that you're dealing with the entirety of the source. So if-- if the issue is not strictly limited to your taps, then yes, replacing all the taps would lead to very rapid re-colonisation of those taps. So in our case, we worked from the inside of the system through to the taps, so shock dosing of all the pipework-- and of the taps, of course, because that chemical goes through the taps, but with the final step of replacing the taps.

Q You're very careful to say you're not suggesting that's the solution, you're simply saying----

A No.

Q -- A plus B plus C seemed to resolve it.

A Exactly.

Q Plus the other practical measures on the ward.

A Exactly. So this-- this is-- this was a live situation; this was not a scientific experiment. These interventions were carried out sequentially. So although it appears that the chlorine alone didn't work, I cannot say that it did not contribute to the resolution of the situation. We have to be very clear about that, because there is no quick fix, often, to these, and so I would not want this to be misinterpreted as saying, "Well, just swap out your taps and you'll be fine."

We-- We did assess as best we could with data from a live situation the effects of the individual interventions, but there could very well be, and likely was, a cumulative effect, along with the more gradual interventions that we could not measure because they did not have a specific start point.

So we increased the cleaning to the point where those-- that ward was being cleaned to clinical standards while it was still closed. That could have had an impact. We increased the flushing even more. Things like that that changed over the timeline.

So there are some confounders to this, but because we sampled quite-- in quite a granular way, four days a week, before, after, and we-- we-- it wasn't a quick, "Let's take one sample before and one sample after". Microbiology data is generally too noisy for that. You need trends, so we sampled.

We collected a large number of samples over many days. The floors above and below, for context, and then before and after each intervention. But yes, long answer to your question, "Was it likely cumulative?": yes, it probably was.

Q Just so again I have it, in your paper you show the results of testing in the floors above and below.

A I do.

Q Which reveal positive tests for a variety of organisms, but not at the same-- let me just use the word "level" for the moment----

A Yes.

Q -- as on 2A.

A In September/October.

Q Yes.

A That's correct. That's important, because water is not sterile, tap water is not sterile. Even with chlorine dioxide, it is unrealistic to expect zero counts in every water test in-- in a potable water system, and so in order to determine whether there's an additional microbiological burden in a particular area, you need to know what that baseline is that you are comparing to.

Additional to what? Because the standard is not, “Is this sterile water?”

So the reason we sampled on the floors above and below was to set that baseline, because we wanted to-- we needed to confirm first, “Is this isolated to that ward?”

Now, of course, we sample across the Queen Elizabeth all the time, so we have a very good understanding of the microbiologies, but I wanted samples on exactly the same day as when we were sampling in 2A so that we had exactly comparable data. As you noted, there are counts occasionally and you detect gram-negative organisms, and you get occasional total viable counts. That is our normal variability.

Q This paper doesn’t discuss the topic of what conclusions might be drawn from the counts in the other wards.

A No.

Q It focuses on that as a check----

A No, because----

Q These are the same wards used by, I think, the same water riser. Is that right?

A It is. So that’s the same-- the same feeds coming up from the basement tank-- tank system and feeding each of these three floors.

Q Can I ask you one-- I think we can see that the conclusion, in a practical sense, is, you apply the various measures, you then do testing, followed by more testing and more testing, and you’re then satisfied that-- if you assume it’s a challenge, you have resolved the challenge.

A Yes.

Q Of course, this Inquiry has been considering other parts of the history of the new hospital, and I was wondering whether I would find much discussion about that in here, and the answer is no.

A No no.

Q The only part I could find, when you turn to the discussion-- Now, to some extent, parts of the paper repeat things that are said elsewhere in the paper because there are parts laid out in factual narrative, then----

A And then----

Q -- they are returned to in the discussion.

A Of course.

Q I make no comment on how one writes a paper to get it into Water Research, that’s a matter you know better than I do, but at the start of the discussion, you say this:

> “In any engineered water distribution system, periods of decreased or interrupted water use can lead to proliferation of microbial

flora, [and then you say], especially in systems that might have pre-existing biofilm."

You then move on to discuss the interventions. Do you know the extent to which what you found was influenced by the presence of pre-existing biofilm?

A No, and I can't see how one would necessarily know that, would be able to. Can I also just perhaps clarify: my background is environmental microbiology and specifically biofilms for some of the work I've done----

Q Well, I was going to ask you about that.

A Yes. Biofilms develop wherever you have an interface between two states. So that could be solid air, desk. It can be water, air. So if you leave a-- a vase of flowers out, you get a bit of a scummy layer on the top. That's a biofilm. It's at the interface between the liquid and the air, and you get biofilms between solid and liquid, so on pipes, on stones in a stream.

I don't know that biofilm development can be entirely prevented. Micro-organisms are hardy, and some of my doctoral work looked at some of the most extreme environments that are on the limits of what should be possible for life and you still found biofilms. These are on rocks in the high Arctic, so solid air biofilms.

So I would be-- I would question any claim that a water system was free of any biofilm. I think our goal is to manage systems to make it as inhospitable as possible for those biofilms to grow, but I'm not sure it's realistic to claim that there will never be-- it is possible in any water system. I'm including a domestic-- you know, not specifically hospitals, but to say that you-- you can operate a system and there will not be any biofilm anywhere is unrealistic.

Now, of course, this not a-- this is not to say, "Well, if biofilm is expected, we should just deal with-- we should just live with it." No. No, of course not. This is a balance of risk, and what we want to do is minimise the growth of biofilm. As I said, we want to make it as inhospitable as possible.

Q Why is that? What's your objective in minimising biofilm?

A Well, biofilm is where microbes have a safe environment to proliferate, and the-- it protects them. It has numerous features that protect them from disinfectants, for example, provides a nice little niche where there's more nutrients and-- and they multiply, and if-- if that's allowed to happen, then it can grow and grow and your microbial load increases, and then it can shed into the system. You-- This-- this has been-- this is not new.

Q No. I mean, I realise, in a sense, an obvious question, but----

A Yeah.

Q -- can I just come back and ask you the-- So your understanding of biofilms, is that based on your doctoral work that you've just described?

A Doctoral, postdoctoral work and general environmental microbiology training, and now, since I joined the NHS clinical, training because, of course, biofilms are very relevant in clinical microbiology as well. They cause all kinds of trouble if they grow on implants or on lines. They're very difficult to treat because the biofilm is protective for the microorganisms.

Q Thank you very much. I think I'll leave the article now because we can all read it.

A No. Something----

Q I don't think there's any point in my going through the detail of it, unless your Lordship----

A If I could add one-- Oh, sorry. Please go ahead.

THE CHAIR: No, add away.

A Just-- so in-- also, in terms of biofilm, it's very difficult to directly measure biofilm. Unless you go into the pipes and take some kind of direct measurement, then what's-- in fact, you're assuming that there's biofilm there based on what you're finding in the water, in the bulk water.

I-- I mean, pipe sampling-- pipe sampling is very destructive and difficult, and you would need to do a lot of it, and this-- we're getting back to normal variability, but it's more of a problem with biofilms because they're spatially heterogeneous.

So if I sample one pipe, that tells me nothing about the biofilm that's one centimetre away, let alone one metre away, let alone in the tub. So it is not realistic to expect direct biofilm sampling. This determination that there was biofilm is an assumption that follows from the water testing results, which is the bulk water.

Now, there are some hints. If the organisms you're finding in your bulk water are species that are known biofilm formers, that's an indication that perhaps these are-- there is a biofilm somewhere, but that's an indirect measurement. Unless you are, generally destructively, sampling your pipes, cutting section of pipes out, then-- then you're not generally measuring biofilm directly.

MR CONNAL: Even if you cut out pipes A, B, C and D, it may tell you nothing about what's in E----

A In E, F, G----

Q -- F, G and H.

A Precisely.

Q Yes, or even what's in another

bit of a nearby pipe.

A And perhaps another point, if I may. The users of the water outlet, whoever is interacting – that will be patients, staff – what's important for them is what's-- what's in the water. Now, if there's a very hardy, thin, tough layer of biofilm that's having an extremely difficult time because we're bombarding it with chlorine dioxide and pushing the water through, if it's not allowed to grow to a certain thickness and it's not shedding anything into that water, (a) we won't see it, but (b) does it matter for the user of that outlet?

Now, of course, it matters if that biofilm is growing and shedding, but we would see that in the water results, the bulk water. So the mere existence of a biofilm alone is not a direct indication of the risk. The risk is when that biofilm-- What's in it, which organisms? Is it growing to the point where it is able to shed into the water?

If your water results are not-- and I don't mean one isolated water sample, because that tells you that that one sample has nothing in it, but, as we know, biofilms don't shed constantly, right? They slough off in pulses, but if we sample to the level that we're sampling-- sampling in this hospital, that does give us some reassurance that if there is a biofilm in there, it is not significantly

impacting on the water that's coming out of that tap in any way that we're able to measure.

Does that-- I-- Is that clear? What we're really-- what's really important for the patients and the users is what's coming out of the tap.

THE CHAIR: Would it be true to say, Dr Chaput, that if one has responsibility for managing a complex water system, in the absence of control mechanisms – and by that I mean temperature control and, if you opt for it, chemical control and regular flushing – it would be prudent to assume that biofilm is developing in that system?

A Yes. If you do not have a good handle on those control measures then, yes, I would say that is a very real risk.

THE CHAIR: Taking into account what you say about the possibility of the biofilm being so robust, or presumably coherent, but it does not shed, if you are managing a system, it prudent to assume that biofilm may shed?

A Yes. I think it's prudent to assume many things when managing water systems and not to rely on any one control measure or, for that matter – and this coming from someone who is a scientist and relies on data – not to rely entirely on testing results either.

And this is known in the-- certainly

in-- in the context of Legionella, that's, I think, fairly well understood in the, if you like, water engineering or water management community, that Legionella testing results provide some reassurance but they do not prove absence. You can't-- you cannot prove absence. You can only try to look for a problem, but none of those answers are-- are absolute.

THE CHAIR: When we're talking about water sampling, help me with this: you will discover what you're looking for.

A Yes, and that is a-- a crucial point.

THE CHAIR: So the value of water sampling depends on which-- Well, as I understand it, all water sampling should provide a total viable count, is that right?

A I don't know if all----

THE CHAIR: Right.

A The total viable count is one type of microbiological test.

THE CHAIR: Right, and that is a regular part?

A That is. That's an-- there are international standards and protocols. It's a fairly-- very widely used test that has been developed and refined over decades.

THE CHAIR: Mm-hmm, and, in addition to that, you have to test for specific organisms if you wish to detect them.

A Correct.

THE CHAIR: Yes.

A So the total viable count test, if it's done according to standard protocols, does not tell you the identification of the organisms that you have grown.

THE CHAIR: Mm-hmm.

A So the culture media used in the laboratory is-- is meant to be broad, non-selective, because you're trying to capture as many of the organisms in there as possible, but it will not tell you what they are. Whereas something like a Legionella test is-- is looking specifically for Legionella.

THE CHAIR: Another slightly different topic before I invite Mr Connal to resume: if one reads the article in-- that Mr Connal has been asking you about, one gets impression that GGC were conducting a particularly focused and organised project. Now, reading an article can often give you the wrong impression. Would that be correct-- There was a team, there was a method, and there was a focus?

A That's correct. This was, if you like, a standalone project, a project-- It was a situation, and it-- but it was a very specific situation limited in time and space, remember, and therefore this was the Water Safety Technical Group who worked on this, and we worked on it very intensively over a fixed period of time because it-- it was one problem that had

to be resolved because that ward needed to reopen.

But we would not reopen it until we had reassured ourselves, and everyone else who was looking at this quite closely, that we were ready to reopen, and so it was a very specific piece of work and an-- you know, almost an experimental design as best as we were able to put one in, not at-- not to do an experiment, but to get the data that we needed to provide that reassurance.

THE CHAIR: Now, we have, as Mr Connal has identified, a number of presentations prepared by you which are part of the Inquiry's documentation. Now, if I was to re-read these presentations, would I detect within them that a project such as you've described was ongoing in the hospital from as early as 2021?

A I'm not quite sure I follow. So by "project", I don't want to say that this was some kind of experiment we were doing for scientific reasons. We-- we had a situation and we had to address it, and in the-- the methodology we used, I guess, is-- is-- could be described as a type of experimental design, but that wasn't to do an experiment. That was to get the data that we needed to address the situation and so the other documents that you have were prepared during that this time, and it was to give----

And I prepared these almost weekly,

much smaller versions, but as the water results would come in from our sampling, I would do a live update, if you like, of the figures that are in the paper and that are in these slides, and that was to communicate to the rest of the Water Safety Technical Group exactly what was happening, as close to real time as possible, so that we could decide on the next course of action.

So it wasn't a research project in that sense. It was, "Here's a situation." It's quite a high-pressured situation and quite a-- we felt quite serious in that we did need to reopen this ward, "and therefore how do we best resolve it?"

THE CHAIR: Well, that's a full answer, but can I return to the question?

A Yes, of course, so what specifically?

THE CHAIR: We've just received this, or recovered this document, and I think Mr Connal was putting you that this is news to us, and I understood from your answer to say, "Well, you've had my presentations," as indeed we have, so----

A I believe it should be clear----

THE CHAIR: My----

A Yes.

THE CHAIR: Excuse me, my question was should I have picked up in my reading of your presentations that what have described as a "project" was ongoing?

A I would have hoped so but, if you didn't, then that's perhaps a failure of communication on my part.

THE CHAIR: Or a failure of understanding on my part.

A Perhaps. Those-- but keep in mind those presentations were not prepared for this Inquiry. They were prepared at the time, with a specific purpose and for a specific audience. I believe some of them were presentations that I gave during meetings with NHS Assure.

And, I mean, there are several of them. It would take-- probably take too long to go through them, but I do begin with September 2021 and, "Here's the situation we faced September '21. Here are the interventions. Here's what we know so far."

And then, depending on the date – as you see, there's some that go from February to the end of March because this was a live situation – I would hope there's nothing self-contradictory, but new data was coming through, and so the-- the very last one is the most complete.

The earlier one from February would have only had the story up to February, but I would hope-- I think they always start in-- with the premise, which is, "We are planning to reopen this ward. Here is what our sampling sweep in September 2021 detected, and here is how we are addressing this."

THE CHAIR: Thank you. Mr Connal.

MR CONNAL: A little while back in these exchanges you mentioned, obviously, you're adding to your experience since you came to NHS GGC, and because not everybody knows exactly what that has involved, can I just ask you this: am I right in understanding that your role doesn't involve any clinical treatment work?

A No direct-- No. No, no, I'm laboratory based.

Q So you don't do things like chair an IMT?

A No.

Q What about advise an IMT?

A I have attended, and if-- so, on the Infection Control Team, my role perhaps is best described as scientific, or data support, so if there's a situation where an ICD perhaps wants to look more closely at some data to support a decision, or to inform a decision, then they could request my-- my help with that. But, no, I'm not generally directly involved in IMTs.

Q Thank you. Now, it may be important, so we don't miss anything, to make sure that we understand what you have produced at various times.

A Yeah.

Q So, if you'll bear with me for a

moment, I'm not going to go to all of them, otherwise we definitely would be here until sometime next week, but I have notes about a number of reports you've prepared. So, for the record, I'm just going to run through them, and then I'm going to come back to one only.

A That's fine, yeah.

Q There's a report on 3 March, which we have in bundle 18, volume 1, page 13. We don't need to bring any of these up on screen, thank you. We have something called a whole campus water summary testing report for March '23, which is in bundle 19, document 18. We have a summary of legislation and guidance for testing, bundle 19, document 54. We have a presentation you made about 2A/2B water test results on 28 March '23. I'm sorry, these may not be in chronological order.

A No, that's-- that's okay.

Q Bundle 18 (Vol 2), page 1030. We have another presentation on 8 February '22, bundle 18 (Vol 2), page 1040. Now, I think, having just looked at that, we may find that that includes narratives such as, "Chlorine treatment didn't shift the problem," to turn it into layman's terms.

A Of course, yeah, that was our understanding at the time.

Q There's a little bit of narrative attached to the lists of results. We have another presentation about 2A/2B water results on 1 March '23, bundle 18 (Vol 2), page 1063. Finally on my list, a presentation on 18 February – so I'm being proved right, they're not in chronological order – at page 1073 of the same bundle. Now, these are what we think we have. Do you think we've got what we need?

A I think so, and if you-- if you look through those, they may begin to sound repetitive, because these were-- these were, if you like, live-- these were presentations to give updates, so they happened-- you know, they were-- as new results came in, I would update the slides with the new results and-- and then prepare a presentation with the updates.

So, yes, but they were all prepared over this period of reopening, and that was because-- and I do-- I touch upon this in the paper a little bit, but there's-- there was an interesting recommendation.

This was-- I cite it, and I won't be able to recall it in the heat of the moment, but about something called "holistic water system management" or something like that, and I actually only came across a reference when I was writing this, but they have some-- some tenets or some recommendations, and one of them is to involve a multidisciplinary team, which we had been doing, but also that a critical

aspect of this is the communication, because, when you have a multidisciplinary team, people have very different backgrounds, and so communication of technical material is critical if we are all going to solve this problem together.

And so, really, the goal of these many presentations was to present the data in a way that my team members could understand, and I sought feedback and I think they found it helpful, so that we all knew or that we all had a similar understanding of what we were facing week-on-week. So, these were-- These are not standalone documents-- Well, I suppose they were standalone at the time, but they must be considered within the context and-- and remembering the audience that they were aimed at.

Q Well, I can understand that in relation to the presentations. I may have slightly different questions to ask you about the report I'm now going to go to----

A Of course.

Q -- which is-- Now, I think I quoted it as 2022, but it's 3 March 2023, which is in bundle 18 at page 13, if we could have that, please. No, 1-3, sorry. Now, I think the first question I have about this fairly lengthy report, and I'm not going to go through the detail of it because we can see what it says, is how did this come to be prepared?

A It's a good question.

Q What was the point?

A Why?

Q Yes, because it doesn't-- if I can make a suggestion to you and you can agree or disagree, the one thing it doesn't have is any context. It's simply a collection of data.

A Well, I don't know if this doesn't have any context. I think it provides context. What it does not have is an analysis in any way that I would normally consider an analysis, so it does not pose a specific question, nor does it try to carry out any statistical analysis to address a question. This was-- So, I-- If I give you how this arose----

Q Well, I think the----

A Yeah.

Q The reason I'm asking is that it doesn't discuss events so much as test results.

A It does. The purpose was never to discuss events. The point of this-- So, when I joined the reference labs in late spring 2021 with an environmental microbiology background, within probably a month or two, I was asked by Professor Leanord if I could-- because of my background in large data sets, or analysing or looking at large data sets, and my environmental microbiology background, would I be able to, for internal purposes, gather together and

summarise all of the water testing that was done at the QEUH since it opened in 2015?

Now, that's not to say that they didn't know what testing was done, but, as you might have read in this report, testing changed considerably over that time. In the earlier period, it was carried out by a contractor, ALcontrol, both the sample collection and the sample testing, and then, at a later point, DMA Canyon became involved, and then there was a shift from testing, ALcontrol stopped being involved, and the GGC environmental laboratory carried out the testing. Throughout the period, that environmental laboratory was also carrying some other testing in specific areas with their own arrangement.

So, essentially, it was bitty. There were different data sets in different spreadsheets, and I was asked, just so-- because of this Inquiry, could we just gather all the data in one place so that we have a starting point and an understanding of which lab was testing, what, when, how did the numbers change over this time, which types of tests were performed at what periods. All of those things have shifted considerably over the period 2015 to 2020, and it was difficult to keep it all in your head, so it was to put everything in one place. It's-- It's a summary, and that was-- that was its

purpose. It was not to make any tests as to whether things were higher or lower in terms of results or counts at any one period compared to another. There's no statistical analysis here. This is purely a fairly dry and-- presentation of numbers.

Q To get the information to create this document, am I right in taking from your preceding answer that, essentially, what you did was interrogate the various data sets and try to bring them all together?

A Correct, and I had to get those from different sources, you know, the-- the water testing that's carried out by the environmental laboratory is recorded in our laboratory information management system, our LIMS, that's Telepath, but then the earlier ALcontrol data that lived on specific ALcontrol spreadsheets that were, of course, you know, formatted differently, recorded differently--

Then there's how DMA Canyon handles data, and a-- a lot of the testing of samples collected by DMA Canyon is carried out in the environmental laboratory, but not all. The sentinel outlets, those samples, due purely to capacity, are sent to Intertek, a different lab.

So the Intertek data-- There-- There's a complex web of different data sources, and-- and by the "complex web", I mean if you look at the entire timeline.

It's far more straightforward and streamlined now, it's far-- because it's-- it's a very well-established system, but I was asked to go back to 2015, and so to get all of these numbers in what looks quite a-- like quite a dry report involved bringing together data sets, especially from different laboratories, that, you know, it takes some work to-- to bring those data sets together.

Q So, at this point, you weren't asked, because you were basically carrying out a task you were asked to do, from what----

A It was. It was purely a data collection and summarising task.

Q And you weren't asked to go and read any of the materials? You know, Water Technical Group materials or anything of that kind?

A Oh, no. No, no. No, I was-- Frankly, at that time, I had just started and I was quite oblivious to the whole thing.

Q Yes. So, why things were happening at a particular time, what was----

A Of course I-- I knew some of the background, but----

Q Yes, but that's not what was to go in here.

A No, of course not, no. No, the point of this was just, can we-- can we see the trend and-- you know, show us all

the numbers over this timeline and what-- what were the results, how did testing change over this timeline, and that's really quite important to understand, that water testing-- that the types of tests that have been carried out have changed substantially over this time, and it was important to summarise that all in one place.

Q That's what I was wondering, because if you say, "Oh, this is to let us know the numbers between 2015 and 2020 of various tests," in some respects, that becomes, then, meaningless, because there are some tests that were not done at all other than in one period, or mainly in one period.

A Well, this is-- Yeah, and this is why----

Q Is that fair?

A -- in this report I don't just present the number of samples that were collected because it's far more complex than that. You collect a sample and then either you just put it through a single test, say, a Legionella test, or you collect a sample and you test it for, say, Legionella and TVCs, or you collect a sample and you do the full suite of tests.

So getting a handle on the number of samples, but how does that translate into the number of different tests? How many organisms have we tested for in this sample? How do we de-duplicate,

right? Because, depending on how this is recorded, I might have an entry in-- multiple entries in my spreadsheet, single sample, four different tests, that could be recorded in different ways, as you could imagine.

So it was-- it was, frankly, quite a tedious data analysis task, but quite an important one, I think, to-- to inform future discussions. If-- If we start with a-- a clear understanding of what happened, that's a good starting point.

Q Well, the "What happened?", insofar as this document informs you, is what tests were done.

A Precisely, yeah, nothing more than that.

Q Yes, because it doesn't otherwise tell you what happened?

A No, not-- not the larger question. By "What happened?" I'm being quite specific in terms of what happened with water testing.

Q Yes. So, for instance, just to take an example, there was a lot of testing going on around Ward 2A when it wasn't being occupied by patients, but you don't link that event to the----

A Well, that happened after this report. This report ended in 2020. Had-- Had I extended the timeline-- Keep in mind I started this-- I started this in 2021, so I was only halfway through 2021, so my instruction was, "Please summarise 2015 to 2020." Now, had I been doing this last year, I would have included that extra work, because-- because the point is to include all the testing.

Q Can I ask you a purely technical question?

A Please.

Q At various points in this paper, you refer to something called WQS-017.

A 017, yeah.

Q Yes, which is an SOP.

A It is.

Q Now, that, of course, sent us off to look for WQS-017, and then we discovered there were any number of different versions of that over the years.

A Yes.

Q The earliest we found, and this is probably our fault, is Version 2 from 2020. By the time you get to 2024, you're on Version 13, which looks very different from Version 2.

A Yes.

Q I can dig them out if we need, but I suspect I don't need to do that. What are you referring to in this report?

A Well, it would have been the one that was in date at the time that I did this work, so the one that was in date in 2021, and I would be happy to look back, because I will have kept a-- a list of the documents-- actually, a folder of the documents I referred to, but it has-- that's the Estates SOP for water sampling,

yeah.

Q That's fine. You will have used the SOP which was in date at the time you did your report?

A Yes.

Q Well, no doubt, if we need to, we can go and follow the trail through, it's just that it wasn't clear to me.

A If I didn't specify the version, yeah, then-- no, that's----

Q Now, just in terms of what this tells us, apart from obvious things like some things were not tested at all at certain points, we know dates for events such as putting on point of use filters.

A Correct.

Q Let's say February of '18. Things like carbon dioxide (sic) dosings in November of '18. So we know these events in the context that we're discussing matters. In terms of testing for Cupriavidus and Pseudomonas before that, am I right in thinking there was either nothing or not very much?

A Of specific testing?

Q Yes.

A So, Pseudomonas testing is a recognised, standardised test, and you might have to-- I do show a plot of specific Pseudomonas testing in this.

Q Let's look at page 21, that's electronic page 21, at the top right-hand corner where you have a Table 2.

A Yeah.

Q That shows----

A There were some Pseudomonas tests being carried out.

Q Some, but not that many, perhaps, for a hospital of that size, and then much increased numbers----

A From-- From December 2018, as you can see, all the numbers increase. As for Cupriavidus testing, no, there was-- there was none because that is not a standardised test. That's-- That's bespoke to this----

Q Can we find anything in this report about Stenotrophomonas?

A So, Stenotrophomonas would be-- So, let me clarify, when it says "Cupriavidus", that it was initially named that in the data set and Cupriavidus was reported separately, but it's a single test. It's a single-- single agar plate, and it's now been called the gram-negative test.

Q Right.

A So you take 100 ml of water, put it through a filter, and this gram-negative test then identifies and reports the species that it finds. So, it's a-- it's a single test, and that test will-- should pick up Cupriavidus, Stenotrophomonas, and all the other gram-negatives that I report from the period when this test was performed onwards, the bulk of those would have been picked up on this test.

THE CHAIR: Right.

A So that's essentially the test

for Stenotrophomonas as well, if you like.

THE CHAIR: Right, and that starts in 2018?

A So, there's-- It was first introduced in March, but not as a routine test. That was at the height of the concerns. And this was new test, this had not been done before, and so the lab developed a method, and it was-- that was the first time that specific growth medium and protocol was used, and so there was a large-- there was a large sampling effort in March/April 2018. There's a-- There's a graph of this, if we're able to go to it, but otherwise I can try to describe.

And then it was implemented routinely from the end of 2018, and can I also say no one else does this test routinely. This is bespoke to the Queen Elizabeth, so we have no comparative data apart from, and I hope we will get to this, a very useful paper where this test, as an experiment or as a project, to us that term, this test was performed at other hospitals.

MR CONNAL: What about Enterobacter?

A Yeah----

Q Is that covered by the same point you're making?

A So Enterobacter-- Enterobacter is a gram-negative. It's also a Coliform. So, Coliforms are part of

what's called, if you see this table, potable tests. What's under that column includes, in fact, four columns of data, three specific tests. So the-- Under potable tests we have TVCs, so total viable counts, at two different temperatures, at 22 degrees and at 37. So one sample of water, two different plates, two incubation temperatures, and that's to try to capture a wider diversity. The 37 is to try to target those that might prefer to grow at body temperature.

THE CHAIR: I'm sure I should know this, but the reference to potable tests, is that by reference to the wholesome water criteria or is it----

A Not specifically, no. Potable testing includes-- It's a standard suite of tests for testing potable water, and it includes total viable counts, Coliforms, and E.coli.

THE CHAIR: The----

A So the wholesome-- I think, no, you're not-- you're not off base. The potable standards for the water utilities do include TVC testing, I believe Coliforms, E. coli, and then some additional ones, I believe Clostridium. Faecal contaminants. Indicators of faecal contaminants.

So within the potable testing, we have the total viable count, the TVC tests, as well as the Coliforms in E. coli, and Enterobacter are targeted by the Coliform

test. If they are there, they should grow on that Coliform test. They might also grow on the gram-negative test.

Essentially, they have two shots at it. If I have a single water sample and I've put it on both a Coliform plate and a general gram-negative plate, which-- I would hope that it would grow on one or both of those. Certainly, the Coliform one-- the Coliform agar is a standard nutrient media that targets Coliforms, including Enterobacter.

MR CONNAL: So we're wrong to look in this report for specific discussion of Stenotrophomonas or Enterobacter because they are subsumed in these other headings that you've given us?

A No, because in the later sections I give details of all the species that were identified.

Q Yes.

A So I give the numbers of all the Stenotrophomonas and all the Enterobacter that were identified. I believe there's quite a long table. There's also a visualisation of the main taxa, so these would have been any species that was reported on the gram-negative test or that was named from the Pseudomonas test, including – and this is important as well – non-target species, because when we say a Pseudomonas test, we-- that agar, that nutrient media, has been refined over the years to target

Pseudomonas, but it's not perfect. You get other things that grow on there.

So the lab will-- Before it reports a count of Pseudomonas, it needs to be sure that those are Pseudomonas, and occasionally-- and this-- this is not required, but in the data set, they would-- occasionally there would be information on non-target species. So all of those are listed here.

Any-- Any named species that was in any entry of any of the 80 plus, 90 plus spreadsheets is in here. There are no named species. Oh, yeah. I'm not perfect, so maybe there's one or two that slipped-- But my intention was to list everything that had ever been detected in those water samples, and----

Q You also list occasions when specific – as you described them – ad hoc tests were sent to look for particular organisms.

A So that's a different type of request again. So the tests we've discussed so far, the gram-negative one is a special case, perhaps, but the others are what would be considered routine tests.

So if you have a-- a routine sampling plan in place for perspective sampling for monitoring, generally, if you choose to do so – and it's not required specifically in guidance, but if you choose to do so – you would usually do

something like TVC testing, standard Pseudomonas test.

You know, there are some tests that are standard; there are well-established ISO-standard protocols. Then the ones that you've just mentioned are-- I would categorise, and I think I do, as reactive testing or ad hoc testing.

This is not planned in advance as part of monitoring. This is because there's been a request by the Infection Control Team, or perhaps as a result of an IMT, and they've said, "Look, we've noticed some cases of this, please can you test the water specifically for this organism?" So it's a different type of test.

The lab-- And this has changed a bit over the years. The earlier data sets did record non-target, but the lab would report a yes/no. So I'm asking you, "Is there an Elizabethkingia in these water samples?" So that's the question, and the lab's answer would be yes or no, generally. So that section of the report where I give numbers is, "These are the tests with that specific request," and then I believe I give the numbers – well, they're all zeros – of when that specific organism was found. It's a different type of testing. It's reactive testing as opposed to routine testing.

Q Yes. I don't think we need to go there, but so everybody's clear, that appears on page 38 of this report, and it's

headed, "Table 4, Organism-specific ad hoc tests requested across the new buildings".

A Correct.

Q That's what we've just been discussing.

A That's what it is, and they're-- Keep in mind, I wasn't there at the time, so this is my interpretation of what's in the water data sets, and the reason I have marked those in that way, those specific samples and entries, is that-- that there's a column for the analysis requested or the test requested, something along those lines, and if the test is requested, it would specify. For this sample, we request TVC, Pseudomonas, E. coli, Coliforms, or, in these cases, the test request is very specific.

Q Yes. So for instance, if you request a test for Elizabethkingia Miricola, that's a very specific----

A It's very specific.

Q -- request.

A It is.

Q Yes. So I think we have a much better picture now, perhaps, than emerges simply from reading the dry text, how this came to be created. Can I just ask you to go to one page----

A Of course.

Q -- just in case of assistance to us, given the wider context, page 34?

A Yes.

Q Because we're talking here about Cupriavidus and everything else that's gram negative.

A It is.

Q The top paragraph is dealing with testing in 2A, which of course has been of particular interest for all the reasons that we know. I see here that you note 24 out of the 35 samples from Ward 2A, 68.6 per cent, grew one or more of the species, with three of these also testing positive for an additional gram negative.

A Yeah.

Q Then a further nine didn't grow the target organism, but grew something else. So you've got quite a high positivity rate of sampling in that ward at that time.

A You do, with a caveat that this is the first time this test has ever been done, so you have no indication of a baseline or what would be considered normal.

Q But even you felt, in your dry recording of data way, it important to point out that only 2 of the 35 samples from Ward 2A were negative.

A Well, that's the fact. Here I'm listing the numbers as they were.

Q Thank you. I don't think I need take anything more from you about this now that we have much better idea of why it does or does not contain certain material. Can I ask you some general questions, if I could, since I've got you here?

A Of course.

Q And since you're apparently the person who's on top of all the water material. I know you don't like the word "contamination", because you say, "Well, against what standard?" but if I could just use that phrase because it's been used by lots of other people, including GGC, can you comment on whether there was systemic contamination of the water system at the new hospital in 2015?

A Could we-- Could we spend a bit of time on that word first? Because----

Q Well, no, because that's the description that's been given elsewhere, and I just really need to know whether you think it's a correct description or not.

A No.

Q No.

A No, I don't.

Q And why not?

A This is where we get into the definition of that word, because if-- And the reason I want to spend a bit of time on that word is that words-- the definition matters, because otherwise, if I understand that word to mean one thing and you understand it to mean something completely different, then we're talking across each other.

Q Well, the inference in this

case-- And this is a phrase lifted from something said by GGC, not my----

A No, of course, and I would have had this same conversation with people in GGC. Of course.

Q At the outset, whether it's because the building was half built for a while or whatever it was----

A Right.

Q -- the likelihood is that the system was systemically contaminated.

A So now I see. Apologies. When you said "widespread contamination", I had-- I thought you were talking about the 2018 water incident.

Q I'm going to ask you about that in a minute, but let's start from 2015.

A Right. So, contamination, I believe I have said this before, possibly in response to how it's been used, for example, in Dr Walker's report. The word has a definition and it means something that's gotten in there that should not be there. Right? It is not-- It is not a synonym of "May pose a possible risk". Risk is completely separate from contamination. You can have water contaminated with chocolate powder.

THE CHAIR: Can I just take this from you----

A Yes.

THE CHAIR: -- because I accept what you say, definitions are important.

A Yes.

THE CHAIR: It is not a synonym for?

A Posing a possible risk. I believe those are distinct concepts that at times have been conflated. Contamination from a-- Now, if I may, a strict definition in terms-- in the context of water would be something that has gotten into your water system that should not be there. Now in terms of-- Now I-- Now I understand what you're asking is 2015 and GGC's position as to some issues around construction, so contamination would include things like if pipes were left open and debris entered your system. Debris should not be in your system; that's a contaminant.

MR CONNAL: But if it's completely neutral biologically, that wouldn't create a risk. Am I right?

A Correct, but it's a contaminant. Now, if a consequence of that contamination, which is the debris, is that normal microbial flora have then had nutrients or substrate to proliferate, it's not the normal microbial flora themselves that are the contamination, it's the thing that got into your system that should not be there.

THE CHAIR: How much weight do you put on "gotten into it" as opposed to "allowed to develop"?

A Ah, so that's a very good question. It brings me to what I would

call my slightly looser definition of contamination, because I will concede that it is sometimes used for a situation-- Say Legionella. Legionella is-- is a normal water organism. That's its niche.

So, in that sense, detecting-- occasional detection of Legionella wouldn't meet the definition of contamination, because it's a water bug. You expect to see it occasionally in water. This comes back to, "Can you assume something's there if it's-- if you've not tested for it?" Well, with Legionella, that's its normal environment.

Now, I will accept that perhaps if Legionella-- if your system has been managed in such a way that Legionella has proliferated – and we're talking to high counts throughout your system that we know pose a risk – then I will concede that that perhaps would meet a looser definition of contamination, but more accurately would be described as microbial proliferation. Contamination, E.coli----

THE CHAIR: Sorry, more accurately described as?

A Microbial proliferation. So when a normal member of the water flora has been allowed to grow to numbers that are undesirable. E. coli-- E. coli is a contaminant, because E. coli is not a normal water organism. That's not its ecological niche. It's a gut bacterium.

So if you find E. coli in your water, that indicates that there's been faecal contamination. Clear definition of contamination. That's why we test for faecal organisms as indicators of contamination. Where the definition I think becomes less difficult-- or less straightforward, and I-- and perhaps no longer applies, is when you start testing for organisms that you've not tested before and you detect species that are normal water flora. That in itself for me does not meet any definition of contamination.

If there's no threshold, no accepted threshold, at which point that organism-- If there's-- If it's not been tested for before, and if it's what you would expect to see in water, then in order to use the term "contamination", surely it's not the presence of the organism that's important.

Then we're talking about what levels. So this applies to Legionella, and in fact it applies to Pseudomonas aeruginosa. There's very good data, and there are guidelines for those. Those guidelines do not transpose. You cannot just extrapolate them to all other gram-negatives, because these are very different organisms.

THE CHAIR: Sorry, just to follow a step there, when you say these are very different organisms, you're referring to?

A Other gram negatives compared to Legionella and Pseudomonas aeruginosa.

MR CONNAL: So, you can't assume from the results you get for Pseudomonas aeruginosa anything about other organisms?

A From a test? Well, no, because you've not tested for them. The-- The point I'm making, though, is, interpreting the results of a new test like the one for gram negatives is-- is difficult or indeed impossible without any knowledge of what the-- what normal is.

If-- if we've only carried out a test in what we think is an abnormal situation, we do not have any baseline. We don't know what normal looks like, and so defining "contamination" in that instance is-- is really quite difficult.

Because "contamination", also, it-- it's an emotive word. It can be-- it's a technical word, but-- but it's an emotive word, and it also implies, because we're fortunate to live in a country where the water coming out of the tap, there's an expectation that it's not contaminated, it's very serious to claim that water is contaminated because it implies that that should not have happened, and therefore there was-- something happened that should not have happened. There was possibly mismanagement or negligence.

Now, I'm saying this is how that

word could be interpreted. Now, if that word "contamination" is being used in a completely new context with no baseline data, that's a problem, I think.

THE CHAIR: Can I take you back a step?

A Please.

THE CHAIR: If I've followed what you've said, you've identified a difficulty in determining whether or not a state of affairs may properly be described as "contamination".

A Correct.

THE CHAIR: I don't think you're challenging the concept of a contaminated water system----

A No.

THE CHAIR: -- where the suggested contaminant is a pathogenic microorganism.

A Oh, what's a pathogenic microorganism, and that's perhaps a separate question?

THE CHAIR: Well, in my simple, uneducated way, it is a microorganism which has the potential to result in infection or disease in human beings.

A And that's-- that would be a reasonable definition, but, in the broadest sense, any microorganism could be a pathogen because it is not as straightforward as "a bacterium infects a person". The patient factors and vulnerabilities play a large role in whether

that organism is pathogenic, so organisms that would not be pathogenic to most of us could, under specific circumstances, be pathogenic to a severely immunocompromised patient with multiple breaches in their physical barriers. By that I mean lines----

THE CHAIR: That might be accommodated by the word “potential”.

A But, in that sense, all microorganisms are potential pathogens, because-- if I remember, it was one of-- I believe it was Dr Mumford and Ms Dempster’s report, they presented a definition of a-- of a pathogen and it seemed quite reasonable, but it-- it did-- there were specifications.

One is that it had to-- and I-- I might have to go back and look up this exact quote, but it-- it said “causes disease at measurable rates” or something to the effect of-- there was some statement on-- on frequency, and I think that-- that’s perhaps an important part of that definition and it’s----

Again, I’m not saying that rare instances of infections can occur from organisms that would be normally considered of low pathogenic potential. Of course, this case reports report-- explain these all the time and report instances of unusual infections, and so if our definition of a pathogen, or a potential pathogen, is any microbe that has ever

been described in a case report of an infection, then all microbes are potential pathogens.

THE CHAIR: I probably took you away from the----

A And I probably diverged as well.

THE CHAIR: -- initial question, which is, as I understood you, you were pointing to the difficulty of determining whether a state of contamination has been reached----

A Yes.

THE CHAIR: -- but it seemed to me you were not challenging the concept of----

A No.

THE CHAIR: -- contamination where the contaminant is a microorganism?

A No, of course not. No.

THE CHAIR: No.

A I think it’s very clear in the case of microorganisms from a faecal source, and as I-- as I said, I-- I concede that that definition could be extended to organisms like Legionella, Pneumophila, and Pseudomonas aeruginosa.

THE CHAIR: My apologies, Mr Connal.

MR CONNAL: Now, I need to take a few things reasonably short with you, so if you could----

A Keep my answers short.

Q Well, that would be helpful on occasion, but don't miss out something that you think is key because, obviously, I'm keen to hear that.

A Yes.

Q The word "contamination", which you have issues with, as we've just discussed, does seem to be reasonably widely used in the context of water systems by lots of people who are spending their days dealing with water systems, you would agree?

A I'm not quite sure which group of people you're referring to----

Q Well----

A Because I work quite closely, as you've seen, with water engineers and-- and authorising engineers and Facilities, and that's certainly not a word that is used with abandon.

Q Well, no.

A It's quite a specific and serious situation. I think that's-- that's the point.

Q Well, I'm thinking, in particular, of the Water Technical Group, which did a lot of work in 2018 and onwards, and included experts instructed externally----

A No, of course.

Q -- experts from Scottish Government departments and entities, and so on and so forth, and-- which reached the conclusion that there was widespread contamination in the water system.

A Yeah.

Q Now, what weight can we give to that, given that you don't like the word?

A No, so-- I think it's important I-- I acknowledge that I'm in a fairly privileged position and that I'm looking back on those events. You know, I started in GGC in 2021. I was not involved in the events around that time, and since that time we've accumulated a lot more data, and so there is a lot more information on, "What do you detect on a gram-negative test in water."

In 2018, at the height of these events, I-- there's a very good chance I would have been just as alarmed at trying a new test and seeing the counts, and you-- I-- I gave the proportions of positivity. Now, that-- that would have been alarming.

Now-- and so I fully-- I understand. This is not a judgment on-- on anyone's decisions at the time or on the-- the terminology that they used. They were operating-- as-- as is often the case in infection control, you're-- you're operating with very limited data and having to make some big decisions, and it's only sometimes much later on when a lot more data has become available that you can reassess, perhaps, some of the conclusions that were made at the time on limited data.

Do you see-- do you see my-- The

point I'm making is that I-- a lot has changed in our understanding. As a result of-- of the concerns at the QE, we now have, I suspect, one of the largest water testing data sets, certainly of any UK hospital, so we-- we have a far more nuanced understanding of the microbiology of-- of water.

And another-- I think another key piece of research-- and this I really want to highlight because it was extremely important, and this was the paper-- and I think I refer to it. This was the paper by Dr Inkster published, I believe, in 2022 where this gram-negative test was performed at 10 other hospitals, because until that-- until that study, as far as I know, it had ever really been done at the Queen Elizabeth. Now, I don't know if I have an exact bundle number for that but, if it would help, I could look it up if we took a quick break.

Q No. I know the one you're referring to. I think Dr Inkster would say that the amount of testing in the other hospitals was pretty small to reach any firm view----

A It was. Oh, no, of course, because it was a study. It was small, but in many of those hospitals the positivity was 100 per cent for gram negatives and the counts were very high, and keep in mind this was not-- those hospitals-- I don't-- there's no suggestion in that paper that they were experiencing, to use the term that's been used, "water incidents". This is the normal-- presumably, the normal background.

When you perform a new microbiological test for the first time, it's important context to know what normal is, and that paper, I believe, is quite insightful, because now that-- in the benefit of hindsight-- That paper wasn't-- that-- that study hadn't been done in 2018. They didn't have a baseline. All they had was what looked like an alarmingly high positivity rate.

In hindsight, they now know-- well, we know, and that paper shows, that when you perform this specific test-- remember, it's bespoke to the Queen Elizabeth. When you perform that test elsewhere, under presumably normal circumstances, you get positivity rates that are, in some hospitals, just as high or higher, and you get counts that are just as high as higher.

So that, I think, is important context now when looking back, because either-- and here I'm-- I'm being quite specific about the gram-negative test results. Those gram-negative test results that you showed me in my report, when you look at them next to the test results from these other 10 hospitals, the Queen Elizabeth doesn't appear to be an outlier, so at the peak of the "water incident", the gram-

negative test results fall within the range, with some variability, that we now know is seen elsewhere.

Now, unless the suspicion is-- well, if we claim that the test results themselves-- again, being quite specific, the gram-negative test results are indicators of “contamination” in that-- both in the counts and the species detected, it then follows that these other hospitals would be similarly contaminated, and therefore, that-- if-- if everywhere is contaminated, that word loses meaning.

We-- This is-- Apologies, circling back. I realise I’ve talked a lot, but if we’re going to apply that word to microbial species that are normal water flora, surely-- and that are normal water flora that we now know we see elsewhere, then it’s essential that we say-- we say what-- what counts. What-- how high do they have to be for that to be contaminated?

Q Whatever happens in other hospitals, the conclusion in 2018 seemed to be that something needed to be done to----

A Of course.

Q -- remove potential pathogens from the water system.

A Yeah.

Q In part because people were reporting unusual infections.

A Yes, understandably.

Q Now, are you saying we place no reliance on that now?

A That we place no reliance on what?

Q The-- the conclusions reached at that time, the actions taken by the assembled experts?

A No, of course not. So, this is-- this is where the-- infection control, keeping in mind I-- I wear, if you like, two hats. I work in a laboratory. I run the diagnostic tests. I-- I do science, but then I’m also on the Infection Control Team, and so I now have a sense of the-- the similarities, but also the differences between those two worlds, if you like.

So, if I could give a-- an example, perhaps, to illustrate this particular challenge with infection control, and I promise it is relevant. Now, through random variability, occasionally, cases will look like there are clusters, right? We are-- suppose there is a-- a fixed background rate. That does not mean that those infections will be equally spaced over time. They can occur in clusters.

Now, when a cluster is noticed, infection-- good infection control will respond. It will-- and clinicians, hopefully, would notice, and perhaps that cluster is-- is a real-- by “real cluster” I mean perhaps there’s a reason, perhaps there is an incident or something that needs to

be managed, but there's a chance it is just random variability.

Now, from the perspective of those on the ground who have to respond to these, you don't know which situation you're facing, but good infection control needs to operate on a precautionary principle in that you have to assume that what you're facing is an incident, because you're operating on limited data. You notice the spike, and you should respond immediately.

But it's incomplete data. It's perhaps very preliminary. Perhaps it's a handful of samples that have a high positivity rate on a test, or suspicions of (inaudible 15:53:27), and so what Infection Control then does with the clinical teams and others is launch investigations, and this will be multiple parallel investigations usually because you don't know what type of situation you're facing.

There will be several hypotheses, and it's important that each of those is explored, but that interventions are also put in place for all of them before you know which, if any of them, is indeed what-- what you're facing.

So, suppose you notice an increase in infections, and this-- None of what I'm saying is meant to dismiss that gut instinct that clinicians have, you know, this-- this sense that, "Oh, the numbers appear to be increasing," or these little spikes that you see in data. If you get a spike, you have to respond, and-- and I believe that was the case here.

There was a-- a noted increase in '20-- at various points, 2017/2018, and immediately investigations were launched and interventions were put into place, including on the water, because that was one of the hypotheses. I realise this is getting long-winded. I promise I will get to the point.

The point is, you had your increase in infections, you put in place multiple different interventions, you investigated in parallel, and now your infections go down. That's what you would hope. The challenge is that, now speaking as a scientist, you have no way of knowing whether one of your hypotheses was entirely correct and that intervention is what brought down the numbers.

Q Yes, so if you do three interventions, you don't know which of the three has succeeded?

A Precisely, or-- It's not even-- It could have been a simple one of them, but you don't know which one, but there are so many factors at play here it could also be it was an interplay between a few of them, it was behavioural changes that arose out of the investigation itself, so it was perhaps something completely different, or it was pure randomness, and

I use this word in a technical, statistical way, but-- that would have resolved itself had you done nothing. But you don't-- You have no way of knowing that, and of course you can never test this experimentally.

It-- It would be unheard of to say, "Well, we think it's the water, let's put filters on half of the ward and see if they have"-- No, of course not. Infection Control has to deviate, and I use this term-- has to deviate from scientific practice. Scientific, you would have controls, you would do interventions separately, and then you could know which one worked, if any of them.

Infection Control doesn't have that luxury, so we need to be extremely careful when confirming causality based on the observation that the numbers decreased after multiple parallel interventions when it could be one, several, or none of them that actually was the reason for that.

And that's a-- that's a challenge that I don't-- I don't see a way to overcome it, frankly, especially when data, and by this I mean infection rates, which I (inaudible - audio glitch 15:58:02) and water testing results when-- with the benefit of hindsight and much longer timelines and detailed statistical modelling, when they show that, actually, what felt like a big peak-- and it would-- I'm not--

Again, it's not to diminish how the people facing that situation would have felt. They only knew the numbers they had in front of them. They didn't have the benefit of a-- well, now, I think, we have 15 years of data, in one of the look back exercises.

What would have felt like a big peak to those on the ground-- In hindsight, if we say, you know, yes, of course, perhaps there's a bit of an increase, but it's not as clear cut as it would have seemed to those on the ground at the time, and so I want to be clear that none of my concerns over things like the-- the use of the word "contamination", it's not meant to be a criticism of anything that was done in the heat of the moment.

This is coming from several years now of-- of data and far more information, and a wider context baseline of what water results are elsewhere, comparator data that some of the experts obtained, and that was-- that was a very useful exercise, was to request data sets from other institutions, because-- but that wasn't available at the time.

Q Well, I can understand that it's possible that the result, i.e. the disappearance of the infection, for instance, the non-recurrence of the infection, is purely random, it's due to something we don't know, it's nothing we'd thought of, it's something

completely----

A For factors that we don't yet understand.

Q Yes. There's something that's happened that we don't know. If you undertake an intervention and things don't improve, you might conclude----

A That your----

Q -- randomness apart----

A Yeah.

Q -- that whatever you're doing isn't helping.

A Correct.

Q On the other hand, if you do intervene, perhaps in a variety of ways because you can't, as you say, experiment on the patients by saying, "Well, we'll try A and B, but, hey, let's not bother with C"-- If you do intervene and the infections decrease, is there not then at least an argument that says the interventions have been successful? One or more of them?

A Possibly, but I would be careful about ascribing causality – because here it's causality, intervention caused a decrease in infection – to something that could be explained by a statistical concept of regression to the mean. Is this-- Would it help if I explained regression to the mean?

Q I suspect I wouldn't be any the wiser after you did so, but what you're saying is you don't necessarily accept that proposition?

A I'm saying it's not as straightforward as that, because----

Q No, I'm not suggesting it's straightforward----

A Yeah.

Q -- because there are all kinds of random possibilities.

A No. If you've put in multiple interventions and your infection numbers have decreased, one of the possible explanations is that one or more of those interventions has had an effect. That's-- That's fine, no, I'm absolutely not disputing that.

Q Well, let's see if we can move on, because I want to ask you some reasonably short questions about some other topics, if I can.

A Please.

Q Usually I spend all my time with people looking at their witness statements, and I'm not really going to spend any great time on your witness statement, partly because it's very short, partly because we've covered a lot of other topics. I really just wanted to ask you two things about that.

THE CHAIR: Matter of housekeeping. Did you ask Dr Chaput whether she had adopted her----

MR CONNAL: Yes.

THE CHAIR: You did?

MR CONNAL: I did. I did.

THE CHAIR: Right, so, in a formal sense, it's part of the evidence just as any witness statement is.

A That's fine.

MR CONNAL: In your witness statement, and I noticed you used it in your evidence earlier, the word "negligent" comes up. Now, you use that in paragraph 22 on page 8. You say that there's an inference that the detection of an unusual species points to "deficits in the built environment and/or negligence."

Now, I just want to ask you why you use the word "negligence" because I can't remember-- now the fault may be mine, but I can't remember anyone actually suggesting that.

A No, no, and apologies if that was too strong a word.

Q I mean, one can see, if somebody doesn't do something that they should have done----

A Yeah.

Q -- and a consequence arises, you can apply various epithets to that.

A Of course.

Q We know that we're talking in a background where, to put it no higher, a lot of effort goes into trying to look after the water in a complex system like the Queen Elizabeth University Hospital.

A Yeah.

Q The only other thing I wanted to ask you about that area around your witness statement is that there was an exchange with Dr Mumford, if I can call it that. You raised certain issues, Dr Mumford replied----

A Of course, yes.

Q -- you read the reply. It's tempting, given the hour, to try and summarise it short. Am I right in understanding that your complaint, if I can call it that, about the way Dr Mumford still presents is that using the reference to unusual organisms but only in relation to GGC presents a sort of biased picture?

A Yes, but let me specify how I use the term "bias". I refer always to an analysis or an approach, right? This is not meant to be an accusation or to imply any intentional bias, right? The term "bias" is used, certainly in the process of academic peer review, for example, when we discuss whether a certain analytical approach might favour, unjustifiably so, a particular conclusion.

And the issue I saw and I raised, and this was-- this was based on Dr Mumford's oral evidence, was that she was quite clear that the GGC list, if I'll use that as a shorthand, had been used to select organisms from the comparator lists, and that the rate was calculated across those. And, actually, Mr Mookerjee said something along those lines in his oral evidence as well, that it was the GGC list that was used to select

the organisms in the other comparators.

Now, where I say this approach is biased is that in, for example, a situation where there were organisms on the other lists that would meet this definition but that weren't on GGC's lists, they would be excluded from such an analysis, and so GGC's rate, if that's indeed how it was calculated, would be artificially inflated.

If we ran the exercise another way and we used the list from Great Ormond Street to select the taxa, it would leave out organisms on GGC's list and it would be biased against the Great Ormond Street rate. Notice I'm using "bias" for the analytical approach here.

So there was this issue of how these rates were even calculated. Now, I note that Dr Mumford has corrected this in her response to me, and that's-- that's fine, I'm glad-- So, she-- she's clarified that, no, Mr Mookerjee used all of the organisms that met this definition in his rate calculations.

I had attempted to check this, but, as-- as you know, I have concerns about some of the other calculations that derive these rates. But if I-- if I may, I'd like to separate the organism lists from the rate calculations.

Q Well, I was just keen to get your answer about the use of the word "bias".

A Yeah.

Q I mean, in an analytical sense, are you still suggesting that Dr Mumford's approach is biased?

A If, as she's corrected in her addendum, so if we now consider that her-- what she said in her oral evidence no longer stands but has been corrected, if indeed the full list was used to calculate the rates, then the rate calculation is not biased, but – and this is where I do want to separate out the list from the rates – looking at the lists of organisms itself is informative, right?

And, understandably, this Inquiry has often focused on different versions of this list. What we have not seen before, and what was not presented and I argue should have been, is the list of organisms from the comparators. Setting aside the rates for now, the-- just the lists, because, as I showed, all of these comparators have a fairly noticeably long list of organisms, or a-- you know, some organisms that do not occur elsewhere. They were unique to each hospital.

Now, why does this matter? The list itself, you know, various-- as I-- as I've outlined in this witness statement, and I realise, you know, we're-- this is running on a bit, but the way that the list, I feel, has been used is to ask, "Should these have occurred?" Right? These questions about background rates, and various highly qualified microbiologists

have said, for this-- for a large number of these, there should be no background rate.

Now, it would be easy-- at least my interpretation of that would be, well, if under normal circumstances these should not occur, and yet here's a long list from GGC where they clearly have occurred, it doesn't take many-- it's not a long jump to say, well, then this-- these are not normal circumstances, right? If----

THE CHAIR: Can you help-- Sorry----

A Yeah.

THE CHAIR: I don't mean to interrupt.

A No, no, of course.

THE CHAIR: Finish what you were saying, by all means.

A So, I-- That's-- So, for me, it was, if it appeared that that was a possible interpretation that various witnesses have said these organisms have no background rate and therefore shouldn't occur under normal circumstances----

THE CHAIR: Well, that was the point I was going to ask for your help, because, previously, when I've heard references to certain organisms having no background rate----

A Mm-hmm.

THE CHAIR: I've interpreted that as meaning, "We do not have sufficient experience with that particular organism to give rise to an expectation of any particular rate," whereas----

A Interesting.

THE CHAIR: -- you are presenting a different interpretation of that expression----

A Perhaps----

THE CHAIR: -- which is that you should never find this organism.

A This isn't my interpretation. This is me----

THE CHAIR: I'm looking for help, I'm not challenging what you're saying.

A -- trying to read how this line of questioning would have been perhaps interpreted, and I think it's there-- if that's even a possibility. If-- If someone says these have no background rate, and it's not one or two, it's a long list, perhaps-- perhaps I'm interpreting this in a-- in an unusual way, but it-- I could see how it would be fairly easy to come to the conclusion that therefore they shouldn't occur, all of these.

Now, therefore, in a comparative exercise, looking at lists from other places could either support or refute that. Suppose-- Suppose the lists from the comparators had been presented and they were relatively short and they were, if you like, the more common ones, and they did not have this big trailing tail of more unusual things, then, if GGC stood

out that, that would be evidence that perhaps something abnormal had happened. Would that be reasonable?

If GGC's list was very long with a lot of organisms that several people say should have no background rate, and then the comparators, had you been shown that, if those lists had been very short, that suggests there's something different about GGC. Now-- So I think it's important to show, for context, what do the lists of organisms look like from the other hospitals.

THE CHAIR: I think probably, for the Inquiry's purposes, it's sufficient if I understand your point, and I think I do.

A Mm-hmm.

THE CHAIR: I hope I do, at least.

A Okay. Basically, I say, for context in a comparative exercise, one should show the data from the comparators including the lists of organisms, because one thing that did come out is for example, Mycobacterium occurred in most of the comparators.

Now, perhaps I missed it, but I don't think this evidence was ever put forward to the Inquiry, but those-- and given the understandable focus on that organism, it seemed relevant, in order to be able to interpret the data from the QE, is to know what other hospitals experience in terms of that particular genus of organism as one example.

So, showing the lists-- So, back to the question of bias, the rates, if the rates were indeed calculated from the full agglomerated list that does address that concern of the calculation. I have other various, very serious concerns about how those rates are calculated, but that-- that would be addressed by the full inclusion of the list.

However, presenting only GGC's list and not the list from the other hospitals as a communication approach, I believe, is biased.

MR CONNAL: Let me try and ask you something else.

A I'll try to keep my answer shorter.

Q That would again be very helpful.

A In the interests of time.

Q Just based on the pure practicalities that we're faced with. I have a lot of questions I could have asked you, but I'm going to shorten it because, for all kinds of reasons, it's preferable that we can conclude your evidence----

A Of course.

Q -- shortly. You were a contributor, if I can use that word, to GGC's Direction 5 response, to an appendix to it that we see in bundle 44, volume 3, at document 1. If we could have that-- That's Dr Peters' response. We want the GGC one, which is

document 1.

Now, if we flip through this to the appendix, because there's some narrative and then there's an appendix----

A Yes.

Q (After a pause) Can we just continue? Were you a contributor to this document?

A Of course, yes. My name's on it.

Q Is this the one where it said, "By [you] and contributed to by"----

A "Infection Control Doctors", yeah.

Q And who were they?

A There were three: it was Dr Marek, Dr Bagrade and Dr Bal.

Q The last name was?

A Bal, B-A-L.

Q Thank you. Is it possible to work out who did what?

A If you have specific paragraphs, I could explain whether I contributed a little bit, a lot, or not at all.

Q Right, so you all contributed to the text?

A Yes. I took the lead in writing it, but based on discussions, and some sections were-- were written more-- were drafted by others, and we all reviewed the final document.

Q Well, there's a lot of material in that document that we might characterise as-- as argument----

A Of course.

Q -- or presentation, rather than evidential material. I had a note about paragraph 15. I don't know where that is. It's not cropping up here.

A Further down, I believe. The appendix.

Q Ah, yes. We're on the wrong appendix. We were in appendix 1, not appendix 2.

A This is the correct one.

Q So I'm only going to identify one or two what you might describe as factual statements, just to see who----

A Yeah.

Q -- is responsible for them. Now, in paragraph 15, there's a statement asserting:

> "... a lack of knowledge of microbiological water testing and of the purpose of the NIPCM appendix."

A Yes.

Q Who contributes to that bit?

A I led-- I drafted that, but we all contributed.

Q Right. Is that from your own knowledge?

A Yes, but also with-- through discussions with others.

Q If we go to paragraph 18. Again, there's a statement that a paragraph is incorrect----

A Yes.

Q -- and we'll ask about that when other witnesses come. Who produced that?

A I did, I wrote that.

Q That's yours again?

A Yeah.

Q How do you know, when you say:

> "There is no way that the laboratory would have failed to report the isolation of Enterobacter."

A Because Enterobacter is a Coliform, as we've been through, and there are strict rules on Coliforms. These-- These are widely adopted thresholds, that there can be no Coliforms in water, and this water testing laboratory is UKAS accredited and therefore meets quite rigorous standards, and so it would be obliged to report an Enterobacter in water. That's just-- That was-- That's a factual-- This is to correct a factual statement, is that the-- the-- This was in response, I believe, to----

Q I think to something Professor Stevens says.

A It's this-- If I can, this is in response to this particular wording:

> "... it is highly probable that the actual number of total Enterobacter... was much higher [than this]..."

Q You don't accept that proposition?

A That's the statement that I do not accept, because that implies that a UKAS accredited environmental testing laboratory is identifying Enterobacter and not reporting them, and I needed to request that that be corrected.

Q If we go to paragraph 24-- This is just so I can take the matter further in due course.

A Yeah.

Q There are comments about blood storage, or sample storage there.

A Storage of isolates.

Q Is that you?

A This was joint. This had more input from-- You know, the Infection Control Doctors are also consultant microbiologists, so in-- but-- but myself as well. This was-- This was joint.

Q I see.

A And I believe it's about the timing-- or how long isolates should be stored, and it's because of some either implicit or explicit criticism that, for the retrospective whole genome sequencing work, some of the very earliest isolates weren't available.

Q The final point I just want to ask, while we've got that open, you comment in paragraph 25-- or you, whoever, comment in 25 that "the CNR authors allude to deficiencies in... IPC

practices".

A That was a comment from the ICDs that, yeah.

Q Right, because there is a section in the overview report in which the CNR authors deal with IPC practices.

A This was something that the ICDs felt quite strongly that they wanted added.

Q Very well. Thank you. Now I think, my Lord, I'm probably getting to the end of the questions that I need to ask, apart from, I just want to ask one series of questions, just because we have the slightly awkward situation where we don't have a document here, for reasons that I think have been explained to you. I just want to deal with that briefly so it goes on the record and everybody then knows openly what's being done.

A Of course.

Q Wednesday last week, you sent a document to the Inquiry which included something called "Supporting evidence, de-duplication"----

A Yes.

Q -- in which, among other things, you set out a critique of de-duplication of GGC data. Is that correct?

A Yes, that's-- that's new. There are other----

Q There are other criticisms there----

A And those have been raised

before.

Q But so far as the de-duplication of the GGC data, that is new.

A That is new, and if I may add, the de-duplication of the GOSH (Great Ormond Street Hospital) data is new.

Q Right.

A Concerns about that. Because that arose from the data table that Dr Mumford provided in her addendum, so her response to me. So I-- I-- That was new information to me, where she showed Mr Mookerjee's workings for Great Ormond Street as evidence that he had included the organisms in his rate calculation, but----

Q Any issue of de-duplication of GGC data has been-- Well, that data has been around for some considerable time, has it not?

A It has, yeah. Why have I only raised it now?

Q Why have you only raised it now? Because you'll appreciate, it creates a practical issue.

A No it's a-- Of course, and it's a fair question. The blunt answer is that it did not occur to me that I would have to go and check those numbers, that when Mr Mookerjee outlined how he had de-duplicated the data, that he had done so. That's the end of my answer.

It's only-- If I may continue, it's only because of his workings for Great

Ormond Street, which were shared at the end of July in Dr Mumford's response, and concerns over how those numbers were computed, because when you compare those – and I show this – he did not compute the Great Ormond Street numbers correctly.

Let me-- Let me point something out here. It was not in GGC's interest for me to point out that the Great Ormond Street numbers might have been inflated. It would have looked much better for us if, assuming our numbers had been de-duplicated-- but as I pointed out back in December, Leeds did not provide de-duplicated data. They state that in their return. That favours us.

In these charts, these comparative charts, if the Leeds numbers are inflated and ours are supposedly de-duplicated, if I wanted to be biased towards GGC, I would not have mentioned this.

Q Well, you'll be pleased to know I'm not about to ask you if you're biased or not.

A No, no, but I-- I think it's important, because there have been-- There are multiple different types of, shall we call them disagreements, around many aspects of this, and some of those types of disagreements I would classify as reasonable professional disagreements: "Which approach is better?", "How do you interpret this?" You know, "Should we use bed days or total admissions?"

Frankly, I don't think it's that-- As long as the person doing the analysis has a good reason and can justify it, neither of those approaches is invalid. "How do you interpret causality?" You will hear different answers, and there will be some disagreement, and this is in the category of reasonable professional disagreement.

The concerns I've tried to raise – and this is not strictly-- this is not limited to the de-duplication; these concerns have been raised in the Direction 5 responses to Mr Mookerjee's work – they're a different category of concern or disagreement, and those ones are what I would call factual or analysis-- technical analysis steps that are incorrect. Those ones I-- are-- I can demonstrate.

We shouldn't have to exchange responses and rebuttals, because, for example, for Leeds, which-- the claim was made that those data were de-duplicated. I would ask that you look at the Leeds FOI response, and they state, "We do not telepath [something]"-- I have it here, but you have it as well. Not yet public, I appreciate that, but I did-- I believe I outlined this in my-- at the end of my comparative organism report from December.

They state, "We did not de-duplicate as telepath-- our telepath system does

not carry information on what constitutes an episode." There's no ambiguity here, right? There's no-- It's not a matter of opinion whether Leeds de-duplicated their data or not. They said in black and white that they did not. Similarly, Cardiff and the Vale, one of the other comparators, stated that they did de-duplicate, but they did not say which criteria they used, what the definition--

And I know there's been discussion about whether it should be 14 days from the first sample or 14 days from the last sample. That point is moot if the de-duplication hasn't occurred at all.

Or, if the de-duplication has been done by single sampling date, because other ways to interpret the term "de-duplication" would be, for example, if a patient has a line and it has two ports, and in one sampling event they have different samples, and each sample grows an organism, the same organism, one interpretation of de-duplication would be that those are combined for a single day.

So it's not clear how Cardiff and Vale de-duplicated their data. It's certainly not clear how or if Oxford deduplicated their data, and, as I explained-- And I'm not referring to the document you received last week, I'm referring to the comparator organism report-- Would it help to have a

document number, or----

Q No, we know the one you're referring to.

A Okay, so these are not reasonable professional disagreements. I was expecting to have plenty of those. We've perhaps had some of those today. This is a different type of concern, and the concern is that those calculations and the comparisons are invalid. I choose that word carefully, because it's a strong word. But, from an analytical point of view, you cannot compare these institutions the way that it has been attempted.

Now, in preparing my response to-- or in preparing for today, I read Dr Mumford's addendum. There were some useful points of information, I think, or clarifications, in that she has confirmed that it's not her position that GGC's lists of organisms was any different. She states that. It's her position that it's the rates as calculated by Mr Mookerjee. So a lot is resting on how Mr Mookerjee calculated those rates, and if you completely set aside--

I appreciate the document I shared with the additional concerns was only prepared-- It was very quick for me as well. Let's set that aside. The concerns I raised in that comparator report where I clearly state Leeds did not de-duplicate, Cardiff and Vale said they de-duplicated,

but it's-- we have to assume that they did it by exactly the same criterion that Mr Mookerjee did. Oxford doesn't say how or if it de-duplicated.

The way that their tables are presented suggests the de-duplication could only have been partial. Great Ormond Street-- Great Ormond Street provided a very detailed return. Hats off to whoever at Great Ormond Street prepared that, because it is very well done. So I had assumed at least Great Ormond Street was fully de-duplicated, because they provide a column with a 14-day-- 14-day episode count.

Now, the additional material I shared last week was when I realised from Dr Mumford's table that the GOSH (Great Ormond Street Hospital) calculations are wrong. So, Mr Mookerjee has not correctly added up GOSH's episodes, but it's not-- Of course, I say this, and I say this because I'm able to show with-- with the information that you hold on your servers. This is nothing new.

If you have the FOI return from Great Ormond Street and Dr Mumford's addendum, as I outlined, please put them side by side. Mr Mookerjee's calculations do not align with the fully de-duplicated Great Ormond Street data set.

Now, of course-- Now I was in a position where I saw, "Oh, Great Ormond Street's numbers are potentially artificially inflated. Leeds' numbers are artificially inflated. That actually looks worse for GGC." So I went back just to check because perhaps that's true, and that's where additional concerns arose, as I've outlined.

All this stems from Dr Mumford sharing a snapshot of Mr Mookerjee's workings for Great Ormond Street, but even that new data aside, the concerns about deduplication alone render that comparison invalid.

And this was-- Dr Mumford responded to this comparator report but did not address that part of it. She still relies, for her conclusions, on that rate calculation and on this ratio, you know, "GGC's so much higher than the others."

A lot relies on that rate calculation and, as we know, there have been concerns about the denominators. I believe it's-- we're now on the third attempt at getting a rate that is remotely comparable at the denominator level, because there were decisions to exclude GGC's day case admission numbers but retain them-- well, use the totals for the comparison. That's invalid.

Now, let's say the denominator issue has perhaps been resolved to some extent, but the numerators are equally invalid, and it was really important that-- and thank you for this opportunity,

because it's important to distinguish this type of concern, which is numerical and demonstrable and not a matter of opinion.

And the fact that I work for GGC, with whatever biases come with that, does not affect what's written on the Leeds return saying that they did not deduplicate their data. These-- this is a different category of concern.

Q Well, I think that's been helpful, Dr Chaput, because, as you say, you have taken an opportunity to expand an answer in order to explain the nature----

A I have----

Q -- of your concern, whether or not you were asked a question about it, but that's by the by. My Lord, I am proposing to finish my questioning at this point. I don't think anything will be gained by continuing it. I have had other questions from other parties, but I am not sure whether there is anything else in the room that we will need to do tonight.

THE CHAIR: Well, on the other hand, as things stand, this is the opportunity to ask Dr Chaput questions, and I appreciate the hour is a little later than we usually sit, but it's only a little later and, therefore, I would propose to follow our usual practice of giving legal representatives the opportunity to make any proposals to Mr Connal that they wish to do. If you could perhaps-- This might take us about 10 minutes, Dr Chaput.

A Of course.

THE CHAIR: So could I ask you to return to the witness room?

A Yeah, of course. Thank you.

(<u>Short break</u>)

MR CONNAL: I have a small number of questions, my Lord. Whether I can get short answers to them remains to be seen.

THE CHAIR: Well, we shall see. (After a pause) Some further questions, I understand, Dr Chaput.

A I'll attempt to keep my answers short, I promise.

MR CONNAL: Once again, it would be much appreciated. First of all, really, almost-- it's a point that I think I was starting to put to you and then it got cut off by one----

A Apologies.

Q -- of your answers. It's simply to make the point, which to some-- It's almost not a question. It's more to make the point that the document we've just been discussing that you produced last week, which has some new challenges to figures, is not one that the other participants who----

A Of course.

Q -- are present here today have

seen and they will not see until it's next to Dr Mookerjee's consideration and response to it, which hopefully will be very soon.

A Yes.

Q So it won't actually emerge, so that when we're having a discussion about it, I take it you understand that that's a constraint.

A Of course, yeah.

Q A couple of questions about the involvement of what I might describe as national agencies: in the context of discussing your presentations and so on and so forth, you did mention NSS Assure.

A NHS Assure.

Q NHS Assure?

A NHS Scotland Assure, I believe, is their full title.

Q At the time that you dealt with a significant challenge for the reopening of 2A, are you aware that they offered to come and inspect and were told no?

A I don't remember, I'm afraid. I was not involved in the discussions happening with NHS Assure.

Q The other point is, just at the risk of getting you excited again by using the word "contamination", we know that I mentioned earlier in the question the Water Technical Group and so on and so forth.

A Of course.

Q That then led, finally, in 2019, to a report by the government agency Health Protection Scotland----

A Yeah.

Q -- which was to have recommendations for the whole of the NHS in Scotland.

A Mm-hmm.

Q Do you know what that was entitled?

A I-- I presume, based on this line of questioning, that it includes the word "contamination."

Q It does.

A Yeah.

Q And that's what you say is, with hindsight, incorrect?

A This is where-- This-- Where I-- No, "incorrect" I reserve for the second type of objection. This is a-- what I would call a reasonable professional disagreement.

Q Okay, thank you.

A I reserve the terms "incorrect" and "invalid" for demonstrable errors.

Q Okay. When you were asked to just carry out an exercise and assemble all these water testing results to produce your report in 2023----

A Start-- Yeah, starting in 2021----

Q Starting in 2021 but ultimately----

A Yeah.

Q -- the report that we saw, and you narrated, at the start of that report, which agencies were involved, what DMA Canyon were doing and various changes in that.

A Yeah.

Q Were you aware at that time that there was a question as to the appointment of appropriately trained people to supervise water at the hospital?

A I was vaguely aware of discussions around that, but no.

Q Here's another question that we could probably have usefully asked you earlier. We know that the report shows that, in the years prior to, say, March/April 2018, there was a relatively modest number of water tests being done, given the size of the campus that we're dealing with.

A Yes, that's fair.

Q Do you have any view as to whether that testing regime at that time adequately met what was required by guidance, particularly SHTM 04-01?

A Bearing in mind this is looking back several years before I was even employed with NHSGGC, as far as I understand, the guidance in place was fairly limited in what it suggested in terms of routine water testing, and my understanding was that, broadly, that guidance was being followed.

Q Yes. Do you have any detailed knowledge on that, or that's just something you're----

A No, that's something I've----

Q Yes.

A That's my interpretation looking back.

Q Okay. Now, finally, I have two or three questions about biofilm which I've been asked to put to you by one of the other participants. I realise biofilm can be a very complex----

A It is.

Q -- technical topic, so I'm hoping that we can nevertheless come to reasonably concise answers to these. The first question is, if you leave water in a large holding tank----

A Mm-hmm.

Q -- where there's not much throughput, it's not flushed in the sense that an outlet would be, is that the kind of activity that could lead to the formation of biofilm?

A Yes, stagnation.

Q And if biofilm is not either disturbed by flushing or adequately dealt with by other forms of disinfection, can it evolve over time and----

A Yes, absolutely.

Q -- and become more complex?

A In microbial ecology, the term "succession" is, first, there are a few organisms that colonise, they set the ground, and then additional species are

able to settle, and that's a term called "succession". It's-- It's also how soils form-- form from rocks. It's-- It's a well-known phenomenon.

Q Yes. Finally, hopefully, is one of the issues with mitigation measures trying to deal with biofilm, whether that's disinfectant or whatever it happens to be, the risk that, in attacking the biofilm, you cause the biofilm then to release its content of microorganisms into the water system where they then make an appearance elsewhere?

A Yes, that's-- that's quite a reasonable-- it's quite easy to picture how that could happen.

Q Thank you very much. I have nothing further, my Lord.

THE CHAIR: Dr Chaput, I think that's all we have for you. You're therefore free to go, but thank you for your attendance this afternoon, thank you for your careful answers, and thank you for what is clearly a considerable amount of work that you've put in in relation to the Inquiry and in preparation for your evidence today. So thank you very much, and you're free to go.

A Thank you.

(<u>The witness withdrew</u>)

THE CHAIR: Well, I think, probably, that brings us to an end of today, but we'll see each other, all being well, tomorrow at ten o'clock, as I understand it, with Dr Drumright.

MR CONNAL: And Mr Mackintosh.

THE CHAIR: Sorry?

MR CONNAL: Mr Mackintosh will be dealing with Dr Drumright.

THE CHAIR: And Mr Mackintosh will be leading that evidence. So can I wish everyone a pleasant evening.

(<u>Session ends</u>)

17.01