Guidance on ventilation revised and updated

Speaking in the 'System Governance' stream on the first day of last October's IHEEM Healthcare Estates 2021 conference, consulting engineer, Malcolm Thomas, the main author of the 2021 version of HTM 03-01, *Specialist Ventilation for Healthcare Premises*, published last June, explained the background to, and aims behind, the HTM's revision, and highlighted some of the major changes that those responsible for ventilation plant in hospitals and other healthcare facilities need to be aware of. *HEJ* editor, Jonathan Baillie, reports.

Malcolm Thomas was the lead author for both editions (published in 2007 and last year) of HTM 03-01, and also of the ventilation-related HTM 2025 that preceded them. Also the lead author of the engineering section of several HBNs, he has worked in the healthcare sector for over 40 years – both within and outside the NHS. He is President of the Specialised Ventilation for Healthcare Society, and a visiting lecturer at the University of Leeds. Welcoming attendees to his presentation, he explained that as the lead author of HTM 03-01 (2021), he would explain some of the main thinking behind it, and set out the reasons for a number of key changes in the 'rewritten version'. He began: "As some background to where the HTMs and other guidance on ventilation originated, back in 1972 Dr Owen Lidwell led a Joint Working Party on ventilation and operating suites, and this was the foundation of all the guidance that has emerged since. Many people have asked me," he continued," why we bother with material that is 'so old'? The reason is that when this work was done, it was very evident what worked well in practice, and what didn't, in a way that's no longer nearly so clear. When you have significant infection rates in operating theatres, it's quite easy to see whether – if you change the colour of the paintwork – it makes any difference. Conversely, with very small infection rates – which fortunately we have now – it's very difficult to know whether changing the surgeons' gowns, the air change rate, or the colour of the walls, or putting carpet in, makes any significant difference. We're talking about low percentage changes. We're in a situation now where people think changes will improve things, but they don't actually know, and it's hard to prove what is a good or a bad thing. Back when Owen Lidwell did this work, it was relatively easy, there were step-changes, and he was able to conduct a number of trials."

Malcolm Thomas, the main author of the HTM 03-01 (2021), *Specialist Ventilation for Healthcare Premises*, published last June.

Comparative trials

Malcolm Thomas explained that in one, Owen Lidwell and his team took a particular acute hospital, and identified two operating theatres as theatres 'A' and 'B', with had two surgical teams – also named 'A' and 'B', staffing them. He elaborated: "They picked out patients at random, drawing lots to decide which theatre they were operated in. They could thus see which team and which patients fared better under certain circumstances, and thus demonstrate changes in the outcomes in infection rate terms." From this work, and drawing on theatres with low infection rates and good patient outcomes, Owen Lidwell and his team were able to determine the optimal airflow and temperature, and consider elements such as the impact of different gowning procedures. This in turn enabled them to draw some conclusions.

"The conclusions they drew have stood the test of time," said Malcolm Thomas. Following Owen Lidwell's work, the Department of Health and Social Security – as it was then – set up a working group, and codified the ventilation of operating departments in a document called DV4, specifying what was required for the theatre, and what worked and what didn't, 'taking Lidwell's work forward'.

Request to update guidance

"When I came on board," Malcolm Thomas explained, "I was asked to update DV4, but soon after I'd finished doing this, I was told it was now going to be an HTM, and HTM 2025 was duly published in 1994. Some years later I was asked if I could I take that forward again, and HTM 03-01, *Specialised ventilation healthcare*, was published in 2007. It was delayed by SARS, and avian flu, just as the Coronavirus outbreak delayed the publication of the current version of HTM 03-01. So, all of these iterations are based on some good solid work many years ago. I've been working in this area for some time, and it's very evident that these earlier learnings have stood the test of time. Where we have encountered problems, it's generally been clear that the guidance wasn't followed."

Historical reasons for not following guidance

Among the historical reasons for failure to follow established guidance, the speaker explained, had been changing procedures in both operating suites, and other 'spaces' in healthcare facilities, while on occasions people 'had not perhaps been as careful as they should have been' –

> **We're in a situation now where people think changes will improve things, but they don't actually know, and it's hard to prove what is a good or a bad thing**

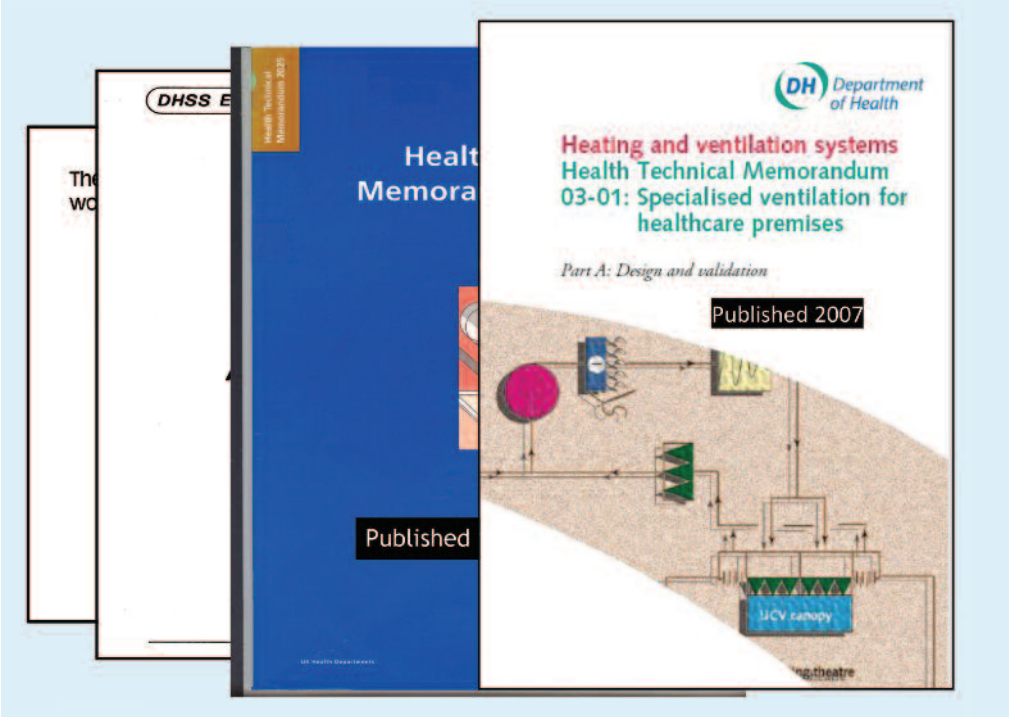
leading to 'something going wrong with the ventilation'. Malcolm Thomas said: "Put the people right, and – if I can put it like that – we'll get the ventilation right. There's a good pedigree, a good history, and we can have some confidence in past learnings and guidance. It isn't just people's opinion; it's what works."
'Backing this up, he added, was 'a fair amount of ongoing research by Department of Health, the NHS, and private companies', with the findings taken on board when HTMs were revised and updated. He said: "So, in these guidance documents we try to avoid just featuring people's opinion of what works and what doesn't, and instead coming down to some facts. History appears to show that this is a correct way of doing it."

Do we need the HTM guidance?

'Back in 2017/18', he explained, when it was decided to look at revising HTM 03-01, one of the questions asked had been: 'Do we need it?' He explained: "We have, in fact, been trying to reduce the amount of guidance issued, because at one point there were something like 400 different pieces of guidance, and it's almost impossible to keep that sort of volume of guidance up to date." Over the years there had thus been some 'pruning', together with a 'focus on what is different about ventilation in healthcare'. The speaker said: "What matters to us is, for example, whether CIBSE guidance on ventilation is adequate. If so, that's great, but if not, do we need to do more than CIBSE is suggesting, or perhaps less in some cases? Things that CIBSE would allow may not be what we want to do. They may not be appropriate in a hospital or other healthcare setting. So," he said, "having decided we did indeed need HTM 03-01, we questioned whether it needed updating, and, having determined that it did, began looking at how." This resulted in a 'scoping exercise' which ran for over a year with wide-ranging consultation, to look at what was in the documents, whether the HTM could just be given 'a dust down' and a little updating, or whether indeed some fundamental changes were needed He said: "That led to the move to produce a new document, in two parts, with part A on design and installation for those putting in something new, and Part B about how you manage an existing healthcare ventilation system."

A 'complete re-write' required

He continued: "It was decided that Part A needed to be completely rewritten, it having become clear from the scoping exercise that in existing form it assumed that designers knew what the healthcare industry needed." "Interestingly," he added, "back when I authored the HTM for the first time, I was told: 'Well, you can't put that sort of thing in, Malcolm. People who do these things already know what they're doing.' On the contrary though, it became very evident – and particularly with the PFI process – that a lot of people designing hospitals and hospital systems in fact had no idea what their customer wanted."



The latest iteration of HTM 03-01 – on which Malcolm Thomas primarily focused – followed several previous guidance documents on healthcare ventilation.

Historical context

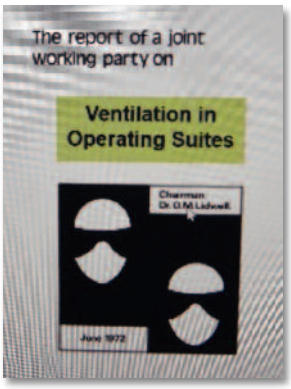
Here Malcolm Thomas showed slides of Owen Lidwell's report, followed by DV4, then HTM 2025, and then HTM 03-01, both in 2007 form and in the latest iteration. Referring to HTM 03-01 (2021), he said: "It was decided that we should produce the latest HTM 03-01 in two parts – it was clear that Part A needed to have more of an explanation, not just of what we wanted, but why – so that people understood the importance of things. We thus changed the title, the Concept, the Design, Specification, Installation, and Acceptance Testing – the whole process. We tended in the PFI days to say: 'Give us a new hospital, and give me the key when it's finished', and clearly that wasn't a good idea. While we have some very good hospitals, constructed and built and working well, some were much less successful than they should have been. Part A of the 2021 HTM 03-01 thus refers both to all new installations, and to refurbishments and changes in use of existing installations. I would stress that it's not retrospective; you don't have to rip everything out and re-start. However, if you're in the middle of the project, and you find that the new HTM would suit you better, then providing everybody else agrees, and you've addressed any cost implications, there's no reason why you can't move over to the new standard." This, Malcolm Thomas said, applied even where a project team was working to guidance set out in the 'old' HTM."

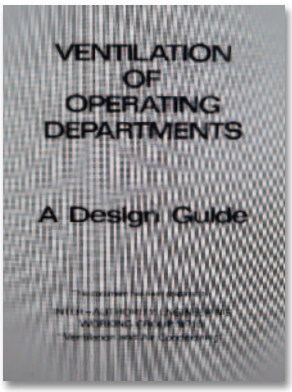
Part B of the new HTM

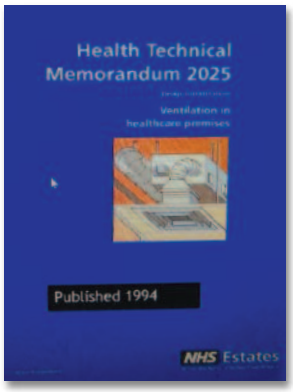
He continued: "Part B is about the management, operation, maintenance, and routine testing, of existing healthcare systems. It's much as it was, but there are some additional changes. The thing to remember with Part B is that it applies to all installations; it doesn't matter how old."
He continued: "I'm often told a hospital installation dates from the time of HTM 2025, and that's why it doesn't conform. However, the minimum standards have been there ever since that HTM was published; in fact they were introduced because of the Stafford outbreak and Legionnaires' disease in 1986, and were in the Big White Book, for which I wrote a section on standards for ventilation plant." These had – he said – been carried forward in every HTM since.

Moving to the 'major themes' in HTM 03-01 Part A, he said: " One thing we have had to focus on particularly is supporting the Government's zero carbon policy – so there's quite a push in terms of energy use, and how we go about things to support this objective."

Also considered in compiling the new guidance, Malcolm Thomas explained, had been the EcoDesign Directive and regulations, which he pointed out were 'legal requirements'; he was surprised many equipment manufacturers still viewed them as 'options'.







Left: In 1972 Dr Owen Lidwell led a Joint Working Party on ventilation and operating suites, which was to be 'the foundation of all the guidance that has emerged since'. Centre: Following Owen Lidwell's work, the Department of Health and Social Security – as it was then – set up a working group and codified the ventilation of operating departments in a document called DV4. Right: On 'coming on board' with official ventilation guidance, Malcolm Thomas was asked to update DV4, but soon after doing so, he was told it was now to be an HTM, and HTM 2025 was duly published in 1994.

Taking advantage of new technology

He continued: "On carbon reduction, we changed quite a few things to try to get maximum benefit from new technology and reduced energy use – fans being a good example." He elaborated: "Those of us who grew up with belt-drive fans know we were stuck with a particular fan speed, regardless of whether it was optimal, and with specific outputs; there wasn't much you could easily do about either.

"Nowadays, we have a whole range of more efficient fans, and more coming along; control technology has moved on – we can be more accurate in how much air comes down the system, and we don't need to build in such a big margin to allow for system deterioration over time. We've striven to take advantage of all this in the new HTM." Malcolm Thomas explained that the authors had also striven to provide background information to assist the understanding of client needs.

He expanded: "So, you will find, scattered throughout, little blue boxes with little aide-memoires, which highlight why the preceding paragraph is important, particularly in a healthcare setting. They are very sound ideas, so please don't depart from them."

A clarification of design parameters

The new HTM also incorporated 'a clarification of design parameters'. "There's been problems in the past with what standards we actually want," he explained. "We've now got much more of a clarification of design parameters." In terms of 'the new elements', the HTM's authors had put in the user requirements, listed under 'surgical', 'medical', 'mental health', 'palliative care', 'and so on'.

He said: "We have thus sought to answer the questions: 'What does the user want, and why have we provided ventilation?', 'What's it for?', 'Is it for infection control, comfort, or to remove odours?' What's it about?' Again, it is about trying to clarify for the designers exactly what is important, and what you can do some adjustment on." He continued: "We've also introduced the concept of the Ventilation Safety Group, mirroring what we already have with the Water Safety Group, i.e. a group of Trust stakeholders made up of people from Estates, Finance, and Infection Control, and other key

personnel, all of whom have an input, and make some decisions on the ventilation systems and their operation."

Derogations

In circumstances where somebody wanted to derogate in future, they would now need to take the matter to the Ventilation Safety Group, which must agree and sign up to the derogation. He added: "The Group must also record what the derogation was, why it was agreed, and who agreed it. It thus takes away this 'Mr Jones said it was OK'-type approach. Notice too," he said, "that somebody from Finance is involved, because some of these things have ongoing financial commitments. For example, some of the ways of installing ventilation plant mean they need more regular cleaning over time, with a financial implication ongoing for the system's lifetime, so it's essential that the Finance people are involved and recognise that if you go down that path, there needs to be provision to undertake the maintenance correctly over a period of perhaps 20 years."

Guidance on refurbishments

Malcolm Thomas explained that while the new ventilation HTM covers refurbishments and change, the old one didn't. He and his counterparts had encountered 'a lot of problems' with people refurbishing theatres, where they had 'completely gutted' an existing such facility, installed new ceilings, plastered the walls, put in new doors, a new floor, new operating tables, lamps, 'and everything', but kept a 30-year old ventilation plant. He said: "This is like buying a new car, but taking the engine out of the old one because that will save you a bit of money." He continued: "The ventilation plants are not as expensive as an operating table; you wouldn't dream of using a 30-year-old operating table, so why consider using 30-year-old ventilation plant? We should surely be taking advantage of new technology. We want new plant with good controls, not old plant 'mashed up to save a couple of bob'. That's an important aspect which is clearly spelt out.

Natural ventilation where possible

"We have also suggested various ventilation strategies; we would like natural ventilation where practical. Such ventilation can, however, 'be tricky in the case of hospitals', Malcolm Thomas acknowledged. As he put it: "You're relying on the wind blowing, and blowing in the right direction, not too much and not too little, so it's not easy, particularly in a hospital." However," he added, "mixed mode ventilation, taking advantage of natural ventilation while it's there, and then supporting it with a fan that will come on when it's needed, and perhaps some supplementary heating etc, can be one potential solution."

Natural ventilation wasn't 'just about opening a window'. The speaker elaborated: "It's about having ventilation openings, which may be supported with some ductwork attached, with a means of adjusting the ventilation rate when the natural ventilation is available, and taking advantage of it when it is." Where full ventilation, 'which costs money', was selected, the question arose about whether it needed to run 24 hours a day, seven days a week, 52 weeks a year. He said: "The answer, in most cases, is 'no'. If there's nobody there, you can turn it off – a really good energy-efficient way of doing it. This is not new; it was in EnCO_2de for many years."

Unnecessary plant operation

Noting that people still left theatre ventilation running '24/7' to keep the rooms sterile, which was 'absolutely not required', Malcolm Thomas explained that he and the co-authors of HTM 03-01 (2021) had expanded the 'Operating theatres' section 'quite significantly'. He said: "We've, for example, changed the parameters for air change rates to reflect what we can do to take advantage of the latest technology. We don't need to have as much slack in the systems as previously. So, the advice is much more appropriate for today, although still in line with what Owen Lidwell found worked, and history has subsequently proven right." Some of the 'old information' for where older theatres were still in use had been retained, but the new HTM 03-01 also incorporated 'a whole new set of information'.

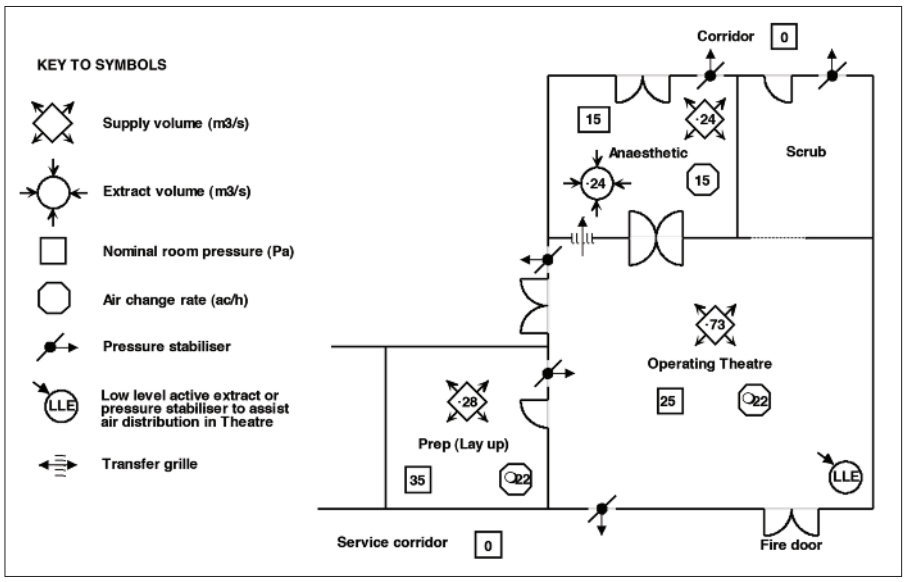
Installation guidance

Malcolm Thomas told attendees: "In a new 'Installation standards' section, we've spelt out some of the things that cause us numerous problems – including guidance on very simple things, which cost no money to do, but if not done right cost an awful lot of time and effort. So, for instance, with a basic thing like balancing damper handles, why install them at the top of the damper? When the ceiling is up, you then can't reach them. Air doesn't know where the handle is, but putting the handle on the bottom of a damper costs no more installation-wise, but means that when you come to balance, or subsequently re-balance, the system, you can reach the handle without killing yourself."

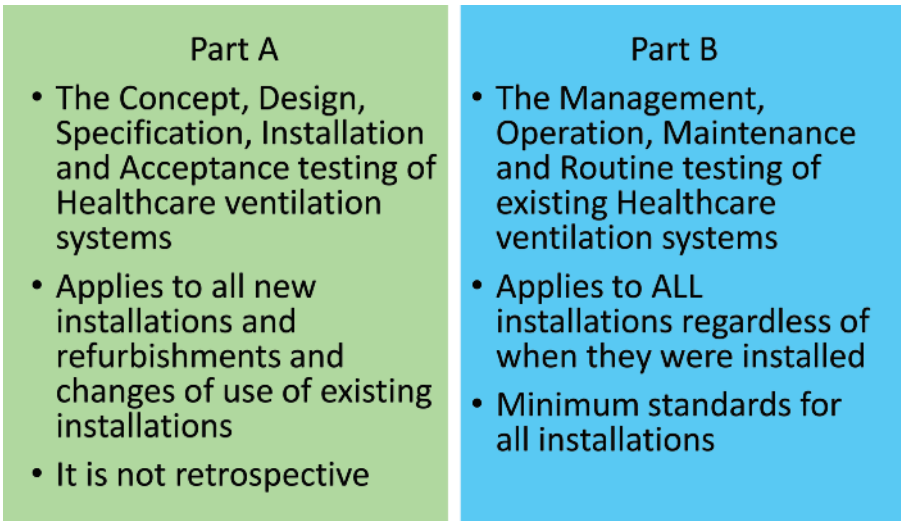
Turning to another key topic in the new HTM – 'Acceptance testing and validation', Malcolm Thomas explained that 'validation is a process of accepting the whole job, the whole project', so in the theatre, wasn't 'just about how much air goes in, but rather about where the air comes from: what the air-conditioning and air-handling unit is like, what the ductwork is like, and what the fabric of the theatre is like'. The speaker stressed that it was 'very different from commissioning', and entailed looking more holistically at 'Does it work, and can we at the end of the validation say it is safe to operate?'

Appendices expanded

The authors had also expanded the appendices 'to cover some of these things'. Here he showed a diagram of 'an example of one of new standard schemes, and the amount of air in the theatre'. He said: "The air change rate has changed, and above this, if you look in the appendices, there's a whole range of information that's much more definitive compared with what we has before. So, there are four schemes – single-corridor and two-corridor schemes for standard theatres and ultraclean, and another four



A ventilation diagram for a standard operating theatre taken from HTM 03-01 (2021).



Malcolm Thomas urged all those with a professional interest in, or responsibility for, healthcare, to read and familiarise themselves both Parts A and B of the new HTM 03-01 – 'including the appendices and the accompanying explanations'.

historical schemes for those of you with older, smaller, theatres."

The authors of the new HTM had also created quite a lot of application-specific guidance – for instance dividing up applications into 'Treatment and Procedure Facilities', 'Airborne Protective Facilities', 'Airborne Isolation Facilities', 'Maternity Facilities', 'Pharmacy Facilities', 'Sterile Services Facilities', and 'Extract systems and local exhaust ventilation'. Malcolm Thomas said: "We have presented that information in terms of tables." Here, by way of example, he showed a slide of an 'Airborne Isolation Facilities' table, covering Isolation rooms, Categories 2 and 3. He explained: "If you want to know what the categories are, look at the bibliography in the index at the back of the HTM, and it's all explained." Down the side of the table were the areas or zones being discussed, with the next column highlighting the reasons and purpose of the ventilation, and the next 'some typical design factors to help make it easier for people to understand what's required'.

Part B

Turning to Part B and its 'major themes', Malcolm Thomas said that, in writing it, the authors had sought to 'clarify things', 'plug up the holes', and 'explain more clearly what we require'. So," he continued, "there is a legal requirement to keep records and information on ventilation systems, but many hospitals don't, so they have broken the law."
In fact, he explained, Part B now includes a requirement for an inventory with a uniform system of identification. He said: "Go round some hospitals and they have 10 air-handling units all called 'Air-handling unit number 1' in 10 different plantrooms, so we obviously need to be a lot clearer. Part B thus suggests that each ventilation plant has a unique number, corresponding to all the information about it, what it is, the spaces it serves, all the parameters and information about the equipment, the system performance over the years, and when we should 'scrap it'. Then," he continued, "we archive that information with its number plate, and put a new number plate on the new plant. We thus have an auditable trail. Generally, when you go around hospitals, a lot of information about systems is in people's heads, so when they leave it goes with them." This, Malcolm Thomas argued, was not only 'not conducive to running an efficient system', but was also dangerous.

Phased replacement

Part B of the 2021 HTM also discusses 'mid-life refurbishment', and phased plant replacement. The speaker explained: "We suggest that after 10 years, the air-handling unit should be taken out of use, cleaned, examined, and any corrosion treated, fitted with new controls, updated to get the best from the technology available, and then put back into use. After 20 years, plant should be replaced. If you don't start thinking about this when you put the plant in the equipment doesn't get replaced, and you then find 30-40-year-old plant still in use in the NHS. We want to take the best, get the most efficient systems, and take advantage of the latest technology; not cling to the older things."

The Ventilation Safety Group

Malcolm Thomas explained that the Ventilation Safety Group had a key role here in getting a phased replacement programme going. He said: "With a brand new hospital, there may be 50 ventilation plants installed, all of the same age; you'll have a mountain to climb to replace them all at the 20-year period, so you need to try to split that up somehow, and start looking at the critical ones maybe slightly earlier."

At any time they needed specialist guidance or help, NHS healthcare engineering teams could, of course, call on an Authorised Engineer (Ventilation) – 'people with independent knowledge, totally independent of the Trust/Health Board', and thus 'there to tell you the truth'. He said: "You may not like what your AE (V) says about your ventilation, but they are there to tell you it like it is, so please listen to them. Similarly," he added, "they should be involved in the process of providing plant to advise on what goes in. The reason I say this is – and I've been a hospital engineer – is that your knowledge here will be limited, and it's very easy to be bamboozled by an outside design team into accepting something they think is alright. It may be that what's being proposed is a great solution, but, conversely, it could be that it won't benefit you long term. Authorised Engineers are there to help with those decisions."

Observing standards

Nearing the end of his presentation, Malcolm Thomas said: "There are minimum standards for all plants – as I said at the beginning – and they should certainly be observed. They are there because there are legal requirements about access, cleanliness, and the efficiency of the plant, listed in both Parts A and B; most of the major pieces of legislation that affect and handling ventilation systems, in a hospital or anywhere else. In a hospital, we also have the Medicine Act, and the Health Act, which impose a duty of care on us for our patients and what we do in healthcare settings." These, the speaker said, 'sat alongside' other legislation such as the Health & Safety At Work etc, the COSHH Regulations, '*et al*'.

Lastly, Malcolm Thomas explained, Part B of HTM 03-01 (2021) included a section on 'Verification'. He said: "This requires you to ensure, every year, that the critical systems in your hospitals are still safe to use. They may be getting slightly older, but the things that matter within your ventilation system must still be working correctly, and then there is the annual routine inspection and maintenance. All the standards on these areas have been there for a considerable time, but need to be adhered to."

He added: "So, to conclude, the HTM has been entirely revised, with many changes, and I would encourage all those with a professional interest in, or responsibility for, healthcare ventilation, to read and familiarise themselves with both Parts A and B, including the appendices and the accompanying explanations." With this, he closed his presentation, and invited questions. hej