SCOTTISH HOSPITALS INQUIRY

Hearings Commencing
19 August 2024

Day 24
Thursday, 26 September 2024
Peter Hoffman

CONTENTS

10:04

THE CHAIR: Good morning. Good morning, Mr Hoffman.

THE WITNESS: Good morning.

THE CHAIR: Can you hear me?

THE WITNESS: I can hear you.

THE CHAIR: Right. Now, as you understand, you're about to be asked questions by Mr Connal but first, I understand, you're prepared to affirm. Am I correct?

THE WITNESS: Correct.

THE CHAIR: Could I ask you, sitting where you are, to repeat these words after me?

Mr Peter Hoffman, Affirmed

THE CHAIR: Thank you very much, Mr Hoffman. I don't know how long your evidence will take. We, here, will break for coffee at about half past eleven but if you, for whatever reason, wish to take a break, just give me an indication and we will take a break. I just (inaudible) feel entirely in control of the process. I think you have available to you a screen dedicated to any documents that you may be asked to look at. Something that's been pointed out to me that in order to look at any document you will probably have to turn to the side and, I think, what I would ask you is to bear in mind that we need to hear you, therefore, we've got to balance you being able to look at a document and being able to look at your microphone. With that, I'll ask Mr Connal to begin.

Questioned by Mr Connal

Q Good morning, Mr Hoffman.

A Good morning.

Q I have a number of things to ask you about, as you probably have gathered by now, but you have produced a statement for the Inquiry, and can I just ask you the formal question? First of all, are you content to adopt that statement as part of your evidence for this Inquiry?

A I am.

Q Thank you. I'm grateful to you for providing that because, as you probably have gathered also by now, a number of people who were involved in the Cryptococcus discussions are not available to the Inquiry for one or other unfortunate reason. So, thank you very much for that. If I could just start by touching on your background. I suspect you're known to a number of participants in the Inquiry, but not necessarily to everybody who is either present in the room with us here or watching. You've set out in your witness statement, and we'll come back to that a little later we

needn't bring it up just at the moment, your qualifications. Am I right in thinking that, essentially, you started off as a scientist in a public health laboratory and then continued progressing through not only professional progression but also changes of name of the various institutions for a pretty long period? Is that right?

A That is correct.

Q So, you spent your entire career working in the public arm of areas concerned with hospital infections in particular?

A Yes.

Q When you list in your witness statement various things like that, was one of these places sometimes called Colindale? Because I think we've had Colindale referred to.

A The location has always been Colindale. Started off with central public health laboratory. Then the public health laboratory service morphed through a variety of organisations ending up in UK Health Security Agency.

Q Thank you. Well, that's very helpful because, occasionally, witnesses have mentioned doing something with Colindale and that's obviously what that refers to. It's one or other of the iterations of that location. Your special interest, you say in your statement, is basically how microbes cause infection, particularly in the context of healthcare. Is that right?

A It is how microbes transmit to susceptible individuals, principally those who are hospital patients or undergoing other forms of healthcare.

Q Thank you. Now, we'll come in due course to the topic of Cryptococcus and we'll probably trip up over it before we get to the formal bits that are covered in your statement, but can I ask you this. We know, in the context of Cryptococcus, you ultimately became a part of a group that were looking at a Cryptococcus issue at the Queen Elizabeth Hospital. So that was, if you like, a particular role in which you were asked to assist.

We also have indications that you were, and I'll use the word “consulted” in inverted commas because the means varied, from time to time by individuals from or related to the hospital. I think you've probably been provided with examples of those, and I'll come to ask you about them shortly. Can you just help us understand, how did these come to be? I mean, if you're consulting, say, a private sector scientist, you'd probably have to produce a fee quote and a programme of work and all those kind of things. Were these somewhat less formal communications that tended to come to you?

A Yes. People would email me, telephone me, catch me at meetings, ask

me questions I would answer.

Q I think you would describe by someone – it's my fault I've forgotten who – as quite happy to make yourself available for these discussions. Is that a fair comment?

A That was an essence of my job, yes.

Q Thank you. Now can I ask you this, then? The-- You've disappeared from one screen, but you've-- You've come back. Thank you. It's all right. One of our screens just went temporarily blank, but it has returned. The Queen Elizabeth Hospital was obviously planned, the building was planned, over a prolonged period but the contract arrangements and so forth were being put together in 2009 and beforehand. Can I ask you whether you had any involvement, to your recollection, in the planning and discussions of what systems were to be in place, say for ventilation, at the new hospital?

A I gather from the bundles of documents that I did, my memory on this is vague, various things are recalled in the bundles of documents. So, yes I did.

Q Yes. Well, what I just want to be clear-- that the first-- I'll come to those documents because it's not fair, given you say your recollection is not good on them. The earliest document that we have you mentioned in is in 2010, and I'll turn to that just in a moment. By 2010, much of the planning for the hospital had been done, a contract had been signed, and so on and so forth. Can you remember anything before that?

A No, I can't.

Q Do you remember ever visiting the Queen Elizabeth Hospital?

A I did not.

Q Thank you. That's you didn't visit? It's not you don't remember visiting?

A Correct. Had I visited, I would recall it. I do not recall it.

Q Thank you. Now, I wonder if we can then go to the first of these documents. So, if we could have Bundle 17. Page 3033, I think we'll start with. Now, there's a sequence of emails, in fact, we'll-- Yes. If you see at the bottom of the page, of page 3033, and I know you're having to look at this on (inaudible), and what's happening there is somebody called Jackie Stewart is asking Craig Williams and John Hood, who I think is a name that you at least recognise as someone you've come across before. Is that correct?

A Yes.

Q Copied to various other people saying:

"I'm going to be on annual leave. Can you contact Fiona McCluskey, who was a member of the project team for the

hospital, with the decision regarding the ventilation for the area that renal outpatients will be dialysed?"

So, that's an outpatient area.

"This will prevent any delay as information is needed as soon as possible."

Then, that's on the 15 October, and we see above that another message saying, "can you tell me what the answer is," basically, "because it's urgent." Then, if we go on to 3032, what we see, and I'm trying to take these in order in the annoying way in which emails run backwards, we find at the bottom of the page John Hood saying:

"Not really happy with reduction of ventilation in a dialysis area, the 2.5 air changes. Air changes are about dilution and removal. The issue in other ACH units seems to be about temperature control, not air changes *per se*. A normal ward area would be expected to have at least six."

Then, if we go back to 3033, he says:

"I'd like to discuss the issues with my colleague and expert Peter Hoffman from the HPA. Unfortunately he's on leave and won't be back until the 25th."

Now, we understand he then got in touch with you. First of all, do you have any recollection of the discussion you had with him?

A No. I don't.

Q Well, if we go back to 3032, what is recorded, and that's all we have at the moment, it is Dr Hood saying:

"Just had a useful conversation with Peter Hoffman. He's happy with the proposal that chilled beams are employed in this renal dialysis area. [It's the outpatient area]. He explained the suggested six air changes an hour is really for temperature control, not for infection control, i.e. not dilution or removal, as I mentioned. He agrees any more invasive procedures should take place in an appropriately ventilated treatment room."

And then there's a comment about something else that we needn't trouble you with. You don't remember having that discussion. Are you able to help us with the comment about six air changes being for temperature control, not removal? Can you explain what you appear to have been saying to Dr Hood?

A Yes, the primary purpose of ventilation in all contexts is for the comfort of people within the area being ventilated. There is, it's almost a global standard which started off I think in the 1950s or 60s with the American Society of Heating and Refrigeration engineers, known by the acronym ASHRI, that in areas where people do not smoke, that the standard ventilation to control

temperature, to control odours would be six air changes per hour. That has become a global standard.

In outpatients' renal dialysis, there is no real infection prevention imperative to dilute to remove airborne microbes. Patients are essentially fairly healthy and there are no open wounds that will be susceptible to airborne microbes landing in them. So, ventilation rate is not an infection prevention requirement.

Q So, although you've no recollection of this conversation, I-- Sorry, I should have asked you, you won't be able to tell us whether Dr Hood has correctly recorded what you told him or not because you simply can't remember.

A It sounds very much like the sort of thing I would say.

Q Thank you. For the reasons you've just explained to us?

A Correct.

Q Thank you. I wonder if I could ask you, I'm going to do a number of similar exercises, Mr Hoffman, of referring you to other communications. I'm trying to take them in chronological order, although I may fail in that endeavour at one point or another. I'll ask you similar questions about them, if I may, whether you recollect them, and so on. Could we now have bundle 14, volume 1, page 31, please? Now, we have had quite a lot of discussion in the Inquiry so far about something called isolation rooms, and I may come to ask you a more general question about that shortly, but what we have here appears to be an email from Teresa Inkster. Is that a name you recognise?

A It is.

Q If you see the bottom of the page, that's someone you knew?

A Yes.

Q At the bottom of the page, she's saying:

"Peter, could I ask your advice about isolation rooms? I've been shown plans for the new hospital, which include a suite of isolation rooms."

So, this is 2012. Now, just so you've got these dates in your head, the new hospital was handed over around January of 2015, and patients came in a few months after that. So, this is still at a point well before occupation takes place. So, Teresa Inkster is saying:

"Could I ask your advice? I've been shown plans which include a suite of isolation rooms with lobbies. I'm not familiar with these rooms, although I'm aware they've been put in new builds elsewhere. Are there any disadvantages as opposed to the conventional negative and positive pressure rooms? "

Now, first question: do you recollect this exchange with Teresa Inkster?

A I don't, but reading the-- so,

no, I don't recall the precise exchange.

Q No. However, looking at the email, we find a reply from you on page 31, saying you "suspect these are positive pressure ventilated lobby rooms" to the design in HBN4 supplement one, which you attach, and then you say you're "not sure of the position in Scotland".

Could you just take us through-- you've made some comments in this email on in the main paragraph. You say you're "not entirely happy" with this concept and you see it as a series of solutions that may not merit – as you put it – “that degree of solution" and then you explain what the concept is. Now, his Lordship is quite keen in the Inquiry to understand about PPVL rooms because there have been various views expressed by different people at different times and what you're doing here is setting out what you think the concept is. Is that right?

A Correct.

Q You say:

“The concept is that a high volume of air supplied to the lobby, and the air then flows out both to the corridor and into the room.”

Is that right?

A Correct.

Q That's what the idea is:

"Creating a barrier to protect patients in the room from airborne microbes in the corridor."

You say you "can't quite see what infectious agents would be relevant." And you say:

“Air flows into the patient's room via pressure release dampers, these moveable flaps you get in theaters.”

Then you say, and I just wanted to ask you about this. You say, "if built precisely to the design parameters…" Why do you sort of put an "if" at the start of that? Have you seen circumstances where the design parameters are not followed?

A The PPVL room was assessed on a model room that was built at the Building Services Research Institute, BSRIA, and I believe that they had to arrange the components fairly precisely in order to get it to do what they wanted. This is hearsay; I have no documentary evidence of that, but it is highly probable that if the rooms were not built precisely to those specifications of the model room, which have not been published, then the rooms would not behave in precisely that manner.

Q I see. That's the point that you make as we go through this email. You say:

“If built precisely to the design parameters [and that's the design you're referring to] of the test setup, the air circulates in a patient room and rapidly

dilutes any airborne infectious agents from a patient in the bed."

And you say "the tested dimensions are not published," and the rooms you've seen "are all variants on the pattern," and you "don't immediately see why there needs to be such rapid dilution. " Then you say:

"The air then issues through a transfer grille in the bathroom door is extracted via a powerful extract in the en-suite bathroom."

Can you then help us with the section immediately after the bit that I've just read to you, where you say:
"Another worry is that while described as neutral pressure, this only means the patient rooms are not intentionally positive or negative [presumably with a significant number of Pascals, positive or Pascals negative, which we've discussed in other contexts]."

So, why is the worry about that point?

A The worry is because rooms will leak to surrounding areas through multiple gaps in their integrity, through pipe and cable entry points, through things like bed doors that link directly between the patient room and the corridor. There will inevitably be gaps in those, so there will be air exchange. If the room is under slight positive pressure, then it will leak outwards. So air will pass through, for example, the bed door, with any contaminants that are of patient origin along with it, air will leak out from the isolation room into the corridor.

If the room is under slight negative pressure, then air that's not of the quality that's been deliberately supplied to the lobby, this uncontrolled air will leak into the patient room along with any contaminants that it contains. So, the room is insecure in either one way or another way for those reasons. The isolation is incomplete.

Q Thank you. You make the point at the end of that paragraph that "the rooms are meant to be leak tested," although you say that's to an energy efficiency standard rather than total sealing, and "then annually thereafter," and you don't know how realistic that is. Then you express your view, I think, in the next paragraph, that you're happier with the concept of negative pressure. So, that would simply be a negative pressure room full stop. Is that right?

A It would. That would be a room for the containment of airborne contamination for the safety of people in surrounding areas. So, it'd be for source isolation, not protective isolation.

Q You describe that as "simple and robust," so not suffering from the issues that you've just described.

A You can expect rooms to leak.

If they don't leak on day one when the room is first used, they will probably leak on day 100 or day 1000. I think for me the imperative is to make sure they leak in a safe direction.

Q So, you make the point if it's a simple negative pressure room, if there's a leak it leaks in the way, and that's okay. Then you deal in the next paragraph with the reverse proposition that “if you have highly neutropenic patients,” and you make the point, “these aren't covered by the guidance”:

“Fungal spores need to be removed. This would be by HEPA filtering and ensuring the rooms leak outwards.”

So, that's the same point within the reverse direction. Am I right?

A You are right.

Q But you say:

“The protection is mostly in the HEPA filtering because positive pressure without HEPA filtration is pointless, [presumably because the air that's coming in hasn't been filtered to the desired standard].”

A This is one of the rare examples where patients who are highly susceptible to infection are at risk from the environment originating outside the hospital; not principally from other patients, but from the air outside the hospital.

Q Thank you. Can we just go-- we better go to page, the previous page, page 30, just to see what happens with that. Then we see that what essentially happens is that Teresa Inkster passes on these thoughts on isolation rooms, and Jackie Stewart says to Sandra McNamee-- Sandra Devine, "here's the email," and there's some discussion about other things, but you weren't further involved in these exchanges. You simply seem to have given Teresa Inkster some advice, as far as we can see from the emails. Well, I can leave that one, thank you.

We'll now move on in time a little and we start to come into 2015. Now, in 2015, the hospital has been occupied and questions, queries, issues start to emerge. First of all, can I ask you generally, do you remember discussions in 2015 about the Queen Elizabeth Hospital?

A I do not.

Q Can I ask you to look at bundle 14, volume 1, page 374? Now, what we're seeing here is a discussion about some deficiencies that were said to be found. The only place you appear on this page, and I can tell you that this is a document to which John Hood, we've been told by another witness, had taken an original document and then annotated it by adding the bits that have underlining in them. So, it doesn't come across so

well in black and white as it would on a normal Word document. He's recorded as saying near the top of that page:

"I would also worry about the commissioning of the new lobbied rooms on this site, as in discussion with Peter Hoffman, they really need careful leak permeability testing, and what is the programme for ongoing checking of their permeability."

Do you remember the discussion with Dr Hood about that?

A No.

Q Am I right in thinking that's essentially a similar point to the one that you made a few moments ago about rooms leaking?

A It seems to be, though I don't really understand the comment because I regard the permeability testing as only partially relevant. It doesn't prove that rooms are leak-proof. It only proves that they leak within certain accepted parameters.

Q I see. Could you just explain that to us so we understand the distinction that you're making between "leak-proof" and "permeability testing"?

A The testing that is recommended for positive pressure ventilated lobby – PPVL rooms – is essentially to replace the door to the room with a door with a fan in it, pump the room up, check the pressures and see that it leaks within acceptable limits. Those limits are primarily intended for assessing the thermal efficiency of new buildings, so it's about energy retention. So, the leak testing, the permeability testing, that's done does not prove that the rooms do not leak, only they leak within acceptable parameters. That's highly relevant for energy conservation; it's deficient for infection prevention.

Q Thank you. Can we look at page 381, please? Now, what seems to be happening here is that a large number of people are getting an email to update following a meeting. Now, this is because issues had arisen with the bone marrow transplant area in the new hospital, the adult bone marrow transplant area, and can I just ask: do you remember discussions about the adult bone marrow transplant area at the Queen Elizabeth Hospital?

A I don't. I'm going by what it says here.

Q Yes. What seems to be-- is a list of actions, and you will see under the heading, the first one, "Infection Control/Microbiology Issues," as "HAI-SCRIBE," etc., etc., and then the third bullet point is confirmation seems to be required from you that, the revised program is acceptable for a BMT unit.

Now, do you remember being approached for some kind of confirmation

of what was acceptable for a BMT unit?

A I don't remember this precisely, but I would have found fairly standard views on that.

Q What would you be looking for then, if you like, to help us with your standard views on something like that?

A The principle is that 100 per cent of every breath patients, in that unit, take has passed through a filter that would retain fungal spores from outside air. This would be achieved by supplying the unit with HEPA filtered air and ensuring that, where patients are, would leak outwards. The outward leakage of clean air would prevent the inward passage of unfiltered air.

Q So, are these the key parameters, as far as you're concerned, that the HEPA filtering and ensuring the positive pressurisation of the room?

A As far as I am concerned, yes. There is very little formal guidance on this.

Q Thank you. Now, can we move on, then – still in July of 2015 – to bundle 27, volume 3 at 299, please, because this seems to be some kind of follow-up in which Craig Williams – who, I think, at that time, was the lead infection control doctor at the hospital – seems to be sending a BMT specification to you and saying:

"I've attached a specification... The unit will house patients undergoing bone marrow transplantation with acute leukeamia. The team will have access to pressurised lobbied side rooms, built to HBN 04-01 elsewhere in the hospital should their use be necessary."

First of all, do you remember being sent that specification?

A I don't.

Q If we just go on to the next page-- In fact, we need to go to 297 and what we find starting at the foot of that page appears to be your response to Professor Williams, and it starts, "Comments on the proposal," and it then continues onto the next page. So, what it starts by saying is:

"The proposal refers to a 5-10 pascal 'differential pressure'. It does not specify a differential between which two areas [or] the direction of that differential."

You say:

"It should be between the patient room and the corridor, and the patient room should be at positive pressure to the corridor."

So, is that the point you've just made to us a moment ago----

A It is, yes.

Q -- you have to have the positive pressure? Then you say, "This should be firmly established." If we go on to 298:

"I've come across situations where

the value of the pressure differential was being measured precisely; that it was in the wrong direction didn't seem to matter."

Is that actually correct?

A Yes.

Q Somebody had worked out what the pressure should be, but wasn't too worried which way it was going.

A They're worried about the number, not the plus or the minus before it.

Q Right. So, that obviously would have given you concerns, and then you're commenting on a room ceiling:

"An MF ceiling is a suspended, solid sealed ceiling. That would prevent the majority of air leaks and is acceptable."

You're asking, "Am I getting that right when I say what I do about the ceiling." Do you see that?

A Yes.

Q Then, the en-suite ceiling, you're not quite as happy with that because of the way in which tiles are being sealed, is that right?

A It's the way that tiles will maintain their ceiling. If a tile-- The function of these tile ceilings is that people can remove the tiles to get to pipes and cables behind them. If they remove the sealed tiles to get to the pipes and cables behind them, the resealing of them to perfect sealability is a poor-quality assurance process.

Q Just so we understand what you mean by a "poor quality assurance process", can you just explain that to us? I apologise, these things will be obvious to you but they're not necessarily obvious to everyone here.

A Not a problem. The people who do this are unlikely to be trained or briefed in the precise requirements. They will see the silicon ceiling often as a cosmetic procedure, not as production of hermetically-sealed ceiling. So, they're likely to put silicon seal back on – if they put it on at all – in a way that looks good but is not necessarily a complete seal.

Q Okay, and in the next paragraph, you deal with lighting diffusers and say that they're marked in such a way that that's probably about as good as you're get, and you say the air handling unit is to be upgraded but you've not been told precisely to what, "No need to change the filters and terminal filters," and then you make a point, I think, about deterioration of filters after they've been in place for a while. Is that correct?

A That is correct.

Q Does this affect their efficiency in filtering out what needs to be filtered out?

A No, it affects the amount of air that is able to pass through a filter. The more a filter blocks, the less air will be

able to pass through it. So, when a filter has just been installed, it's as good as it will get.

Q Yes, and the desired amount of air will flow through it according to the design, but after time, the amount of air will diminish because the filters, even with normal maintenance, will be less good than they were on the first day they were put in?

A That is quite possible. You can get variable speed fans – things that push air through the filter that respond to pressure differential – but I don't think these are very common.

Q Then, you say in the next paragraph, the one that starts, "Filter blockage," you assess this using a pressure differential across the filter, and you ask, "How is this going to be monitored?" Then, you suggest your ideas as the best way of doing that, is that correct, electronics feeding into a BMS system?

A Yes.

Q So, is this presumably to alert someone if the pressures are not what they ought to be?

A It is to alert someone in good time that the filter should be changed, or is due to be changed, shortly. It should not alarm when the filter is at critical but should alarm when the filter is coming up to critical.

Q Thank you. What you've said in that short paragraph is, ideally, this will be done electronically and go into a building management system, but it seems to be something else being discussed in the next paragraph, "Mechanical micromanometer gauges," generally called "magnahelic," and you have some thoughts about whether they're a good idea.

A Those are for local alarms. These are for whether the room is at the correct pressure differential, essentially is leaking in the right direction; that, if there's a failure in that, then there should be a local alarm so the clinical staff know that there's a problem, can act on it immediate. This is an immediate problem as opposed to the filter blocking, which is a problem that will develop at some time in the future.

Q You suggest, rather than mechanical gauges, electronic ones are used, not only with a local display but also an audible alarm at the nurses station rather than in, you know, an estates department somewhere else?

A A building management system is a central alarm system that monitors thousands of parameters throughout a hospital. If there's an alarm, it won't necessarily appear and be acted on immediately, so that's for longer-term things. Where something is of immediate

clinical relevance, then the local staff need to know about it immediately.

Q Yes, thank you. You make the point that you need to make sure these don't sound every time someone opens a door, because otherwise they're going to be going off quite frequently.

A Correct. If an alarm goes off frequently, falsely, people will ignore it.

Q You make some comments about sealing the hatches and you ask whether patient room windows are sealed and which windows elsewhere are sealed. Now, that's obviously not information that you could have had, and then you have a heading, "Commissioning and validation." What's the point about, "taking AHU swabs is pointless"?

A People like to do microbiological sampling within the ductwork, the large pipes that feed air into clinical areas. Particles within ductwork are going to fall broadly into one of two particle size ranges. There are particles that are sufficiently small and light to be entrained in the airflow. Those will disappear within a few minutes of the system being switched on. There are particles that are too large and heavy to be entrained in the airflow. They're going to stay where they are, so they might contain microbes, but they're not going to contain microbes that are going to be delivered into clinical areas. So taking microbiological swabs, in ductwork, generates irrelevant data.

Q And you ask how the gauges will be calibrated and then you pick up on something about the pressures between ward corridors to non-ward areas, but you're not clear what the areas are or whether it's intended to be safe for patients so you're just not sure what the point is that you were looking at there.

Then you talk about smoke testing, and you say that's all that immediately occurs to you, and you say the document's rather basic, so you might have assumed things that someone else has not assumed, and then you add a suggestion that perhaps someone in Health Protection Scotland should look at it because it's not really within your remit to approve the specification for a hospital in Scotland. Is that really the point you're making there?

A It wasn't within my remit to approve hospitals anywhere – I was advisory – but particularly not outside the remit of Public Health England.

Q So, you're offering some advice, but you don't see yourself as being the person to sign this all off and say it's all correct. That wasn't your role?

A Most definitely.

Q Well, I think we can leave that email, but thank you for your assistance

on that one. Could we now go back to bundle 14, volume 1, at page 425, please?

It's just because I've picked up a number of references where your name appears, Mr Hoffman. If you can't assist us further on them, just do say, but we see here that there's an email from Brian Jones, who's another person involved in infection control, to Mr Grant Archibald, who is in management, and I think he's picking up a point about what guidance does or does not provide for.

What he's saying here seems to be that in the SHPN supplement, it states that:

“It doesn't describe the facilities required on wards where severely immunocompromised patients are nursed. There could be a need for positive pressure isolation rooms”

Then he refers to the English supplement about protective facilities for severely immunocompromised patients. Now, what he says in the next paragraph:

"Peter Hoffman's advice has been consistent over the years and remains that these rooms are not appropriate."

Now, I think that's referring to the PPVL rooms, but I thought I should ask you whether you remember giving consistent advice about what was appropriate for the protective isolation of severely immunocompromised patients.

A It has long been my view that PPVL rooms are not suitable for highly immunocompromised patients, and it states that in both the English and Scottish PPVL room guidance.

Q So, that when Dr Jones records here that you've been consistent in your view over that, that's likely to be a correct representation of what you have said over a period of time?

A Yes.

Q Thank you. If we move on, we're still in the middle of 2015, we're in August. If we could go now, please, to bundle 12 at page 294. Actually, I probably need to go back to 293 just to get the context. So, this is Sandra McNamee, now Devine, at the very foot of page 293, and she's emailing-- if we go back over the page 294, she's emailing John Hood and Peter Moir, who's on another part of the hospital functioning and she's talking about summaries of the meeting. It's Peter Moir, it's referred to there:

"The confirmed rooms have been tested have passed the permeability tests.”

Dr Hood is noted as putting a comment on that, smoke tests, and so on. So, if we go back to 293, we find in the bottom half of 293, John Hood writing to you saying:

"Thanks for all your help. Any

comments on the email below would be happily received."

And then your comments appear above that. Now, do you remember this exchange?

A No, I do not.

Q And you start out by saying, "Well, the rooms may be to specification, but the specification is irrelevant." What's the point you're making there?

A Are we talking about rooms for highly immunocompromised patients here?

Q I believe so, yes, because we're talking about rooms for BMT patients as we see further down in the email.

A Right, and PPVL rooms are specifically excluded for highly immunocompromised patients. Therefore, if these are PPVL rooms and have been tested to the recommended parameters for PPVL rooms, they're still irrelevant for highly immunocompromised patients.

Q Then you go on to say:

"The permeability test doesn't show total sealing and applies on the day of testing. The rooms are likely to get more leaky as time passes. [Which, essentially, I think is a point you've already made, and then you say] The smoke tests show ingress of unfiltered air through gaps in the rooms integrity [and describe that as "not good news]."

A Yes, this means that air that has not been filtered to remove fungal spores will enter the patient's room.

Q And then you make a comment about how to test producing the extract, and another one about-- you come up with another suggestion. You say:

"Why not make the patient room HEPA filter positive and the anti -rheum a bit negative."

Why are you making that suggestion?

A To make sure that the only air available for patients to breathe in their room has passed through a HEPA filter. So, you make sure that air supplied to the patient room has passed through a HEPA filter and make sure that the gaps in the room leak outwards so there's a loss of clean air but no ingress of contaminated air.

Q Thank you. Now, we've jumped forward a little bit to December of the same year, 2015. So, could we go please to bundle 14, volume 1, 494. What we have-- we'll see that this particular email that we're looking at at the moment is an email from Mr Walsh to Teresa Inkster saying that-- a summary timeline of external advice and subsequent changes to the building and operational spec the BMTs is required for

a meeting with Mr Calderwood, who at the time was the chief executive of the Glasgow Health Boar, and she's asked to put some material together.

So, if we go to 493, I think. See-- just bear with me a second. No, we go back to 494 and then we go on to 495, and obviously what's been happening here is Dr Inkster is setting out some material as to what actually happened with this area, and we go to 496. What has happened, as narrated in the note against 4 December, is a situation background analysis and recommendation had been received from HPS with recommendations on based on HTM 03-01 input from Health Facilities Scotland and Dr Peter Hoffman. Do you remember inputting into a document being prepared by HPS?

A I do not.

Q And what's said out there is that key points:

"Rooms must be positively pressured at 10 pascals. All air entering the rooms must be HEPA filtered. Rooms must be completely sealed, including bathrooms, and air changes of 10 ACH in each room."

Do you have any view now on the key points? I know you don't remember the specifics.

A This would appear to be an amalgam of advice from myself and HFS. "All rooms must be positively pressured." Yes, I would concur with that. “At 10 pascals," I don't think it really matters as long as they robustly leak outwards, robustly and reliably. "All air entering the rooms must be HEPA filtered.” Yes, I definitely agree with that. "Rooms must be completely sealed, including bathrooms." I think that's ambitious. I would allow them to leak, but make sure that they leak in a safe direction.

"Air changes of 10 air changes per hour in each room." I don't see that as relevant. I think-- Air changes for patient comfort. For these rooms, for protection of highly immunocompromised patients, you're trying to exclude contamination, not dilute contamination. The contamination that's generated in that room would largely be contamination from discarded skin fragments from both the patient and staff within that room. These contain microbes that are irrelevant to the patient. So these rooms are about exclusion not dilution.

Q What if there were bedside procedures carried out in that room during the patient's treatment? Would that potentially generate something that needed diluted?

A No because these will be from the patient themselves.

Q Thank you. Right, well, we can move----

A I'm not sure what you mean by bedside procedures.

Q Well, one of the issues with a-- presumably a patient like this is that something may occur during their treatment which requires the intervention of medical assistance or some step or other, which doesn't actually involve them being hauled off to an operating theatre but can be carried out there and then. I'm not a doctor so I can't tell you precisely what might have to be done to a patient who is engaged in-- struggling with this particular problem. So, the question was simply a general one. If there were some kind of procedure had to take place in the room, could it lead to the need for dilution?

A Okay, by that I'm taking it as meaning some sort of procedure that causes minor and superficial breaches in the integrity of the skin. The current guidance for minor procedures is that these can be carried out in rooms without specific ventilation. These are things like a GP would carry out in their surgery, sort of removal of small lumps and bumps, those don't need special ventilation.

Q So, those wouldn't need-- there would only be something which was more significant than that which would need special ventilation?

A As in a major surgical procedure, yes.

Q Can we ask you to now move forward in time-- sorry----

THE CHAIR: Mr Connal, could I just clarify my own thinking? Mr Hoffman, I'm assuming you're not going the distance of excluding the utility of dilution of potential contaminants in air by enhanced air change rates or am I misunderstanding what you're saying in this context?

A This is specifically for accommodation of highly immunocompromised patients.

THE CHAIR: In the context where you're assuming the supply air has been HEPA filtered?

A Yes, for highly immunocompromised patients, I am excluding a requirement for dilution.

THE CHAIR: Right. Just so that I'm keeping up, that is because you would always recommend that these patients are protected by the highest standard of filtration?

A Yes.

THE CHAIR: Yes. Thank you.

MR CONNAL: All we can tell, at the moment anyway, is that it would appear that, as you put it, what's recorded there is the-- as it were, the Scottish Health Protection Organisation has put together some things that you're in favour of and some things that they've added and that's-- such as the air change rates?

A Yes.

Q Now, can I ask you now, I'm going to move on in time, if you have any recollection of a discussion with Teresa Inkster about possible aerosolisation of material found in drains and sinks. Do you remember any such discussion?

A I don't, but I will be guided by notes of the time.

Q Thank you. If we can have a look now at some exchanges, and we're now moving on into 2018, when other issues were arising in the hospital. So, could we look at bundle 14, volume 2, at 140? What we're going to see here are a series of exchanges. I put up 140 because that's where we end, but if we go to 145, and just take it from me this is Teresa Inkster who's speaking in this email. She's saying, "Peter, I hope you're well. I have a question." She starts by saying, "You're aware of the water problem in Glasgow hospitals". First of all, do you remember being aware of a water problem in Glasgow hospitals?

A I don't, but I'm certainly not excluding discussion having occurred about it.

Q Essentially, what I'm going to suggest to you as background to this is that there are-- issues are occurring. People are trying to find out why they're occurring and looking at various parts of the system, the water system where the water is, and taps and drains, and so on. So, Teresa Inkster here seems to be saying to you, the current issue is the drains in children's hospital. "After we put the filters on," and I think that's probably a reference to point-of-use filters being added to taps:

"We noted an increased incidence of Enterobacter and Stenotrophomonas Bacteriomas, and staff pointed out an issue with the drains. They were full of black gunge and, in some sinks, there was backflow into the sink. We grew a range of organisms from these drains, as you would expect, including two that were mentioned earlier. We concluded the drains were the likely source."

And then:

"Dismantling, we found evidence of corrosion of the aluminum spigot and build up of biofilm. Drains were all cleaned, spigots removed and replaced, six weeks, no further Bacteriomas. However, over the past two weeks, we had further infection. The staff reported a drain issue again."

So, she goes on further down the page to say:

"In addition to control measures for water and drains, we implemented a range of infection control measures, including focus on routes of transmission. Practice on the ward is of a high standard."

She's saying, basically, from an infection control perspective, she needs an understanding of the underlying issues as she's run out of control options. "It's been suggested we can carry on with weekly drain cleans and use HPV."

Now, I think that's a disinfectant method for a room, isn't it?

A It is using gaseous hydrogen peroxide to disinfect room surfaces.

Q **Yes.** But she's suggesting that doesn't take us to the root of the problem.

"At our IMT this week, the recommendation was a decant of the ward to enable us to find out what the underlying issues are, and conduct drain service etc., etc. I can't provide assurances the unit is safe."

Then she just-- and she refers to a telephone conversation. So, if we can go on to 144? So that's-- She's getting in touch with you. Then, we see your reply. In fact it starts a little earlier, probably at 143. Yes. You see at 143, you seem to be replying, and you start by saying, "This might be an extended email exchange. If so, not a problem." So, this is you making yourself available to help again and you thank her for the detailed description. You say:

"From that description, I see the problem as direct and indirect dispersion from the drains, but do not see aerosol spread as one of the transmission mechanisms."

You leave aside the spigots. Just at the foot of the page, you start to deal with ventilation. Can you take us through what you're saying there? You're talking-- starting by talking about particle sizes.

A Okay. The larger a particle is, the more bacteria it is capable of containing. So, with particle sizes, the particles of major concern are the large ones. Infection is microbe-number dependent. One microbe is very unlikely to cause an infection. A million microbes are very likely to cause an infection if they're a suitably pathogenic microbe, and there's a gray area in between. So, small particles containing very few microbes are of lesser significance than large particles. So, the water would break up into various particle sizes. It's the larger particles, aerosol splashes and slightly smaller particles, droplets, are the major concerns for infection transmission.

Q We see at the foot of this page you say, "The larger the particle, the more bacteria it can carry, but also the heavier it will be." You say it takes a lot of energy to break water up into, in effect, an aerosol, sort of like a gas.

A Yes.

Q So, can we go on to 144 so we can see what else you say? You said you don't see activities relating to sink use or cleaning as having the energy

input to produce aerosols, but you do see them producing splashes and droplets. So, these are, what, heavy particles with potentially lots of bacteria?

A Heavy particles, lots of bacteria. They will fall out of the air reasonably promptly within a few seconds to a minute or two. They don't need special ventilation systems to dilute and remove them. They will disappear because of their own weight. They will fall under gravity.

Q Then, you go on to talk about how the bacteria in drains will present in a profuse biofilm. Just for those of us who are not necessarily sure what the correct definition of a biofilm is, what's yours?

A Microbes, predominantly bacteria, that fix themselves to surfaces with a slimy capsule. If the environment is right, those bacteria will replicate, each in their own slimy capsule. Other bacteria will come along, other microbes will come along, including protozoa and fungi, and become part of that biofilm. A biofilm is a living dynamic community. Bacteria and the other microbes will compete with each other for dominance. Think of something like a slimy pebble picked up from a garden pond. That slime is biofilm.

Q You say in the second paragraph on page 144 that they're not susceptible to chemical disinfection because that generally doesn't penetrate the slime. Is that right?

A Yes. It will disturb the microbes on the outermost layer. It won't penetrate to the underlying layers. So, you can, to a certain extent, suppress biofilm with chemical disinfectant. It's very unlikely you would kill the biofilm.

Q Then, you say, if you clean a waste trap, all that happens is you clean it and then the biofilm grows back from the nearest point and colonises it again. Is that right?

A Yes. So, you can replace something like a waste trap for a sink. That will give very temporary suppression of the local biofilms but, in doing so, you're likely to spread contamination in the act of changing the plumbing component.

Q So, the conclusion of the second paragraph is you say-- well, having explained some of the problems, you say, "This has to be addressed by containment and not elimination." Now just help us understand what you're saying there, please.

A Just make sure that whatever is in the drainage system is on a one-way route away from the clinical environment. So, you learn to live with contaminated drains because there's nothing you can do about them, but make sure that

contamination does not reflux back into the clinical environment.

Q That explains, presumably, why you then say in the next paragraph, under, "Two aspects that concern me." First, you detail drainage phases with reflux back into the basin. So, that that would concern you for the reason you've just mentioned.

A Yes.

Q And high numbers of microbes in the drain. Second, weekly cleaning, most probably the drain waste traps, and you're not very keen on the idea of weekly cleaning of the drains. Just leave them?

A How will the drains be cleaned? I have seen, in some hospitals, domestic staff use bottle brushes to try and clean the drains. That just means they're going to splash around the contamination that comes out on those bottle brushes.

Q That's why you ask how the weekly drain cleaning is done?

A Yes.

Q Then, what's the point you're making in the next paragraph about your reluctance to correlate control measures and bacteria?

A Clusters of infection can depend as much on the susceptibility of patients as well as availability of bacteria that cause the infection. So, if you do get a change in the numbers, the observed numbers of infections, it could just be because of changes in patient susceptibility as specifically the dispersal of the microbes. You're looking at multifactorial causes here. I wouldn't necessarily be too quick to correlate a decrease in an observation of patient infection with a decrease in bacterial dispersion.

Q Then, you refer in the next paragraph to hydrogen peroxide room disinfection, which I asked you about earlier, but won't penetrate the drains, it distracts, and otherwise it's not critical. That's your view of that process?

A Yes.

Q Well, can we go to page 143, please, just so we can try and follow this through. 143, obviously, shows us the start of the longish email you've just done. So, we go to 142, Teresa Inkster is replying to you:

“Thanks, Peter. There is a theory that the application of filters has led to aerosolisation from the drains. There's some literature around this. By shortening the distance between the outlet and the drain with a filter in situ, there's increased splashing, which is felt disrupts biofilm, leading to aerosolisation of bacteria.”

She says she'd done some air sampling and not demonstrated this, but

only three sinks. Then, at the foot of that page, she's saying:

"The initial cleaning done using Actichlor Plus and a brush agitation method to remove the grime."

We go on to 143.

"Children were removed from rooms while we did this. The room was cleaned by domestic staff, followed by HPV. We then took a drain apart."

That's where they found the corroded spigots. There's a discussion about a change to the component. So, this is Teresa Inkster replying with some of the details that you asked her for of the earlier email. So, if we then go back again, please, and we'll go to 142 again. New reply of 16 September 2018. Again, I take it you've no direct recollection of this exchange, you're simply working from what you see on the emails.

A Correct.

Q You're saying:

"Hi Teresa, does the flow from the filters fall directly into the sink drains? If it does, this is unsafe."

So, this is a tap with a filter attached to it producing water going into the sink, and you're concerned that it might be-- the water might be going directly into the drain and thus disturbing what's there. Is that the point?

A The filter is irrelevant to this water flow. It's water flow from the tap falling directly into the drain. If it falls directly into the drain, it will cause splashing from the drain. That splashing will be contaminated with organisms that originate from the biofilm in the drain.

Q Then there's a couple of references which we can pass by and go to the last paragraph on that email where you say:

"The drain cleaning worries [you]. Substantial contamination of surfaces around the work area and possibly beyond. Cleaning this might spread it further. Hydrogen peroxide might not kill it. How was the equipment decontaminated?"

So, you're still concerned about this business of cleaning the drains, the kind of bottle brush analogy that you explained to us earlier?

A Yes.

Q So, we move then to 141. I think what then happens is Teresa Inkster sends some papers onto you that she's got from a colleague and says she'll get back to you on a cleaning method which she needs to dig out. You reply, "Thanks, I've seen these papers." Apparently they seem to have come from other jurisdictions from Holland and Spain. You say:

"Yes, links between multi-resistant gram negs and drains, but how the bacteria transfer is never clear. [And you

say] lots of other papers similar."

So, was that something that you'd come across before?

A It looks like it. People will find bacteria in drains, find the same bacteria in patients, but the mechanism of transfer remains conjectural.

Q Your general point that you're making there is you really aren't keen on this idea of drain cleaning because the risk is of putting more significant droplets back into the patient environment.

A Both droplets and also what's in the drain will physically come out on the equipment that's used for cleaning, then onto the person's hands and be spread around the clinical environment.

Q Thank you. If you go to 140, so at the second half of this page Teresa Inkster is replying to you and thanking you again, and has clearly got your message because she says:

"The most important thing here is to prevent drain contents coming back up the way in the first place."

That would be a reasonable summary, in short form, of what you were saying. Is that correct?

A Yes.

Q Then she says:

"I have a question re ventilation. Outwith the BMT rooms we have chilled beam technology with 3 ACH for our other haemato-oncology patients. 6 ACH are recommended in SHTM for neutropenic rooms. [Then she asks] Is the theory behind chilled beams that you can reduce air changes but still have the same air quality?"

So, I think you're being asked in a way what your view is about chilled beams, because Teresa Inkster is wondering whether it's anything to do with air quality, and your reply appears at the top of the page. First of all you acknowledge that Teresa Inkster has got the core approach right, and then you say:

"Nothing special but chilled beams are just a way of altering temperature, but not quality of water."

That's your understanding of these-- we're using chilled beams, there are different technical descriptions for them, but I think you know what we're talking about.

A I do. I'm certainly not an expert in chilled beams, but I think the majority are beams with controlled temperature fluid circulating within them, and air circulates through heat exchange elements in the beams and will pick up the temperature change in the beam. They could be used to both cool and warm air. So they provide you with the same air just at a different temperature.

Q So they're nothing at all to do with air quality; they're simply a question

of temperature.

A Yes.

Q You then make the point that neither the HTMs or the SHTMs don't address ventilation for highly immunocompromised patients, and we've touched upon that, I think, in relation to an earlier email. You say:

"They need protection against inhalation of fungal spores, typically originating of outdoor air. All air needs to be passed through a HEPA filter."

That's really your key message, isn't it?

A It is.

Q "The rooms should be at positive pressure so all gaps leak outwards, preventing inward ingress of unfiltered air. Positive pressure without HEPA filtration is just an expensive way of channelling pores from outside to inside. Air change rate is irrelevant. You're not trying to dilute anything."

This is essentially the same point that you were making before. Is that right?

A It is.

Q Then you say:

"Three or six air changes – doesn't matter. Six air changes is the generally accepted level for temperature and odour control, but it's not focused on preventing infections."

That's your view.

A It is.

Q Nevertheless, six air changes is the generally accepted air change rate recommended not only for wards but for single rooms, is it not?

A And for environments outside healthcare, it's just the general basic health-- air change rate.

THE CHAIR: At a very sort of superficial level, Mr Hoffman, can I take from that, that if one is in an environment which is ventilated at three air changes as opposed to six, one might think of it as more stuffy or just somehow less comfortable?

A It is likely to be, but it depends on the rate at which that room either gains heat or loses heat.

THE CHAIR: Right.

A If you can control the temperature of the air coming into a space, you can maintain that temperature. So, six air changes per hour might not be sufficient for a room in a hot climate with direct sunshine into it. It's a reasonable general level for comfort, though there may be instances when that has to be changed.

THE CHAIR: Right, thank you.

MR CONNAL: Well, I think we'll leave that email if we may. I have just a few more to ask you about, and I'm afraid in this case they're a slightly more random collection. These were at least in

some kind of sensible order, but if we could look at bundle 14, volume 2, and I just want to pick up briefly a number of references. If we look at page 107, please. Now, here what we appear to have is a teleconference to support the technical advice about the RHC water situation, 17 March 2018.

So there seems to have been a gathering of people by phone, and you're listed as one of those there. Can you remember attending such a teleconference with a cast of that order?

A I can't, but it seems reasonable that I did.

Q We see the first point of the discussion is “source.” "What is the likely source of water contamination and clinical infections?" What is recorded here is "input from PH", which appears according to the heading to be you.

A Yes.

Q We seem to be looking at Cupriavidus and Stenotrophomonas, and you're making a point there about them being "dedicated aerobes." Now, just again, so that the lay among us are understanding the point, just explain this to us.

A Bacteria that need a ready supply of oxygen.

Q So, you're making the point in this note:

“It would appear that they're unlikely to colonise remote biofilms, more likely to colonise biofilms close to the air-water interface within a few centimetres of outflow.”

Are you familiar with the organisms Cupriavidus and Stenotrophomonas?

A Stenotrophomonas, yes; Cupriavidus, less so.

Q Some witnesses have suggested Cupriavidus is a relatively unusual organism to find. Have you any view on that?

A I have certainly come across them less, but whether that's because they're less frequent or less frequently identified and laboratory technology has developed so they're frequently identified now, that's a series of factors I can't comment on.

Q Thank you. So, in the first bullet point, you recorded as saying that they're:

“Most likely to colonise biofilms close to the air-water interface. Multiple sites of isolation of that organism are likely to reflect common environmental conditions and cross-contamination rather than a point source.”

What's the point you're making there?

A Two points. One is that biofilms are mixed microbial communities. They will contain bacteria that need a ready supply of oxygen, they will contain

bacteria that don't require any oxygen, and they contain bacteria which can switch their metabolisms. If there's oxygen around they can use it, if there's no oxygen around they can switch their metabolism and survive without oxygen. If the biofilm is remote from a ready supply of oxygen then those latter bacteria – the ones that don't require oxygen and the ones that don't necessarily require oxygen – will predominate and crowd out those that do require oxygen. Only at or close to the air-water interface will there be sufficient supply of oxygen that these obligate aerobes – bacteria that need oxygen – will be able to compete with the others.

Q I should have asked you that when we talked about biofilm because I wonder whether I'm correct to assume, and please correct me if I'm not, that a biofilm will rarely be a monoculture of a single bacteria or a single organism of any kind. It's likely to contain a variety of different organisms, possibly a large number.

A In general, yes. In things like urinary catheters, where there might be a single organism that is causing an infection, they could be a single species but in the wider environment, they are mixed and dynamic communities of microbes. So, they will change over time according to environmental conditions as to which can gain dominance.

Now, in the third bullet point, you say:

"The levels of Stenotrophomonas reported by Teresa Inkster from water samples are very high."

So, somebody has obviously reported a number that you recorded, at least, as saying, well, that's quite a lot to find. Then you say that:

"Samples isolated from the showers may reflect the fact that shower tubing has a large air-water interface and prone to developing large biofilms, but it's unclear why this has only recently resulted in infections."

So, is shower tubing a kind of known place where these things lurk?

A It will be polymers and plasticisers that will leak organic compounds that are essentially good bacteria food, and there's a high air-water interface so that the aerobes in biofilms that form on those have a lot of area to grow on.

Q So, it's not simply that it's a piece of shower tubing. It's the product of which the tubing is made that will determine whether it's producing lots of food for the bugs.

A Yes.

Q Then you say:

"Plastic piping [and that's probably the same point] and flow straighteners

may promote biofilm growth."

Why flow straighteners?

A These can be plastic devices that are placed as the last component in a tap that are intended to give a coherent waterflow. These are devices with a large surface area, so again, lots of room, lots of area for biofilm to grow on. It's very much the same principle as the shower hoses.

MR CONNAL: I think the last point that you are recorded as making, you say:

"[You] need to pay due attention to the routes of infection of patients from affected water, such as management of indwelling IV lines and their hubs."

So obviously, you're identifying a bacteria, but you still need to work out how it's getting to the patient. Is that right?

A Yes, you're very unlikely to be able to control the source of contamination. You control the route by which that contamination might travel to a susceptible site on a patient.

Q I might just ask you about one more document, perhaps, before we break for a few minutes. Can we have 114 of the same bundle, please? Now, I think I may have asked you this, but I'll ask you again. "Point-of-use filters", is this something you came across in your practice?

A Yes.

Q As I understand it, the intention is to ensure that every drop of water that issues from the end point, as it were, is filtered in such a way that it's safe. Is that a layman's description of what they do?

A That's quite reasonable, yes.

Q What we have here is an email also in March 2018 where Teresa Inkster's saying:

"We're running a bit behind in relation to filters and testing of their efficacy... hoping to rely on one set of negative results from a shower and a tap. Someone suggested three – I can't remember who it was. Do you have a view? My concern is that waiting for three negative results will take us into next week and will have continued impact on the clinical service."

Your view is set out above an established technology with good production quality assurance. Was that your experience of these?

A Yes, it is. I'm not sure whether I have a lot of experience, but these are an established technology.

Q Yes. Your point essentially is, well, they're an established technology and, provided you check that there's no dribbling from joints or whatever it is to all the water that is of significance is coming out of the end of the filter, then you think you can just take them as effective?

A Effective to a certain extent. They're as effective as they will ever be. One of the problems with point-of-use water filters is that you can get contamination of the end of the filter closest to the point of water delivery. So if, for example, someone cleans a sink with a cloth and picks up contamination from the drain and then cleans the point-of-use filter, they can transfer contamination to the output end of the water filter and the water filter can develop a biofilm, but that's not something you would be able to detect by three tests from a water filter just after you fit it. That would happen with time.

Q Do they have to be changed, or replaced, as well?

A They will block up and that blockage will reduce the contaminate-- reduce the throughput of water through that filter.

Q Thank you. My Lord, I'm finished with that particular email. I still have a few to do, but this might be an appropriate point to take a short break if it's convenient.

THE CHAIR: As I said, Mr Hoffman, we usually break at about this time for 20 minutes. Could you be back in place to resume at five to twelve?

A Five to twelve, certainly.

THE CHAIR: Thank you very much. Right. Well, we'll take our coffee break now.

(Short break)

THE CHAIR: Hello again, Mr Hoffman. I think we're ready to resume. Mr Connal.

MR CONNAL: Thank you, my Lord. I'm going to ask you about a few more exchanges since we have you available, Mr Hoffman. I will assume when I do so that you have no recollection of the issues that are revealed in these exchanges, but if that is incorrect, please tell me because otherwise I'll simply have to repeat the same question and you'll give me the same answer, so----

A Yep.

Q Can we go to the same bundle we were on immediately before the break, but at page 156? Now, here seems to be another question. This time it's about the specification of the Paediatric Hemato-oncology ward, and what Teresa Inkster is saying this time is:

"They've got a 24-bedded room, eight rooms designated for bone marrow transplant, four HEPA filtered rooms with air changes of 10 an hour, positive pressure of 10 pascals, they have anti-rooms with no HEPA filtration in the corridor. The other four are PPVL rooms, which hopefully we will upgrade at a later date. The rest of the ward, however,

appears to have rooms that are slightly negative pressure."

Let me just check my reference here.

"With 3 air changes, now, and chilled beam technology, I've asked for the pressures to be clarified by the external engineer."

So, Teresa Inkster is concerned that the environment that she's describing in that email is not a safe one. The end question is:

"Do we aim for the SHTM 03-01 neutropenic room spec of 10 air changes an hour and 10 Pascals? Increasing air changes will be a challenge but my feeling is achieving a positive pressure and HEPA filtration is more of a priority. Any thoughts?"

I don't think we have immediately got the answer to that, but let's just check on 157-- maybe 155. Yes. Here we have your reply:

"Agree: HEPA filtration positive pressure are precisely what this type of protective isolation are about. You are trying to protect these patients from fungal spore inhalation."

Can I just ask, while we're at that point, is it only fungal spores that you're concerned with when you're considering the diluting effect of air change rates, or could you be also concerned about bacteria or other infectious items?

A I'm concerned not about the diluting effect, but the exclusion effect. So, with HEPA-filtered air, that's supplying outside air. The only things that are going to be a risk to the patients from outside air are going to be fungal spores. But, if something filters out fungal spores from outside air, it will also filter out bacteria from outside air. So, I can't see there being a risk from bacteria in the outside air supplied, but if there is it will be taken care of, it will be eliminated by the same process that eliminates the fungal-spore risk.

Q What about bacteria which come into the room, either from someone entering the room like a visitor or a member of staff or because some kind of procedure is being undertaken, as we discussed before? Is it possible that there's bacteria that need to be diluted or at least might need to be diluted and therefore air change rates are a good thing?

A I can't see the mechanism by which bacteria that are a risk to the patient will come into the room with visitors and be dispersed in such a way that they're a risk to the patient. People can come in with gloves that either they haven't changed or that have picked up some contamination after they were put on. People can come in with aprons that can carry contamination. I see that as a

contact risk, not an aerosol risk. I don't see how they're going to get into the air and then into a susceptible site on the patient.

Q So, this is why you make the point in the next paragraph:

"The air change rate determines the rate of dilution in the room, but what needs dilution"?

You say that neither the patient's microbes or staff skin present a risk?

A That remains my view.

Q So, if somebody visits the room and coughs or something like that, would that be a risk?

A It could be a bacterial or viral risk but that would be at close range to the patient and it will be the larger particles that are more a risk. These will be large particles carrying lots of microbes, either bacteria or viruses, but they would fall out of the air through gravity and not be affected by ventilation. So, a short-- a close-range risk, not an aerosol risk.

Q Can we go to 161, please, of the same bundle? I think we see at the foot of the page the start of the emergence of Cryptococcus as an issue. You've been asked this in your state, but I might conveniently ask you it now. In your lengthy experience dealing with healthcare and infections, had you come across Cryptococcus in a healthcare environment previously?

A No.

Q So, at the foot of the page, we see Teresa Inkster again saying that she has two cases of Cryptococcal neoformans in blood culture 17 days apart, in patients, both inpatient for some time before positive results, so considered hospital-acquired. Then there's a reference to the infection, I think, regularly being found in bird droppings. Is the association between Cryptococcus and, it's usually pigeons that people are talking about, pigeon droppings, is that well-established?

A This is not an area of my expertise. I had done no reading about Cryptococcus before this. After this, I did limited research onto what the literature had to say about Cryptococcus. I think there is a definite association between the occurrence of Cryptococcus and pigeon droppings but, reading the literature it struck me that people were predominantly looking for Cryptococcus in pigeon droppings.

So, if you only look at Cryptococcus in pigeon droppings you will only find Cryptococcus in pigeon droppings. I think, from the small amount of reading I've done, people have also found it in things like rotting tree stumps. To me, this means can also find it in rotting vegetation. That then widens the

potential sources of Cryptococcus far more than just pigeon droppings. So, I think pigeon droppings are probably *a* source. I'm not sure whether that can be extended to pigeon droppings being the source.

Q We just look at 162 for a moment just to see the end of that email. Teresa is saying she:

"Had an incident management team to discuss. Estate's colleagues tell me the building is sealed and there is no way for droppings to get in windows etc. Also, there is no way for them to enter a ventilation system."

She disagrees and she says:

"I have two HAIs of a rare infection classically found in bird droppings with visible evidence of a bird issue, so at the moment a link to birds is my strongest hypothesis. Do you have any experience of this?"

I think, in part, you've just answered that question because it wasn't something that you had particular experience of at that time. We can go back to 161 to see how you replied because your immediate reply to Teresa Inkster is that you agree with the suspicions that she's voiced. So, whatever your reservations now, you appeared at the time at least to think that that was a sensible connection to make. Would that be fair?

A Yes. Yes, I did.

Q Then you picked up the point about building being sealed and said, "Well, is that absolute?" Then, you say:

"There's always a possibility of dust from disintegrating droppings entering ventilation systems. Maybe as to what level the air is filtered and whether there's a possibility of air bypassing filtration via gaps between filters around their edges."

We'll come back to that when we come to the Cryptococcus hypotheses. "Does the air enter the relevant air handling unit directly from outside, or is it drawn from the plant room?" Then, you raise a slightly different point, which is, "Are water tanks covered so that there's no risk of pigeons or the like getting into them?" which is probably not the issue (inaudible). So, at least at that stage, you thought the hypothesis of a connection was a fair one, you know, before any further work had been done on it. Is that correct?

A Yes. It struck me as a very sound initial hypothesis.

Q Thank you. I just want briefly to pick up a couple more before I turn to Cryptococcus more generally because this-- I think we're seeing in December 2018 that's the very early communications about Cryptococcus which then go on to be looked at in more detail later. Can we look at 166 in the same bundle, please? We're back to

ward specification issues starting, "Happy New Year", so we're into 2019. Another ventilation question. Patients have been decanted to another AOR. We upgrade the ward and she says, at the bottom of the summary that I've attached

"There's reference to extract ductwork distribution and an abnormal strategy. I am told the hospital utilises thermal wheel technology which is acceptable, and this wasn't a design error."

And she's struggling to understand how this could be acceptable and how are thermal wheels related to the ductwork distribution, or is this separate issues, and can you help? So, can we look back to see how you respond to that? 165, I think. Yes. Probably go back to 166, I think. I seem to have lost the reply. 167? All right, let's just pick up this exchange. I'm afraid some of the printing here is a little difficult to see.

So, what I might do is ask those assisting me here to move to bundle 14, volume 1 at 649, where I think we should get the same exchange in a rather clearer font. Somebody just flicked past my eyes a reference to thermal wheels. What's your view on thermal wheels in relation to ventilation?

A My grasp of thermal wheel technology is not good. I gather it's a way of having a sort of honeycomb within the supply and extract system such that temperature but a minimal volume of air can be exchanged between them. I understand that there can be a certain amount of air leakage between supply and extract which, I think, would make them unsuitable for specialist systems in healthcare where control of contamination is paramount.

Q Well, I think we'll leave that exchange. I don't think we need to deal with that in any more detail, but can we go back again to the previous bundles? That's bundle 14, volume 2, and just look at 167. I think we may need to get the-- Now, I've lost the top of the page. This is-- This shows a response from Christine Peters. So, that's a different enquirer on this occasion. Can we go back, go to 168, please, just so we see what's happening here? Right.

So, what's happening in this exchange is that a Dr Kennedy is asking Dr Peters, wanting to check where the call to Peter was, that would be you, so a facilities colleague can join. Then, what we then see, if we go back to 167, is Christine Peters copying in, to you, a note of a call. I think what this is is an initial exchange about investigations, that might be useful, into the possible sources of air entry with Cryptococcus spores into the air system. What Christine Peters seems to say is:

"I'm just off the phone from Peter to clarify information re the plant room and AHU. I think it will be worth having a further call with him and estates when we have all the information required:

1. a clear schemata of which AHU supply which wards
2. F7 filter manufacturer details [about pressure and so on]
3. Records of pressures across F7 filters
4. Records of filter changes
5. Are the pressures recorded on the BMS?

[Just make sure we go on to 168 to see if that list continues]:

6. Smoke testing… to assess possible air.
7. SOPs for filter exchanges.
8. Particle counting pre and post F7 filter.
9. A risk assessment re turning off the air handling unit for half an hour."

What Dr Peters seems to have been doing is recording matters that had been apparently discussed with you. Does that sound a reasonable summary of the kind of things you would expect to raise?

A It does.

Q Then we see your reply on 167, where you're saying, "very minor changes." I think these are largely bracketed here. In paragraph 2, you're looking for the minimum pressure differential values, and then in 3, you're looking for clean filters. Then in 6:

"Assuming air from plant room is in communication with a void, hence a possible route from plant room into rooms of cryptococcal infectious particles."

So, you're just really tidying up the list, if I pick it up correctly. Is that right?

A I'm not sure what you mean by "tidying up". I was trying to focus the questions on points that would give information about the possibility of Cryptococcus coming from the plant room into patient rooms.

Q Yes. You've been suggesting various investigations that you thought might help in that regard.

A Correct.

Q I think we might move now to look at your witness statement at page 193. I've already asked you if you'd come across Cryptococcus before, and you told me you hadn't. In 193, you're asked about what you know about it, and you're making the point there that if there's a Cryptococcus issue, it's prevented by specialist ventilation systems that supply air at a grade that removes fungal spores. So, that's what will be necessary for what I think you described there, "a susceptible patient." Now, is that a HEPA filter that's needed

for that?

A Ideally. Some sub-HEPA filters can remove a large majority of fungal spores, but they do so with a lower quality assurance. They will remove a lot of fungal spores, but the problem is that with some ventilation systems as installed, air can either leak around the filters or between the filters, and thus bypass filtration.

Q Can I just ask a follow-up question on that, if I may? I accept, of course, that you don't claim to be an expert specifically in Cryptococcus, but when you're talking about possible infections caused by fungal spores, do you need a lot of spores to cause infection in a vulnerable patient, or just one, or is there no way of knowing?

A I think there's no way of knowing, but the more fungal spores, the greater the infection risk to the patient.

Q I'm just wondering, because we're going to come to look at a number of hypotheses in a moment. If you have even a small amount of spores, does that create a risk?

A I'm assuming, but have nothing to back it up, that a few spores would create a low risk.

Q Thank you. Well, we can move on now. You don't recall when you were first contacted, but you thought it might have been Dr Hood, and we've just looked at something from Dr Peters, so we can move past that to page 194.

And you're asked there:

“Did you give the infection control team any advice about Cryptococcus prior to the setting up of the Cryptococcus subgroup?”

But you say you "advised exploration of pigeon dropping accumulations found in the plant room,” but you don't remember who you gave that to. Is that right?

A Correct.

You think you were asked to attend meetings of the subgroup, probably by Dr Hood. In the same page, the answer to question 13, you say you weren't aware what the Cryptococcus subgroup’s reference terms were. Is that right?

A Yes.

Q Did you not need to know that in order to function as a member of the subgroup?

A I had understood that I was there to clarify and inform on technical aspects. I would do that just as I've been answering questions by phone and email so far. The group would have its own terms of reference. I can't see that I needed to know that in order to function--or to provide the function that I was required to.

Q So, your perception was that you were really there as an advisor on

technical issues, and was that technical issues relating to ventilation systems?

A Primarily, it was whatever I could help on. I believe that on the papers you sent me, in the terms of reference to the group, I'm listed as being-- my membership as being on an advisory basis and that was what I understood to be the case, even though I don't think I had seen the precise terms of reference.

Q So, you wouldn't have seen your role as a, if you like, decision-maker? You were there as an advisor to whoever was going to make whatever decisions the group was going to make. Is that right?

A Yes, correct.

Q Then you're asked at the foot of 194 about the functioning of the group, and you thought it functioned well and everybody contributed, although Dr Hood was the main contributor. Is that your recollection?

A That is my recollection.

Q You didn't need any particular materials or investigations; you were simply there to advise as the group's discussions continued, on the basis of your prior knowledge?

A Advise and comment, yes.

Q Just before we look at the hypotheses that were discussed by the group, you were asked a question at 19 on page 195, whether you'd put forward any hypotheses, and your answer to that was, well, you think they were all formulated by Dr Hood. Could we just look at bundle 9, please, at page 7? Near the top of that page-- I'm not going to take you through all the minutes of the meetings because that would be wasteful of time, but there's a suggestion here-- if it would come back:

"Peter Hoffman also advised that not all pigeon droppings are contaminated with Cryptococcus. In relation"--

Sorry, I'm having a little bit of a technical issue here. Have you got that on your screen?

A I have.

Q Can you just read us through what was said after the words, "Peter Hoffman?"

A "Peter Hoffman also advised that not all pigeon droppings are contaminated with Cryotococcus neoformans."

Q Can you just carry on reading, because for various technical reasons I don't have that document in front of me just at the moment.

A "In relation to maintenance staff transferring contamination on their shoes into the AHU, if pigeon droppings were trodden into the AHU, the lighter particles that were capable of being

entrained in the airflow would be entrained within minutes. Any larger particles too heavy to be entrained in the airflow would remain in place. Any contamination thus introduced would provide a brief bolus of contamination, rather than a continuing source."

Q That sounds a little bit like a hypothesis, or a part of a hypothesis, as to one possible route, you know, treading in of contaminated droppings – assuming they were contaminated, and you make the point not all were. Do you know if that was further examined?

A I believe it was certainly taken into consideration in whether or not contamination could get from the air handling unit into clinical areas. I'm not sure whether specifically contamination on shoes is capable of being explored further. It's worth bearing in mind that it could happen, but I don't know how you would explore whether or not it had happened, but my point there was that it wouldn't account for a continuing source; it would account for a very brief episode of contamination.

Q Presumably then the question is if there was a very brief episode, how many spores were generated, assuming there were spores, and where they went.

A And whether the patients who were affected would have been in rooms supplied by that ventilation system at the time.

Q I see. So, it's a possibility, but it was not one that is easy to follow through and investigate?

A Yes.

Q Presumably the same as if the suggestion was that some visitor had tramped through pigeon droppings, come into a room of a vulnerable patient, left them there, and they'd realised there might be a short amount, but it would never be possible to work out whether that had happened or not.

A I think that is an even more remote possibility. Contamination, say, on the soles of someone's shoes, would wear off with successive steps. If you imagine somebody in the street-- If you imagine in the street, if somebody has spilled paint and somebody has trod in it, the first footprint after that would be very heavily paint-contaminated. The second one less so, the third one less so, and so on. So, by the time they've gone, let's say 20 or 30 steps, there'll be nothing left on their shoes. So, unless the pigeon droppings were very close to the patient room, then it's likely that everything that was going to come off a visitor's shoe would have come off a visitor's shoe by the time they get into the room.

Q Well, presumably it would be very difficult to find out whether that hypothesis that you've just posited is

accurate or not, because there'd be no easy way of examining that possibility, remote though you think it is.

A Agreed, but the general principle remains as I described.

Q The first hypothesis that was looked at was, in oversimplified terms, that the access came via air from the plant room. Do you know whether there was any method or system in place that could have been used to track where aerosols went if they were released in the plant room? I'm just wondering because we've heard about simple things like smoke tests, which are no doubt demonstrable but not hugely complex. Somebody puffs smoke into a room and they watch where the smoke goes. You know whether there was anything in place that could have helped to work out where any aerosolised contaminants in the plant room might go?

A My recollection is that there were two possibilities for airborne contamination getting from the plant room into the clinical areas served. The first is air bypassing filtration; air going either around the outside of the filters or between poorly abutting filters. I believe that local Estates people looked at that to the best of their ability and didn't find it. This also relates to my point earlier on about looking for a minimum pressure across filters. Filters would exert a resistance on air passing through them. The manufacturer will be able to supply data for their particular filters as to what the minimum pressure should be on their filters when they were clean and what the maximum pressure differential is on their filters for when they are blocked, such that they can't pass suitable amounts of air.

I was interested in the minimum pressure. If the minimum pressure when the filters were installed was lower than the manufacturer's specification for clean filters, then that would indicate that air was bypassing the filters and there's a lower pressure differential resulting than there should have been. I'm not sure whether that was feasible, I don't think I ever got any feedback on that.

I believe there was visual inspection of the filters as installed and local estates people could observe no gaps, so if there were no gaps, then all air would have to pass through the filters. The other possibility is that air could pass down the duct system when filters had been removed because they needed to be changed. I recall that I was told that, when filters had been removed, there was an upward flow of air from the clinical area, so air was flowing back from the clinical area, up through the ductwork and into the plant room. That backward flow of air would preclude contaminated air

from flowing down from the plant room into the patient rooms.

Q Can I just perhaps, at the risk of interrupting your narrative here, ask you a couple of things and then we'll return to the way in which the hypotheses are examined in your witness statement. Later on in your witness statement, and it's in fact when you're considering hypothesis number 2, you say this:

"Whether the presence of what were reported to be modest accumulations of pigeon droppings affected the microbiological quality of the plant remain in question."

Now, is that what was reported to you, that there were "modest amounts of pigeon droppings"?

A I believe so.

Q Because the Inquiry's heard some evidence that there was heavy contamination in a number of areas such that men with special protective equipment took, you know, a whole day trying to clean it all up, the suggestion being, at least in some areas, that there was heavy contamination rather than modest.

A I think I was shown some photographs which I would interpret as showing what I would classify as modest accumulations, though I'm not sure how the density of accumulations would be assessed. I think-- Yes, you said the

people who went there to clean up were wearing special protective clothing. I would believe that was standard in anywhere they worked, and the duration they spent on cleaning it up is probably due to more a function of how widespread it was than the density of accumulation.

Q I simply wanted to ask you about the word, "modest" accumulations, because while there are undoubtedly photographs which show something that a layperson would describe as a "modest accumulation" – small amounts, small areas – there was at least some evidence suggesting that there was quite heavy amounts of accumulation, at least in one of the plant rooms, but you can't help us with that.

A It may have been, but I saw no evidence of that.

Q Thank you. The other general question I wanted to ask you about was a comment made near the top of page 196 of your witness statement, just about the third line:

"I don't find the absence of Cryptococcus neoformans on air sampling particularly evidential. The nature and level of air contamination in any environment may vary over time."

Now, I just wanted to make sure we were understanding that the point there-- Is this the point that it's quite-- air

sampling, if you're trying to find something, can be perhaps challenging because you're trying to catch a sample of air that happens to have whatever you're looking for in it and you may or may not succeed. Is that a lay version of the point you're making?

A Yes. It would need an aerosolisation event to take whatever the contamination is on a surface and turn it into an airborne form where the air sampling, which is for a fairly brief period, could detect it. So, we're in the situation that air sampling would sample for, let's say, three minutes, five minutes, 10 minutes, on a single occasion, whereas patients' lungs sampling the air that they're in 24 hours a day. So, air sampling is of limited informative value.

Q Okay. The other point you make there is that if you're going to have an air sample which caught the event, it has to be taken at the time when the aerosolisation takes place. So if, for the sake of argument, somebody scuffs with their feet a pile of dried pigeon droppings and a lot of it goes into the air, you would need to be almost there on hand to catch that in order to determine whether it was what you thought it was.

A You would, and if there's a directional flow of air wherever you're sampling, you would need to be the right side of that event.

Q Yes, thank you. Well, if we can now come back to these general points to hypothesis number 1 that was considered by the group, which was the plant room air. The first point you consider on page 196 is the point I think you touched on briefly a moment ago, could entry have arisen while the air handling unit was shut down for maintenance, and the final filter removed for replacement, and thus, the air handling unit open to plant room air.

I think the point you're trying to make here, if I get this right, is this chimney effect that, when the air handling units were deactivated, air was observed to flow strongly up through the ductwork. Now, can I just ask, were you there and observed that, or is that something that was explained to you?

A It was reported to me.

Q So, your general answer to a question I asked you fairly early on about visiting the Queen Elizabeth Hospital, you didn't visit to assist with the investigations of this group?

A I did not visit.

Q So, it was reported to you that air flowed strongly up through the ductwork into the air handling unit, into the plant room, so coming out rather than going in, and you comment that this is called a "chimney effect." Is this something you've come across

elsewhere?

A I think I would call it a "stack effect", but chimney effect does-- It's known by many things. In general, air flows up vertical spaces exiting a particular room, as would happen in a chimney, even a chimney with a fire that's not lit.

Q I've been asked to check with you, would that be true if a damper had been closed to allow the filter change which might be one practice that was followed? Would you still get the chimney effect?

A It depends how sealed the-- how the ceiling caused by the damper would result. Some dampers are there to adjust the level of flow, in which case, when they're closed there could still be a level of passage of air. Other dampers are for complete obscuration, such as fire dampers, in which case there will be very little, but even if a damper doesn't seal properly, that air that bypasses them would still go the same way as the chimney effect, the stack effect. Yes.

Q So, it depends on precisely what the damper is and how sealed it is when closed?

A But even if the ceiling was not complete, air would still flow in the same direction.

Q Yes. After your comments on the chimney effect on 196, we're about a third of the way down, at the word, "Additionally," you note an observation that:

"The air handling units in plant rooms related to case patient rooms/wards were not opened when the case patients were in these wards."

You say that that makes-- that route of contamination makes that hypothesis "less feasible."

A That was reported to me, yes.

Q That includes, according to your next comment, "Cryptococcus ingress... when the ventilation is running as normal," because the spores would need to enter the air handling unit via the plant room and then gain access.

A I think that relates to spores bypassing filtration.

Q Yes. That's what I was just going to come to, this point about filtration that what-- We'll come back to the detail of it in a moment but, taking it short, what you're pointing out there is that, while there's an ideal world in the structure of air filtration and air handling units, there can be gaps. There can be gaps and, if there are any kind of gaps, then air which might contain spores could go through past filters and enter patient areas. Is that the broad essence of what you're saying here?

A Very much so.

Q You describe that, I think, in

more detail here. You say that air filters-- This is about a quarter of the way down:

"Air filters are supplied as preconstructed units... which slide into mountings... [and] there can sometimes be unsealed gaps between the outer surface of the mounting and the air handling unit so air can pass through these gaps."

I think your point there is air will take the line of least resistance and therefore, rather than battering its way through the filter, it'll slide through the gaps or some of it. Is that----

A Yes.

Q -- the point? Of course, if that happens, this is unfiltered air, and then you say, "There can be gaps between the filtered air units." Is that just because of the way that's built?

A It's-- A function of that air would slide into mountings and, if the filter units haven't been put in tightly so they are butt each other without gaps, there can be gaps between them, if the mounting allows that.

Q These are not sort of huge defects, but they could exist and you asked for them to be checked, and you were told that these gaps couldn't be found?

A That is my recollection.

Q Then you're going on, I think, after talking about possible gaps, to talk about a quite different possibility, which is essentially the fan and the filter being in the wrong place in relation one to the other.

Now, am I right in thinking from your written evidence that you've had some experience of encountering precisely this problem with consequences for the number of spores that we're accessing?

A Yes.

Q Is this in another location?

A In several other locations.

Q Am I right in thinking it's because of the pressure that arises if the fan is after the filter?

A Yes. All of the air handling unit, that expanded section of ductwork, where the function of air conditioning occurs, all of the air handling unit before the fan will be under negative pressure because the fan is sucking air towards it. So any gap in the ductwork before the fan will drag air in. The fan is pushing air down the ductwork, so any gap after the fan will be under positive pressure, air will go outwards. So, the fan needs to be in place before the final filter. This means that any gap in the ductwork after the final filter would leak outwards. There will be no ingress of unfiltered air.

If the fan is after the final filter, there will be a section of ductwork after the final filter and before the fan which is under negative pressure and air, unfiltered air,

will be dragged into the airflow.

Q And in fact, I've now found the reference, I think you say in your statement that you found this on a number of occasions in operating theatre ventilation systems, which were under examination.

A Yes.

Q And again, this possible manufacturing issue, or-- it's almost like an installation issue rather the manufacturing issue, was reported as a possibility, and we see, on page 197, that you received a report that the air handling units had been inspected and the final filters were after the fan, which is what you would want. Is that correct?

A That is correct.

Q So, there's a possibility of leaks. None have been found. There's a possibility of the fans and filters being in the wrong sequence. None found. The next question you deal with under this heading, I think, is the efficacy of the filters. We've touched on this already. Just so I have it from you before I ask you any more questions, we've heard about HEPA filters. What are F7 filters?

A They are filters which are below high-efficiency grade, but which still filter out a high proportion of particles of fungal spore size. It's impossible with each individual filter to say what that percentage is, but I know from long

experience of sampling in operating theatres that, unless there's a defect, I find very few fungal spores in operating theatres.

THE CHAIR: Sorry, just so that I've got that correctly. F7 filters are below the specification of HEPA filters, but did I note you correctly as saying, "but they filter a very high proportion of”-- Did you say fungal spores?

A I did say fungal spores, yes. That is my experience.

THE CHAIR: Thank you.

MR CONNAL: You deal with this near the foot of page 197, and you describe something we've heard about from other witnesses of HEPA filters being challenged in order to presumably quality assure their performance.

A Yes.

Q Is that something that's done for HEPA filters routinely?

A There are two stages. First of all, the filter is generically challenged at the point of production so that that particular way of making a filter produces a filter that produces a specific reduction in particles of a specific size, but then with HEPA filters, there should also be a procedure that when the HEPA is put in place, it is challenged with small particles and you examine the filter after the air-- afterwards in the airflow, but any of those particles get-- passing the filter. So, that

filter, the fit of the filter such that no air can bypass is also verified.

Q So, not just the performance of the filter element but the performance of the mounting, if I can call it that, as well.

A Correct.

Q And you spoke positively about F7 filters a moment or two ago. At the foot of page 197, you say they filter to lower quality assurance and they're not tested for resisting the passage of particles after fitting. So, I suppose, if you fit-- If you fit a HEPA filter you then test it, you know whether the filter's working and you know whether the mounting is excluding air, but with an F7 you don't necessarily know either of these other than from the label on the item. Is that right?

A Yes. So, I think it would be fair to say F7 filters work more often than they don't work but that is not of high reliability.

Q In fairness to you, you say on page 198 that, from long experience of sampling and operating theatres where air is supplied via F7 filters, fungal contamination is occasional and sparse, but, I suppose, the question someone might have listening to this discussion is, if, in the context of the Cryptococcus analysis, any of the filters were F7 filters, then their both filtration and mounting reliability would not be assured as a protection against spores in the same way as it would be if it was HEPA.

A The filtration efficiency would be, I think, in the context of fungal spores, marginally lower than HEPA filters. It's the integrity of the filting-- sorry, the integrity of the fitting as to whether air could bypass them was my main question. This is the point that I repeatedly raised and was assured by the local Estates people that on examination they could not observe gaps around or between filter units.

Q We know that the ultimate conclusion on air entering via the plant room of the group was that it wasn't feasible, but can you exclude it if there are F7 filters in the mix?

A As a function of filters, if the filters had been fitted such that no air would bypass filtration, then the number of fungal spores, including Cryptococcus that will get through them, would be very low.

Q But not excluded in the way that they would be if there were HEPA filters?

A Correct.

Q Now, the second hypothesis that was tackled by the group, and it's convenient just to with these in the way they come, was that any contamination could have come from an outside air source because certain wards had F7

filters but did not have HEPA filters, and you note it here: the summary of the report says that this would allow through a percentage of Cryptococcus spores if present and then the question is, well, where are they present? And presumably that's something of an unknown. Is that right? Is that essentially what you're saying there?

A It is. Now, there are different definitions of outside air. Here, are they talking about outside air that comes through the ventilation system or outside air that leaks into rooms independent of the ventilation system, and this is something that I was never quite sure of. I think they chose here to use a definition that was outside air which came through the ventilation system, but this is an area that I was never actually able to resolve.

Q So, we know from other evidence that the hospital relies entirely on mechanical ventilation although no doubt, at some parts in the hospital, air enters from other sources, but the plant rooms were open in various ways to the outside air. So, presumably, that's why there was a focus on the ventilation systems.

A Entirely right to do so, but I don't see a hospital as being entirely sealed so that only air supplied by the ventilation system gets into patient areas. I think hospitals, unless there's a lot of attention gone into the ceiling, are fairly leaky places.

Q Thank you. In any event, the outside air source was recorded as a possible source, no more and no less. The third hypothesis was lack of protective isolation, and your immediate question that you note in your witness statement is, "Well, what does protective isolation actually mean? How are we defining that?" Now, when you were discussing this with the group, was there an agreed version or can you help us at all?

A I think it was, as I described earlier, of highly filtered air being supplied such that only that air was available for a patient to breathe, but I think that was a fairly informal agreement.

Q What you say in your witness statement at the foot of page 198 is your definition of protective isolation, and I think this is echoing something you told us earlier, would be:

“A ventilation system that ensures 100 per cent of every breath a patient takes is passed through a filter that ensures removal of all fungal spores.”

So, that would have to be, as you point out, if you're going to achieve that target, supply air through a HEPA or EPA filter in an air handling unit designed for specialist healthcare application, and also ensuring that the rate of the supply

exceeds the extract rate, presumably. Otherwise it-- the room takes in air from somewhere else.

A Correct.

Q So, you're putting more air in than you take out.

A You ensure that the room, which is bound to leak, leaks in a safe direction.

Q And your recollection, therefore, it-- you put in in 199, is that that kind of level of protection was only available in Ward 4B patient rooms which the investigation addressed and therefore presumably by definition any other areas such as, for instance, 6A didn't meet that particular definition of protection.

A Yes.

Q And hence, if there was a susceptible patient not protected in that way, it is at least possible that they were infected by spores which were not caught by the existing filter system.

A Or entered their rooms from an area that was not supplied with safe air, that contained unsafe air. So, either through the ventilation system or, probably more likely, air entering their rooms that hadn't been through a ventilation system.

Q So, air from the outside corridor when someone comes in, or brought through the hospital air generally?

A Or being drawn into their rooms because the room is under negative pressure.

Q Thank you. My Lord, I'm conscious of time, I haven't a great deal to do, but it may take me a little time to finish.

THE CHAIR: Right. I think we'll take our lunch break now, Mr Hoffman. Can you be back and available to us by two o'clock?

THE WITNESS: Two o'clock is fine.

THE CHAIR: Thank you.

(Adjourned for a short time)

THE CHAIR: Good afternoon, Mr Hoffman.

THE WITNESS: Good afternoon.

THE CHAIR: Mr Connal.

MR CONNAL: Thank you, my Lord. Mr Hoffman, we were working our way slowly through the hypotheses that had been discussed at the group on which you advised as you explained to us, and I think ultimately you retired before the final throes of that were completed. Can we just go back to these and we go back to your witness statement at 199, please?

(Inaudible) into my system. If you just bear with us until I get my technology resolved, please. I don't know whether your Lordship has the document on screen.

THE CHAIR: I don't, but it may not matter. When you say “document”-- the witness statement, I have it in paper.

MR CONNAL: Screen’s been adjusted, apparently. Apologies for the delay, Mr Hoffman. The wonders of technology.

THE CHAIR: Thank you.

MR CONNAL: I was going to page 199 of your witness statement, where hypothesis 4 is considered, which is a cylinder room and unfiltered outside air circulating in the cylinder room near the Paediatric Intensive Care unit entering a patient room, then the qualification is put that the case patient was in a PPVL room.

In the section that you set out in your witness statement immediately after that statement on page 199, you set out, for a second time, a point that we discussed fairly fully earlier about PPVL rooms and how they're apparently meant to operate, and you record at the top of page 200 that you have reservations about these and we needn't go back to look at these again, but the essence of your concerns, I think, are expressed at the end of the first paragraph on page 200, where you say that, depending on how this attempted PPVL protection operates, "It could, I put it no higher than that, lead to contaminated air entering the room.” Is that right?

A That is correct.

Q And then you go on, I think, to raise a sort of definitional point, if I can call it that, about PPVL rooms, which we've touched on with other witnesses, but I might just take it from you, that-- You point out that in the report what is said is:

“The PPVL room is trying to achieve the best of both worlds, the room is ventilated, the lobby is under negative pressure to both patient room and ward corridor with air being pulled in and extracted from the room and the ward corridor itself.”

And your point is that whatever is being described in that section is not a PPVL room outlined in the Scottish guidance.

A What is being described is a room with a negative pressure lobby. That's not a positive pressure ventilated lobby room.

Q And you point out that in the guidance, and I might come back to guidance briefly with you later, the entry lobby is to be at plus 10 Pascals with respect to the corridor, and this is not what's being described in the Cryptococcus report.

A Yes.

Q And I think your conclusion on hypothesis 4 is that, while it's possible, some air could get in, but it might not be

a significant component of the air, in which case, am I right in thinking that it then depends on how many particles of fungus, if they are present, happen to come in with the modest element of air that comes from that source?

A Yes, but there may well be significant volumes of air from-- unfiltered air from elsewhere that could come into the PPVL room.

Q Right. So, I think that hypothesis was labelled possible in one case at least, and the next and perhaps most exotic of the hypothesis is the helipad hypothesis that the downdraft was aerialising cryptococcal spores from pigeon guano dust into air intakes and what happened, as we understand in the course of the group, was that another expert was instructed to do a computational fluid dynamics study on this particular point about air flows during helicopter activity.

Now, you quite properly say in the middle of your answer to question 24, you have no expertise in CFD, but then go on to describe what you understand it to be and there are different phrases all appear in the one sentence: "precise, approximate, and sporadic."

Now, you say it's a precise mathematical modelling. So, I think I understand that but then you say it can be "based on input data that are approximate and sporadic." Can you just help us understand what point you're making about CFD at that stage?

A CFD is mathematical modeling. The mathematics itself, although I don't understand it, I believe to be a very precise model. A model depends on what assumptions and parameters you put in there to be modelled. So, not a lot is known about the whole bundle of variables that might affect fungal spore resuspension that can be fed into this model.

So, you're putting in a series of assumptions that may or may not include relevant factors, that may or not be relevant assumptions into a precise model. So it's a precise model of some assumptions, other assumptions the models might be totally unaware of and have left out. So, this is essentially what is fed in: are known unknowns and unknown unknowns. So, the model is only as accurate as those assumptions are both accurate and complete. This is often not the case.

Q However, that said, you're recorded as saying that this particular hypothesis is unlikely to be correct because either the pigeon guano will be firmly stuck and therefore not mobilised by the helicopter air flows. Alternatively, if they weren't then every time the helicopter takes off and lands it will shift

them and therefore they don't build up. That's what you're, I think, saying in that hypothesis.

A Correct. This is very similar to what I was saying about particles within ductwork early on. Either they are light and are going to get moved out very rapidly, or they're heavy – in this case stuck to a surface, and don't form part of the game.

Q So, that's a hypothesis that was marked as unlikely. Then hypothesis 6, now we've had some evidence about this pneumatic tube sample conveyance system which replaced the need for-- or reduced the need for porters to take samples from A to B to be analysed, and I think we probably understand, at least in general terms, how it operates. So, is the question about this hypothesis really about the amount of air that will be released into any particular environment each time the system is opened for the purpose of inserting or removing a sample?

A I'm sorry, I didn't get a question there.

Q Oh, I'm sorry.

THE CHAIR: No, I don't think there was a question.

MR CONNAL: I'll reframe that. The pneumatic tube system moves sample containers around – I'm probably not using the right word; I think somebody used the word "pods" – via compressed air drawn from a different plant room, as it turns out. So, they then discharge that air into the treatment room when they're open to remove the travelling pod having reached its destination, and I think I was trying to get to an understanding of whether the real question about this as a hypothesis is focused on the amount of air that we're talking about, which sounds very small, but maybe I'm wrong in understanding what the point is. Why is this hypothesis not likely?

A I'm not sure I have a reliable understanding of the pneumatics of these transport pod systems. I gathered from what was spoken about at the various meetings that the volumes of air involved were fairly small and I'm not sure that the major air discharge points were necessarily in clinical areas, but this is not something I understand in great depth.

Q But if one assumed that-- because there's, I think, a quote from you in your statement. If you assumed that a small amount of air did emerge into a patient room, you're noted as saying, "Well, that amount is likely to be very small in context."

A I think the air would emerge outside a patient room in a more communal area of the ward, and I can see comparatively little of that getting into

a patient room compared with all other sources of unfiltered air.

Q The final hypothesis, 7, is described as “dormancy reactivation,” which appears to be the proposition that someone has acquired the Cryptococcus bug elsewhere, and then it reactivates when they're in the hospital. Your position on that, as I understand it, is it's simply not an area on which you had any expertise to allow you to comment on?

A That is correct.

Q I suppose the only question I have for you is this, given your long experience with hospitals and hospital infections and associated matters. Pigeons are-- well, let's say that they're not an uncommon bird to encounter in various locations, including urban locations, whether we're talking about Trafalgar Square or anywhere else. They're a fairly ubiquitous bird. Therefore, is it fair to say that if it was a common thing, i.e. acquisition of the Cryptococcus bug and then going into hospital and then it reactivating, you would perhaps expect to see similar incidents to the one we're talking about here in various locations. Or can't you help us with that?

A I really don't know what the incidence of Cryptococcus occurrence is as normality in hospitals, so I don't think I can help.

Q All you can say is you hadn't come across it?

A It has not been brought to my attention, correct.

Q Thank you. Having talked through the various hypotheses, the issues, the possibilities, the knowns and the unknowns, I'm just trying now to assess what overall conclusion might be feasible. You're asked in the witness statement what you thought of the report, and you've made some comments on it. What I'm interested in is part of your answer 28, where you say this:

“I would not refer to the likelihood assigned to individual hypotheses as conclusions, but more as assessments of possibilities. That definitive conclusions were missing is perhaps a realistic reflection of abilities to establish what precisely occurred in each case of patient acquisition of Cryptococcus.”

Now, in the course of your evidence earlier today, we've been talking about possibilities, likelihoods, question marks, if I can put it that way. Perhaps with the possible exception of the helipad, would you expect phrases like "conclusively ruled out" to be used about any of the hypotheses that we've been discussing?

A I don't think so. What I was doing in my answer was rather taking issue with the word "conclusions" in the question I was asked. I think they're an

exploration of possibilities. I don't think the report has arrived at conclusions.

Q Thank you. I think that you were asked one further question about the Cryptococcus issue, which appears on page 203 of your witness statement, where you're asked, or you're told, that another four cases of Cryptococcus, or possible Cryptococcus, within the hospital have been found. You say you're unaware of this. You're asked if it makes any difference, and you say it doesn't make any difference, the fact that there have been other cases found. Is that right?

A Correct.

Q So, it doesn't-- it wouldn't make any difference to your assessment of the hypotheses if further cases emerged?

A No, because the hypotheses are still as valid or not as valid as they remain for one case as for, say, six or seven cases, and there doesn't have to be a single route of transmission. If however many people, let's suppose six, have acquired it, there could be six different routes of transmission.

Q Based on the information that you had, would you be able to say to us today how any of these six were likely to have got it or not? Is that simply not known?

A It would be impossible for me to say with any degree of certainty what the route, or routes, of transmission for each case had been.

Q Okay. Well, I'd like to leave Cryptococcus now and perhaps return briefly to a couple of things that arose from your earlier evidence. I wanted to ask you first of all about performance of air handling units in producing air change rates. It doesn't matter what the rate is just for the present question.

Do you know – and please say if you don't – is it correct that the performance of an air handling unit when installed, which let's say for the sake of argument produces six air changes an hour, will deteriorate over the passage of time so that sometime later, even if maintained in the routine way, it may be producing less than six air changes an hour. Is that something that is an accepted fact?

A This is engineering that I'm not very familiar with. My understanding is that many modern air handling units have variable power motors for the fans so they can compensate for filters blocking up. So, there would be two types of deterioration. One is the motor not achieving what it's meant to, so the fan rotates more slowly. I think that would not be typical of modern air handling units. The other is of filters blocking up and not being able to pass as much air as they should do.

Now, this will be detected hopefully on the building management system by the pressure differential across the filter, and the filter would be changed before it gets to a critical point. So, there might be minor impairment of the ability of the system to provide precisely the volume of air or the rate of air that it was supposed to, but this should be detected and corrected routinely.

Q So, if you were if you were envisaging a period of time between installation of the filter and replacement of the filter, if you were, say, three quarters of the way – just to take a figure – through that period, the performance of the system may have deteriorated, but hadn't quite reached the alarm point yet?

A It may have deteriorated. I think that deterioration will be marginal, and in many modern systems there will be feedback to a variable speed motor that could increase the rate that air was being supplied to the filter to compensate for filter blockage.

Q Thank you. I just want to ask you one other thing. In the course of-- you remember I showed you a-- I won't call it a specification, but a list of features that might have been expected for a BMT unit room, which included 10 Pascals, HEPA filtration, and so on, and also had 10 air changes an hour, which you-- that particular compilation you said was an amalgamation of your views and presumably HPS who were marked as the other contributors. Your view was that the air changes were irrelevant. Really, I just have two things to ask you there. One is, do you accept that both HTM 03-01 and SHTM 03-01 have tables in them suggesting, for instance, 10 air changes for a neutropenic area.

A Yes.

Q So, the guidance or advice or whatever we want to label them, we won't quibble over the words, does nevertheless include required air changes, largely of six and then of 10 in a series of specialised areas?

A Yes, I would accept that.

Q So, do you not give any significance to air change rates in ensuring patient safety in these areas?

A No, I believe they're for patient comfort.

Q So, even if 10 air change rates were advised, you would say that's still just for patient comfort?

A Yes.

THE CHAIR: Well, to state the obvious, we have heard evidence that there are significant infrastructure implications involved in achieving an air change rate of 10 as opposed to an air change rate of six. Are you going the distance of saying that the recommendations in the Health Technical

Memoranda are superfluous?

A I regard them as being superfluous in terms of patient risk in highly neutropenic patients, yes.

THE CHAIR: Again, and forgive me for repeating myself, does this depend on the premise that the environment within which a neutropenic patient is being treated has been filtered to the degree of a HEPA filter?

A I regard these as two independent factors. If it's not HEPA-filtered air, then there is a lower reliability of fungal spore removal, and that depends precisely on what type of filtration the sub-HEPA filtration is. But, earlier on, I was talking about the ventilation for these rooms being about exclusion of fungal spores, not dilution of anything, and I stand by that.

THE CHAIR: Right. So, the purpose of filtration is to exclude?

A Yes.

THE CHAIR: Right. Do you see dilution of air, by reason of the number of air changes that are applicable to a particular space, as having any infection protection and control function in spaces which have-- well, first question, filtered at a specification below HEPA filtration?

A If you are supplying air, which is contaminated with, say, fungal spores, then you can supply it at any rate you like. It doesn't make any difference to the concentration of fungal spores. They will be in the supplied air.

THE CHAIR: Right, because you have a constant-- you assume a constant content of fungal spores?

A Yes. So imagine you're putting contaminated air into a bath. It doesn't matter at what rate that air goes into the bath, it's the same contaminated water.

THE CHAIR: And I think at the moment, if that applies to fungal spores, would you say that applies equally to any other microorganisms in the air supply?

A In the air supply, yes, I think the question here is whether relevant microbes are generated within the patient room, not in the air supply, but within the patient room, that are a risk to the patient. I can't see what they would be.

THE CHAIR: So that brings me back-- I think, listening to what you say, your position would be that in a ventilated space within a hospital, you can't see the rule for air change rate as impacting on infection risk?

A What I said applies specifically to accommodation for highly immunocompromised patients that is positively pressured. It definitely does not apply to areas where you have patients who are infectious; their airborne dilution plays a significant role. There's a difference between protective isolation and source isolation.

THE CHAIR: Yes. Thank you.

MR CONNAL: I really only have one other question to follow that. During the pandemic, there was a lot of discussion over the fact that somebody might be exhaling particles infected with COVID, whatever the number was, into the environment even before they were necessarily symptomatic – coughing and sneezing and all that kind of stuff – and that was one of the issues. Now, if you envisage then the possibility of an individual entering the room of an immunocompromised patient who was COVID positive and emitting these particles, would a higher degree of dilution not be helpful in a situation like that?

A The whole science around that is very poorly established and mainly by mathematical modeling with imprecise inputs. I would see there the major risk as being from larger particles, splashes and droplets, rather than aerosols but this is certainly not well-established.

Q I have nothing further for this witness, my Lord.

THE CHAIR: Mr Hoffman, I have to check if there are other questions in the room. So, we will break off our contact with you for what I would hope to be no more than ten minutes or so in order to find out whether there's any more questioning, and we'll get back to you.

THE WITNESS: Okay. So about 2.40?

THE CHAIR: About-- let's say quarter to three.

THE WITNESS: Fine, thank you.

THE CHAIR: Thank you.

(Short break)

THE CHAIR: Mr Connal.

MR CONNAL: My Lord, no further questions have been intimated to me.

THE CHAIR: Mr Hoffman, no further questions apparently and therefore that's the end of your testimony today. Before we break contact, can I express my thanks both for your attendance-- your online attendance today, but also the work in preparing your witness statement and reading the documents we provided you with. So, many thanks indeed, but we will now say goodbye this afternoon. Thank you.

THE WITNESS: Thank you.

(The witness withdrew)

THE CHAIR: Now, Mr Connal, we, I think, plan to resume tomorrow. Is that correct?

MR CONNAL: That is correct, my Lord.

THE CHAIR: Again, at 10, I think.

MR CONNAL: Yes.

THE CHAIR: Right. Well, can I wish everyone a good afternoon, and we'll see each other at 10 tomorrow.

(Session ends)

14:49