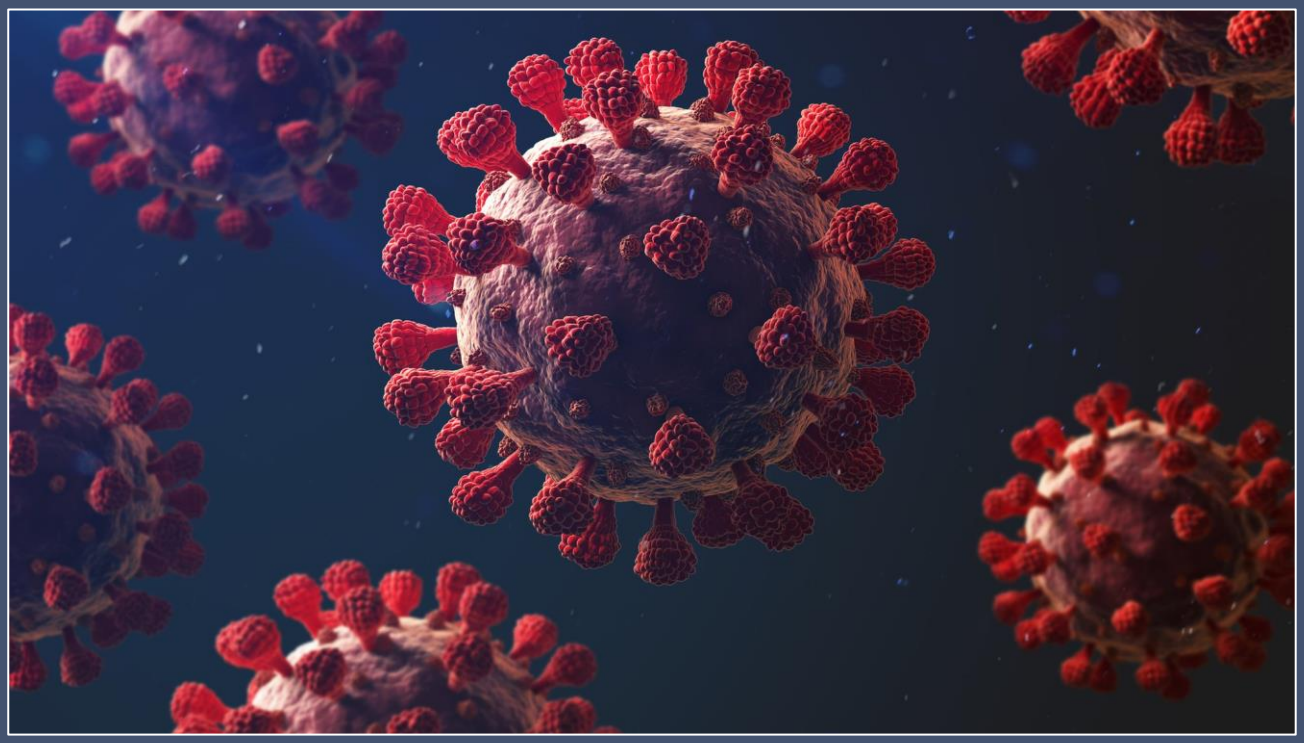
A 10-step guide to using air-cleaning units in schools



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There is now **robust evidence** that the risk of Covid-19 is reduced by good ventilation. However, in schools it is not always easy to generate good ventilation - windows may only open partially and cold weather, noise and external pollution can all be barriers to ensuring good airflow.

Where issues with ventilation can't easily be addressed, air-cleaning technologies (ACT) - such as high-efficiency particulate-absorbing (HEPA) filters - can be useful to help reduce exposure to airborne viruses and other pollutants.

The government has now made 9,000 of these types of units available but it's likely many schools will decide their air quality needs will not be met through this scheme and will investigate using their own funds to purchase ACT systems.

But ACT is not a "magic bullet" solution and deciding whether to invest in ACT and choosing a device needs careful consideration - and after selecting the right device, it must be implemented properly to be effective. This can be challenging because every school environment is unique, with airflow affected by multiple factors including the building design, room use, people's behaviour and the weather. As such, providing one-size-fits-all guidance on what to buy and how to install it is not easy.

Covid: Using air-cleaning units to improve ventilation in schools

However, **at the Centre for Applied Education Research, we have been working on a trial to understand** whether fitting these systems throughout classrooms in a school produces a notable decrease in school absences related to airborne-associated illnesses - especially Covid-19.

It's worth noting that the trial is still in progress, so it is important to emphasise that we currently have no direct evidence that the use of ACT will decrease Covid-19 transmission rates in schools.

But there is **a wealth of evidence** showing the benefits of good ventilation and indoor air quality that go beyond reducing disease transmission - improving classroom learning, protecting children's health and futureproofing schools from possible pandemics downstream.

Taking this into account, there is certainly a strong case for leaders to consider whether ACT should be deployed within their schools.

With this in mind, we have created a 10-point guide to support schools to understand the role of ACT and how these technologies can be deployed most effectively within classroom settings.
This guide focuses on "HEPA" air cleaners, although our trial is also evaluating wall-mounted "active UV" systems' as well as portable floor-standing HEPA devices. There is currently no evidence to suggest one solution is better than the other.

HEPA devices contain a fan, a control unit and a series of filters, and work by drawing air into the unit and passing it through a fine multi-layered filter material.

The HEPA filter material can remove bacteria, viruses, and other particles from the air. The clean air is circulated back into the room by the fan.

1. Optimise ventilation

Ventilation is one of the most powerful tools possessed by schools seeking to limit the transmission of Covid-19 and other viruses from infected staff or students.

Actions to optimise ventilation should always be taken before considering whether to use ACT.
It is possible to use carbon-dioxide monitors as a guide to whether classrooms are sufficiently well ventilated. These monitors measure the amount of air previously exhaled by others in a room and provide a proxy estimate of ventilation.

If a monitor is normally reading around 800ppm or less when the room is occupied, and the classroom is normally comfortable, then ventilation is good, and ACT is unlikely to add significant benefits unless the air is polluted.

A reading regularly over 1500ppm when the classroom is occupied indicates that ventilation is poor and if ventilation can't be improved by additional measures (eg, opening windows), ACT may be useful. This should normally be seen as a short-term measure while ventilation is improved, especially if readings are significantly above 1500ppm. ACT only cleans the air, it doesn't lower CO2 levels and so it is not a substitute for ventilation.

2. Evaluate whether ACT is a good investment

Some existing school buildings do not have optimal ventilation, and this can result in poor air quality within classrooms and other shared spaces.

This is why ACT can be an important measure against Covid-19 transmission rates. However, it is also worth considering that filters can remove other particles such as soot, pollen and dust and so can help to manage exposure to hay fever allergens and pollutants from traffic that may exacerbate asthma.

In these situations, you might look at whether ACT investment is needed as a short-term solution (for six to 12 months) until ventilation improvements can be made, or whether ACT is likely to be needed for the longer term (one to five years) to create a healthy learning environment.

3. Undertake a cost-benefit analysis

Following on from the above, you need to understand that although ACT can reduce the amount of virus or other particles in the classroom air, it cannot guarantee that the air is virus-free and it does not reduce the risks of inhaling a virus when people are interacting closely together (eg, pupils next to each other in a small classroom).

Given that the cost of devices varies significantly (around £100 to £1,500) depending on their size, quality and features, it is worth making sure that any purchase will actually have a realistic impact on improving air quality in the classroom.

This is especially the case when considering the purchase of a cheaper model - it may suit the budget more but many cheaper devices are aimed at the domestic market and may provide insufficient airflow in a classroom or may not be suited for robust use within a school.

A more robust device may appear more expensive in the short term but may be more cost-effective in the longer term as it is less likely to need replacing.
It is also important that investment in ACT is compared with the cost of measures to improve ventilation - in many cases, the long-term cost benefit of investing in better ventilation is likely to be greater than purchasing portable ACT devices.

4. Choose the right equipment

Choosing the right unit for a setting is not straightforward but there are some key features to help you identify suitable devices.

To effectively remove viruses, the system must have high-quality filters to effectively remove a substantial proportion of very small particles, around 0.5 micron in diameter.

This is usually expressed through a clean air delivery rate (CADR) - essentially the amount of air processed per hour by the unit for a particular particle size.

The amount of clean air needed depends on the size of the space and the existing ventilation, and if a ventilation assessment is carried out this can be calculated with a reasonable degree of accuracy. As a rule of thumb in a typical school classroom with 32 people, a total CADR of around 720 m3/hr is usually a good

estimate. This is often better provided by two or three smaller units with a CADR of 240- 360 m3/hr each rather than a single large unit.

Then you need to think about noise - all ACTs produce some noise, which may be a distraction but some are quieter than others. For example, most units operate at more than one fan speed - a higher fan speed gives a higher CADR but increases the noise.

Ideally, the noise level should be **under 45 dB for normal operation** but slightly higher values may be acceptable in many environments, especially when devices are used as a temporary measure.
Devices with noise levels over 55 dB are likely to be more noticeable, particularly when run on full fan speeds.

It is usually quieter to have two or three units that operate at a lower noise level rather than a single large unit with a higher noise rating - this is because acoustic is complex and noise levels cannot just be added together.

Noise is a particular consideration for some children with special educational needs.
In addition to noise, other practicalities of the device need to be considered:

- How big is a unit?
- How robust is it?
- Is it easy to clean?
- What is the filter change procedure and cost (see below)?
- What type of controls does it have and how easy are they to use?
- Are there any risks for children who may (for example) push the device over or drop objects into it?

If several devices are being bought for a school or group of schools, then the needs should be discussed with a supplier and preferably a demonstration device should be tested to be ensure its suitability.

The Department for Education has created a marketplace that already has a number of ACT devices and has created guidance to support the selection and use of these units. It has also established a scheme to apply for funding for ACT devices.

5. Identify where units will be placed and any modifications to classrooms

Ideally, portable devices should be positioned away from a wall and should not be located in a confined position where furniture or curtains could affect the airflow.

It is therefore important to identify in advance whether there is space for the units in the classroom. If there is just one device, it should be positioned as centrally as possible without causing a hazard.

If there are several devices, they should be distributed around the room as far as the electrical sockets will allow.

Indeed, our trial showed that many schools had insufficient plug sockets so this issue may need to be addressed and associated costs factored into the decision making. Wall-mounted units, such as the UV-based units in our trial, may be more suitable when floor space is tight. However, these will usually require more substantial electrical work to provide power.

6. Plan a maintenance strategy and running costs

In addition to the capital costs, there are costs associated with running the devices.

It is important therefore to factor in the cost of replacement filters and determine where these can be purchased from, as well as the frequency with which they need to be replaced. A manufacturer will provide guidance on this, but if ACT units are used in more polluted environments the filters may need to be replaced more frequently.

The devices have a running cost associated with their power consumption, though this may be offset by savings in heating costs if windows do not need to be opened as wide.

It is not necessary to run devices overnight, but then they will need to be switched on every morning and turned off at the end of the day. This could be the responsibility of the classroom teachers or the person in charge of managing the devices.

If done manually, this can take a considerable amount of time, but some devices may have timers that allow them to be switched on/off automatically or you could also use a timer on the plug socket.

It is important to make sure that devices can be set to operate in a continuous air-cleaning mode. Some devices have sensors to measure air quality and can change the flow rate of the device in response.

But these sensors cannot measure viruses and could inadvertently reduce the effectiveness of a unit. It is worth checking on the features of any ACT before purchase and questioning suppliers.

7. Schedule filter replacement into the school year

Usually filters last between three and 12 months, depending on the model of the air-cleaning device and the contamination levels of the air. In polluted locations, the filters will get dirty more quickly.

Changing filters is typically a straightforward task but it is essential it is done correctly to maintain the longevity of the filter.

Filter changes can often be done in-house but if you have a larger school with multiple ACT units, it may be more effective to have a maintenance contract with the ACT supplier.

Filter changes pose a low risk but are better carried out when children are not in the room as it involves taking covers off the unit with an associated risk of exposure to the virus.

The person changing the filters should be aware of the manufacturer's instructions and should have carried out a suitable risk assessment.

Disposable gloves and a mask should be worn when changing filters, and the used filters should be sealed in a plastic bag for disposal in the normal waste.

The inside of the device will normally require a clean before inserting the new filter. It is important the filter is installed correctly so that the device works properly.

For some devices, the life of filters can be extended through vacuuming the filter following the manufacturer's instructions. This can introduce substantial cost savings when there are many devices within a school but must be balanced against the work required.

In our trial we provided a vacuum cleaner containing a HEPA filter that was dedicated to this purpose.

8. Provide staff training

Portable ACT devices are usually simple to use and staff should not require significant training.

It is, however, important to ensure that all staff who use the classrooms know: why the devices are in classrooms and what they do; how to operate the device on a daily basis; and what to do if there appears to be a problem with the device.

It is important to remind staff that they still need to open windows and doors, although probably not as wide or as often.

An air filter only removes particles from the air - it doesn't flush out other substances (eg, the carbon dioxide we exhale). It is therefore important to ensure that you are still ventilating the room even when you are using an ACT device. There are lots of studies that show that ventilation is important for health and wellbeing beyond Covid-19.

It is worthwhile having a simple instruction notice in each room to provide a reminder.

9. Complete a health and safety risk assessment

It is important to carry out a risk assessment for using and maintaining the ACT devices.

This should be simple to conduct and, as with all electrical equipment, should cover electrical safety checks, and ensuring that the devices or their cables do not pose a trip hazard.

It is also important to check that devices are not blocking access to fire doors or facilities in a classroom.

10. Ask someone to take responsibility for the units

It is a good idea to have one person designated as a responsible officer for managing the ACT devices. This could be someone from the school estates team, a business/site manager, a technician, or a member of teaching staff.

The responsible officer could take direct responsibility for unpacking units, positioning them in classrooms and checking they operate correctly, or they could be the point of contact for an external organisation that provides the unit.

Some devices are wi-fi enabled, which can allow remote monitoring of the status of the device, but this can be problematic if a school has a firewall so IT services may be required to help, too.

In between filter changes, it is important to keep the outer surfaces of devices clean and inspect the devices regularly for wear and tear and any electrical issues.

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The Class-ACT trial is led by the Centre for Applied Educational Research at the University of Leeds