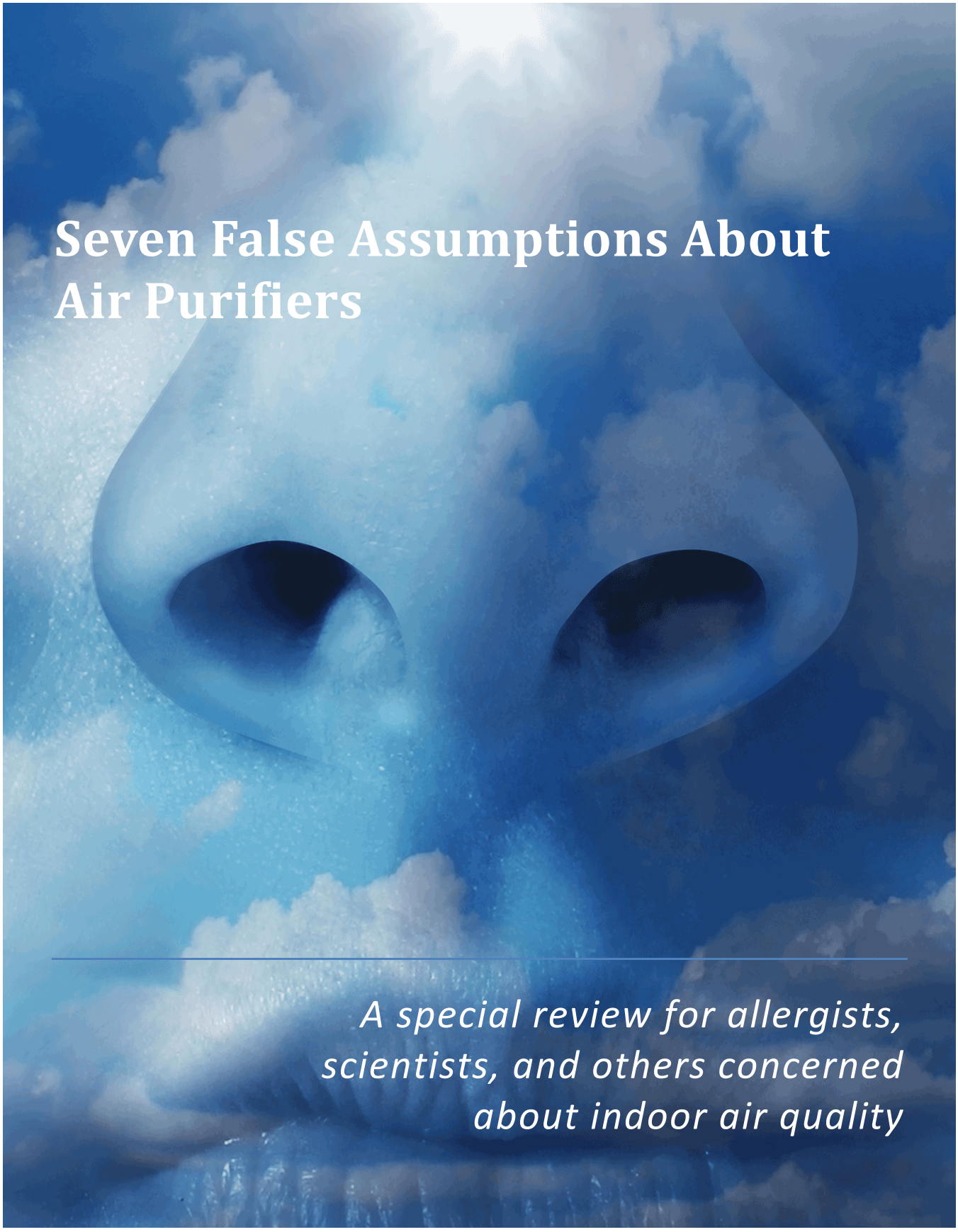


Seven False Assumptions About Air Purifiers

A special review for allergists, scientists, and others concerned about indoor air quality

Introduction

In recent years air filtration sales have led the pack in home appliance market growth, yet there is still no definitive proof of their effectiveness. Consumer Reports laments this reality in a 2016 report, stating, "Most people who buy air purifiers do so in hopes of easing asthma or allergies. But despite product claims, there's little definitive medical evidence that air purifiers help to relieve respiratory symptoms."[1]

It is reasonable to assume that if air is passing through a filter before they breathe it, it should be healthier for them, so consumers keep hoping...and keep buying.

Why aren't they experiencing relief?

To address this conundrum head-on, we revisited individual studies as well as a broad literature review on air purifiers, allergy and asthma. We find a consensus that removing harmful particles is the best strategy to avoid triggering symptoms. However, if it is true that air purifiers remove harmful particles, yet we still are not seeing symptom relief, where is the disconnect?

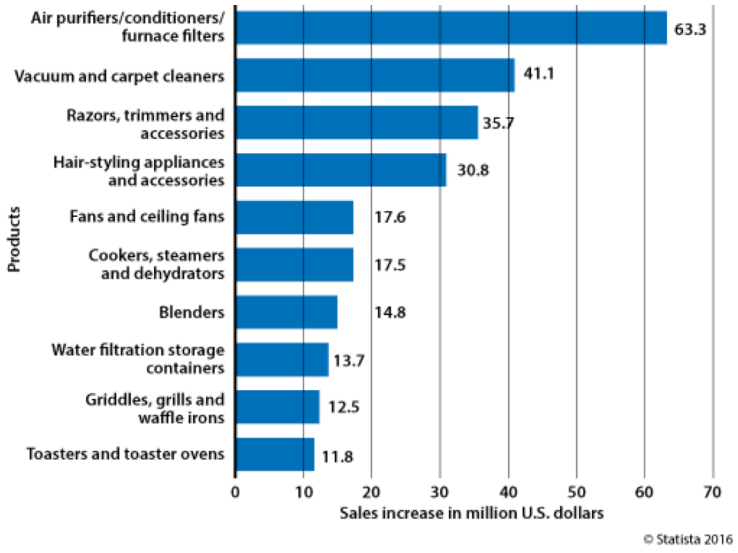


Fig. 1 *Air filtration is growing faster than any other industry in the home appliance sector.*

The logical conclusion is that particle removal and the generation of clean air must not relieve allergy and asthma symptoms after all. If this is true, a multibillion dollar industry has been built on a faulty premise and there is no hope in sight for allergy and asthma sufferers beyond traditional drugs and cleaning routines.

We suggest a different conclusion -- one that, paradoxically, has been right before our eyes, yet obscured by industry claims and derived logic. This special review links together the evidence from the research and preeminent authorities in the field.

The conclusion is clear: current air purification technology simply does not remove harmful particles by any significant measure.

We invite you to peek behind the blockades to our understanding of what air purifiers actually do. Only when we see the totality of evidence that has been in the literature all along can we be realistic about their capabilities. This clear reckoning forms the only viable basis for prescribing these devices and for developing better solutions.

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Why consumers are in a fog

The volume of evidence continues to mount, revealing the increasing number of diseases related to poor air quality. Our bodies begin to suffer damage from polluted air, including even blood vessel degeneration, early on in life.[2]

The Association of Home Appliance Manufacturers (AHAM) establishes the standard for these air purifiers at an 80% Clean Air Delivery Rate (CADR).[3] One can infer from this that a system that meets AHAM standards is one that captures enough particles in enough room air that the air is steadily (meaning no actual time given) 80% cleaner[4]. *

But if the air were that much cleaner, wouldn't allergists, the FDA and device manufacturers all be confident in prescribing these products for their allergy and asthma sufferers? Instead, the best most doctors can say is, "It may help" or "it is better than nothing."

Choking Facts

- The cumulative effect of poor air quality leads to 200,000 premature deaths per year in the U.S. -- six times the number of fatalities from traffic accidents.(a)
- Worldwide, one in eight deaths, or seven million total, were a result of air pollution exposure.(b) WHO explains that "this mortality is due to exposure to small particulate matter of 10 microns or less in diameter (PM10), which cause cardiovascular and respiratory disease, and cancers."(c)
- Approximately three million deaths are attributable to indoor air pollution.(d)
- About one in five people suffer from allergies or asthma.(e) The CDC reports 11.1 million annual visits to U.S. physician offices due to allergic rhinitis.(f)
- Asthma affects 300 million people worldwide, causing 250,000 deaths annually,(g) and over 14 million missed school days annually in the U.S. alone.(h)

See endnotes a-h for sources.

If air purifiers work as suggested, why are we still coughing? To answer this question, let's dismantle seven flawed assumptions that divert us from understanding the science of air purification.

* Note: The EPA refers to the different types of technologies, such as HEPA, activated carbon, PECO, etc., simply as "air-cleaning technologies." Despite the commercial value of differentiating these methods, in this paper we will focus on the most common (and the only officially recommended) type: the HEPA filter.



"How effectively air-cleaning devices alleviate allergic and other health symptoms remains uncertain. Strong data linking air-cleaning devices to reduced health symptoms do not exist."
EPA

"There is insufficient evidence to determine whether or not the use of particle air cleaners is associated with decreased asthma development."
Institute of Medicine

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ONE

Assumption: Harmful particles moving toward the unit are drawn most strongly toward the intake vent.

Reality: The exhaust vent draws particles with a much greater force, overpowering the intake vent.

Two fundamental laws underlie the design of air purifiers:

1. Newton's 2nd law of thermodynamics, which dictates that air in a high pressure zone moves toward a lower pressure zone.

2. Bernoulli's Principle (underpinning hydraulics and pneumatics technology), which demonstrates that a low pressure system is created by air that is moving at a high velocity.

When air is accelerated, the pressure drops. This, in turn, attracts slower, high pressure air towards it. This movement of air results in the "wind" we feel. In the case of an air purifier, the fan creates a low pressure zone at the intake vent, increasing air velocity, and thus drawing air toward the filter.

It is important to consider that, due to this principle, fans, regardless of whether they have filters, can push dirty air directly into our breathing space. In doing so, they may deliver dust and other harmful particles that might otherwise never reach a user.

Plus, with these devices, the goal of attracting air to the intake vent is thwarted by a much stronger low pressure system created by the exhaust vent. This occurs because air leaving the unit is forced out at a high velocity (high velocity creating low pressure).

You can test this effect by feeling the exhaust blowing hard onto your hand, yet not feeling an equally strong suction on the intake side of the fan. As a result of these differences in velocity, slow floating particles that theoretically move through the unit's filter bypass the intake instead, moving directly toward the exhaust vent.

The Mystical Bladeless Fan

Bladeless fans derive their blowing power from the laws that govern high and low pressure areas. These devices produce a small, high speed jet of air which, in turn, attracts an air volume many times larger, resulting in a strong breeze that is sometimes felt all the way at the other side of the room.

While this makes for an impressive fan, it is poor technology when used in air purifiers. The reason is quite simple. Only the small high speed jet of air has been filtered. The larger volume of ambient air it draws from the surrounding environment remains dirty, since it is attracted to the exhaust side of the device, bypassing the filter. The resulting mixture being expelled into the room still contains this significantly higher proportion of uncleansed room air.

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Air purifiers based on this technology demonstrate the worst performance of all.[5] Ironically, we see an insidious effect when we increase the fan speed. We expect faster, better cleaning, but the bypass problem is exacerbated by the stronger low pressure system at the exhaust vent.

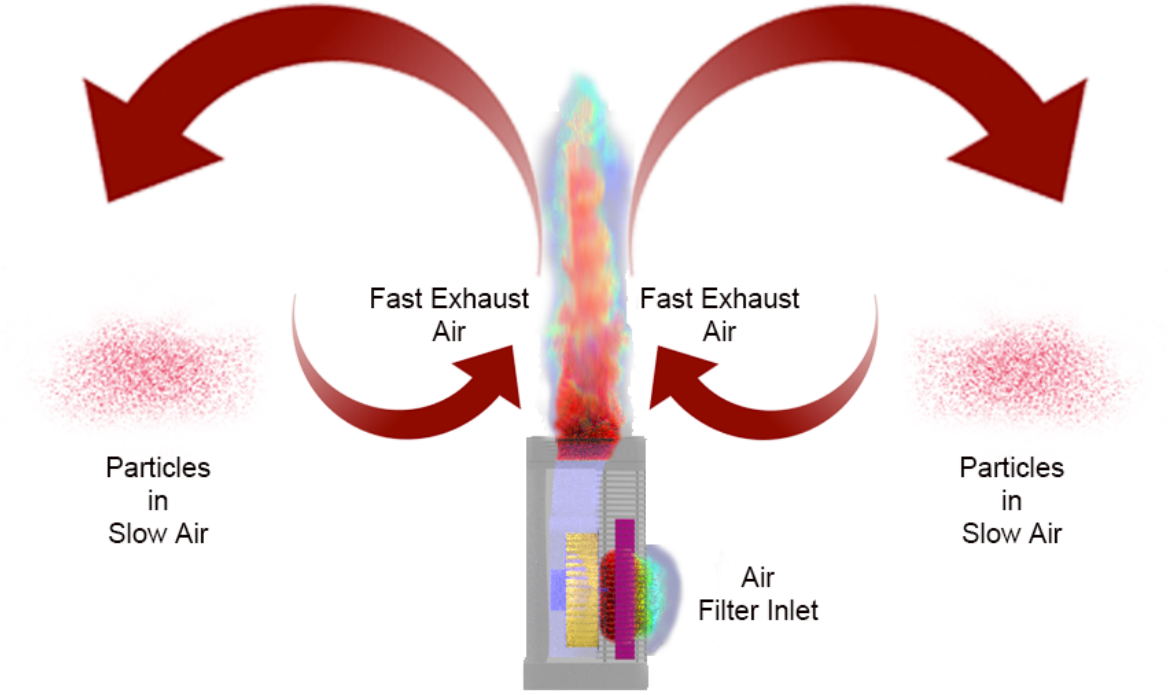


Fig. 2 *How exhaust vents draw air*

In our laboratories, we put many top-rated commercial air purifiers to the test, tracking the movement of the smoke and other large particles to simulate pollen. Throughout these simulations, the diversion of air toward the exhaust fan was clearly and consistently demonstrated.

Exhaust vents are powerful counterforces to the intake vent's capacity to attract particles.

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TWO

Assumption: An air cleaner operates like a powerful vacuum cleaner to remove particles from the air we breathe.

Reality: The distance from which an air purifier's fan draws particles to the intake vent is limited to mere inches.

Most products on the market focus on moving more air by controlling the speed of the fan, under the presumption that high speeds will extend a suction effect all the way to the far reaches of a room. BUT, just as a vacuum cleaner has little suction power when raised slightly off the floor, the capture zone created by an air purifier's intake vent is small.

The American Conference of Governmental Industrial Hygienists (ACGIH) illustrates this limitation in figure 3. It is based on an equation by J.M. DallaValle developed over half a century ago. This model is employed in the industrial ventilation industry when designing hoods to capture toxic fumes from welding, chemical and other processes.

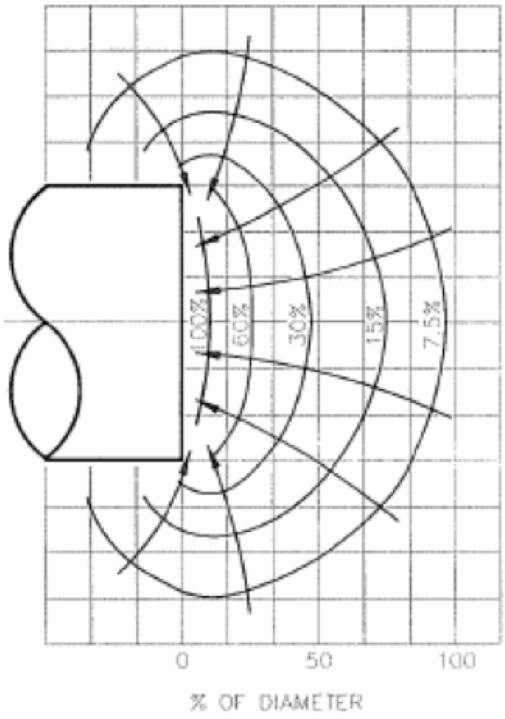


Fig. 3 *Velocity Profile: As a rough rule of thumb, the velocity at a distance equivalent to the diameter of the intake opening will be around 10% of that at the intake face. Beyond the distance of the diameter there is virtually no power to capture.*

The results of our experiments support the math. Even with whole room air purifiers running on the highest fan speeds, particle capture consistently occurs roughly within this small "true capture zone." Since most portable devices' intake vents are under one foot in diameter, this renders them anemic. Meaningful particle removal is not occurring past a few inches in front of the filter.

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Further, it is important to understand that just because a fan is drawing in air (even at close range) does not guarantee that particles, particularly heavier ones like allergens, are captured.

To illustrate the impact of fan velocity on particle movement, imagine two types of debris, such as branches and leaves, falling into a slowly flowing body of water. The leaves may flow with the current but the heavier branches will quickly sink and remain stationary while the same volume of water flows past. Only if the current is fast enough, will the heavier debris be carried along.

In a paper published by *Indoor Air*, author P. Ole Fanger estimates that less than one percent of the exhausted air from a whole room air cleaning device actually reaches a person in the room.[6]

Doesn't expelled exhaust circulate air toward the intake vent?

Theoretically, all air purifiers are designed to utilize expelled exhaust to push clean, filtered air around the room. Manufacturers will cite the Coanda effect to explain that air forcefully blown up to the ceiling will move in a pattern that delivers unreachable particles to the inlet filter.

This may work impressively in a controlled test chamber the size of an average small bedroom, where particles are intentionally mixed to perfection by a ceiling fan. But most rooms do not have a ceiling fan. Further, they are larger or unenclosed and furnishings and fixtures create an obstacle course, disrupting ideal flow patterns. Open vs. shut doors also create variables in air speed and flow patterns.

Instead of a smooth Coanda effect, the air flow pattern is unpredictable and extremely dynamic. When these conditions are not factored into testing chambers, it skews results and prompts dubious conclusions. (see Fig. 4)

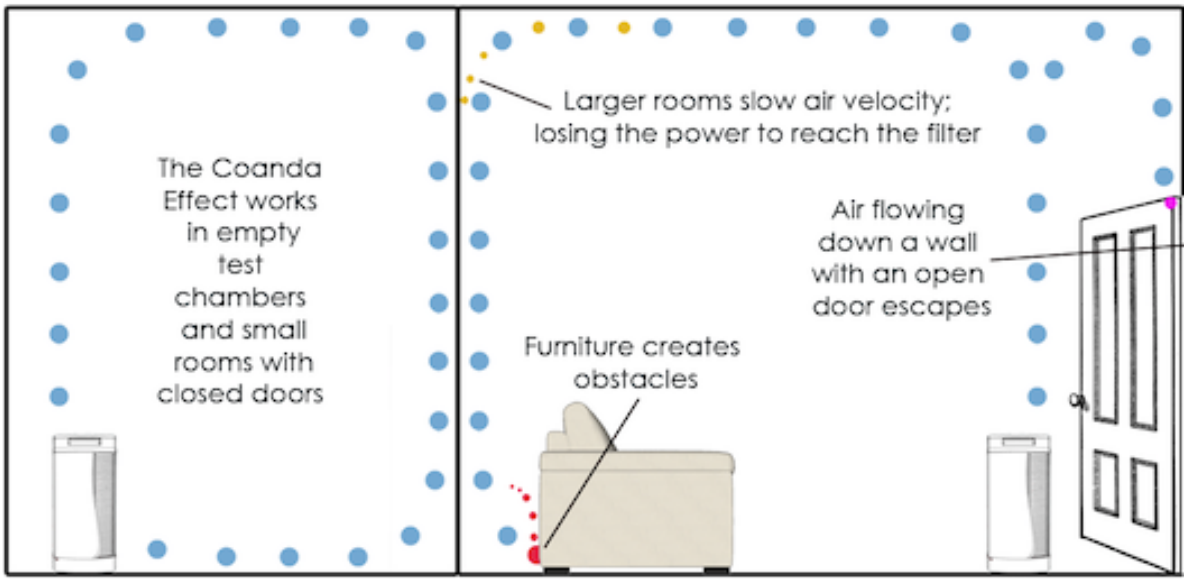


Fig. 4 *The Coanda effect idealizes air flow patterns*

Direct capture and removal of all harmful particles is simply not possible for any fan-driven devices. What removal does take place is limited to small particles within inches of the intake vent.

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THREE

Assumption: CADR implies proportionate particle capture.

Reality: CADR masquerades as particle capture through the "cover" of dilution.

The output from an air purifier is a rated volume of filtered air over time, called the Clean Air Delivery Rate (CADR). An EPA report defines CADR as “a measure of a portable air cleaner’s delivery of contaminant-free air, expressed in cubic feet per minute." "For example," the report continues, "an air cleaner that has a CADR of 250 for dust particles can reduce dust particle levels to the same concentration as would be achieved by adding 250 cfm of clean air."[7]

If the ultimate goal were simply to lower particle CONCENTRATION, there are two ways to achieve it:

a) the addition of clean filtered air, or
b) the removal of particles.

Think of your air as lemonade that can be made less sweet by either adding more water or adding less sugar. Given the difficulty of quantifying particle removal, the EPA standard allows a measurable quantity of cleaned air to be the stand-in for particle removal. But while this substitution may seem reasonable, it is not an equitable comparison. Adding air is tantamount to adding more water to the lemonade. There is no less sugar, but the dilution makes the lemonade on your tongue taste less sweet.

The Difference Between Clean Air vs. Filtered Air

Use of the term "clean air" assumes that it must have originally been dirty. But if any air, dirty or clean, flows through the filter, the more appropriate term should be "filtered air." But would consumers buy a device that is said to deliver "filtered air"?

An authoritative document on CADR metrics by the Association of Home Appliance Manufacturers defines CADR in this way:
$\mathrm{CADR} = \varepsilon * \mathrm{Qac}$,
ε represents the filter efficiency and Qac is the air flow specification of the fan.

Simply put CADR is the amount of residual air left after reduction by the filter (which inherently restricts flow). As evident in this description, it really stresses "filtered air," since there is no direct reference to the removal or capture of contaminants. Only if such capture and removal were accounted for, could we say the air had been “cleaned.”

We see, therefore, that the assumptions about particle capture are derived from the ratio of filtered air to unfiltered air. Relying on derivations can be a tenuous business. In fact, The Institute of Medicine was skeptical enough about this substitution to state that the scientific and medical community, "should develop revised recommendations regarding the selection of air cleaners by allergic and asthmatic individuals, and air cleaner manufacturers should respond by providing new air cleaning products."[8]

CADR is largely a measure of the clean filtered air, but the impact of introducing this air may be very short-term if removal is not accomplished as well.

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FOUR

Assumption: HEPA removal rates approximate room cleaning rates.

Reality: The 99.97 percent removal rate applies only to the air that passes through the filter, NOT the percentage of room air that is cleaned by the device.

Why is this distinction important? Most air filtration systems utilize HEPA filters, which correctly boast 99.97% removal of airborne particles and gaseous pollutants. This is a high efficiency rating, but unfortunately fosters an exaggerated confidence in its powers.

As the allegory of the six blind men with the elephant teaches, we can get into trouble when we extrapolate broadly from a single piece of information. Capturing a high percentage of particles that flow through a filter does not translate into a high capture *quantity*. The logical mistake is in thinking most of the air in the room is going through the filter, and therefore nearly 99.97% of particles are *removed* from the room. But effective removal requires more than just an efficient filter. It requires a robust ability to attract and move the harmful particles within the reach of the filter. To make things worse, the the HEPA filter creates an inherent high resistance to airflow due to its very design.

Industry regulators do not try to define product performance goals in terms of particle removal because there are too many elusive variables: the amount of air processed, the type of pollutant, the rate of particle formation and particle movement. Elusive or not, however, the fact remains that removal is the only true measure of an air purifier's performance. Plus, no matter how impressive the filtering technology, a device is not effective if only a small proportion of the room's harmful particles ever reach the filter. It is like vacuuming one corner of a rug with a small handheld device and wondering why the room is still dirty.

The EPA clearly delineates between an efficiency and effectiveness: "The efficiency of an air-cleaning device, usually expressed as a percentage, is a measure of its ability to remove airborne particles or gaseous pollutants from the air that passes through it. The effectiveness of an air-cleaning device is a measure of its ability to reduce airborne particle or gaseous pollutant concentrations in an occupied space."[9]

Effectiveness is artificially -- but necessarily -- inflated in CADR certification testing chambers. A ceiling fan is used to mix the chosen particle contaminant with chamber air to achieve a near perfect mixture. Without the steady results this mixing produces, data would be erratic and impossible to evaluate. The problem is that this doesn't match the real world, in which particles do not mix perfectly, if at all.

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Imagine a blender filled with water, to which various fruits are added. Without mixing them one would simply pour out water with the occasional random fruit piece spilling out. If, however, they are blended together, they will pour out as one.

Fans move air by design, but the problem is that discrete harmful particles are left behind when adequate mixture is not achieved, like the chunks of fruit in our example, with many falling to the floor.

Elliot Horner, lead scientist for Underwriter's Laboratory describes this persistence, saying, “Studies have looked and often cannot even show that particulate matter is reduced, much less [results in] a health benefit, in the real world rather than in a lab setting.”[10] “The issue is that in the real world, there is often poor mixing of air. This means that much particulate matter (PM) in a room — in pockets of stagnant air — never gets pulled into the air cleaner. "[11]

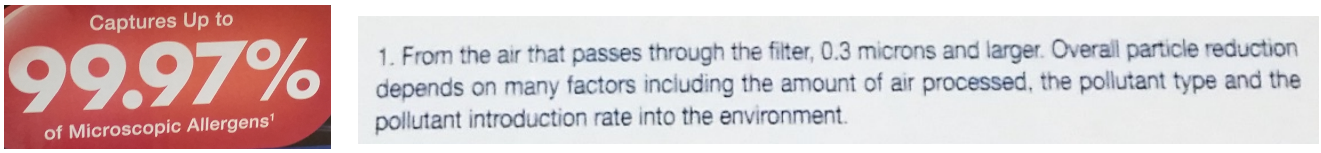


Fig. 5 *Efficiency claims are made for advertising, but effectiveness is only vaguely addressed*

*Only particle removal translates into an **effective** process.*



Assumption: Though it may take longer, current air purifiers will eventually remove the larger particles along with the smaller ones.

Reality: Air purifiers do not seem to be effective in capturing particles over 2 microns in size.

When an air purifier delivers clean air, as verified by a particle sensor, we falsely assume the particles are being captured at some point in the cleaning process. But large particles settle to the floor in hours, minutes or even seconds (see fig. 6). A study by J. Sublett, published in Clinical and Experimental Allergy, illustrates that large particle capture may be an illusion, noting that "allergens such as cat [dander] will fall out into settled dust within a few hours and will not be affected by air filtration."[12]

This effect of gravity on larger particles is widely underestimated. Small particles suspended in the air can take five days to fall even three feet, but particles like cat dander (at PM2.5) fall more quickly. This

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makes them difficult to capture into a filter because more of them are on the floor. Plus, the ones that are suspended have greater inertia (greater mass, so greater inertia) that keeps them from moving with the air toward a filter. Electrostatic and other forces come into play as well, making bigger particles harder to dislodge from surfaces.

The Institute of Medicine review notes that "The predicted effectiveness of air cleaning diminishes rapidly with increases in particle size above 10 microns because gravitational settling rates increase with particle size. Thus, air cleaning does not appear to be an attractive option for reducing exposures to dust mite allergen, which predominantly involves particles larger than 10 microns."[13]

They conclude that "Theoretical and limited empirical data suggest that air cleaners are most likely to be effective in reducing the indoor concentrations of particles smaller than approximately 2 microns. Much of the airborne allergen appears to be within larger particles."[14]

TABLE A-1 Theoretically Predicted Rates of Gravitation Settling of Unit Density Spheres in Still Air

Aerodynamic Diameter (μm)	Terminal Settling Velocity (m/s)	Time to Fall 1 m
0.2	2.2×10^{-6}	5.3 day
0.5	1.0×10^{-5}	28 h
1.0	3.5×10^{-5}	7.9 h
5.0	7.8×10^{-4}	21 min
10	0.003	330 s
20	0.012	83 s
30	0.027	37 s
50	0.075	13 s

Fig. 6. *Source: Clearing the air, Asthma and Indoor Air Exposures. National Academy of Sciences*

If this is true, then particles, particularly larger ones like most allergens, are being captured in very low quantities, and the measured CADR is not the right yardstick for measuring effective air cleaning.

The EPA report on residential air cleaners echoes this conclusion in stating that air filters are "ineffective in removing larger particles because most settle quickly from the air and never reach the filters."[15]

That said, the exhaust vent, with its higher velocity, does indeed re-suspend some of the large particles, like cat dander, from the floor and surfaces in the room.[16] However, these re-suspended particles tend not to mix throughout the indoor air because their weight causes them to fall before there is time for much diffusion to occur. Therefore, few of these re-suspended particles reach the inlet of the air cleaner.[17]

Large particles elude capture in higher proportions.

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SIX

Assumption: I can see dust on my filter so it must be capturing effectively.

Reality: Visual cues are superficial and the smallest particles can be the most dangerous.

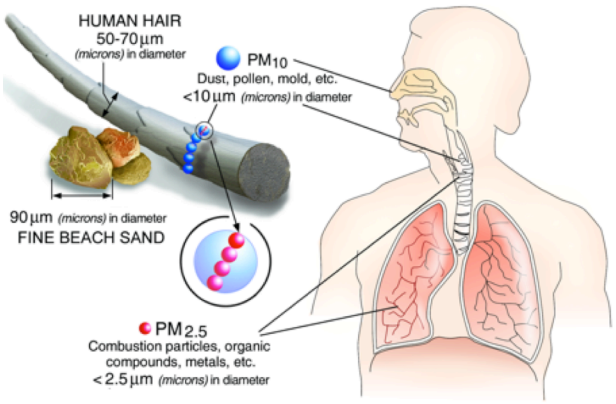


Fig. 7 *Source: EPA, (left), Kairma (right)*

Large particles like pollens may trigger upper respiratory (nose, mouth and throat) reactions, but the most dangerous still are the particles we cannot see, as illustrated in fig. 6. Around 40 microns is the lower limit at which particles are visible to the naked eye, so hair and visible dust that we mostly see collecting in filters are generally captured by our nose, mouth and throat. On the other hand, the ultrafine invisible particles (PM2.5, or under 2.5 microns), like those that come from smoking products, are inhaled all the way into our lungs. Thus, it is these particles that can cause the most harm.

Third-hand smoke, defined as residual nicotine and other chemicals left on indoor surfaces by tobacco smoke, is gaining infamy for its toxic impact on health. Research shows it increases the risks for diabetes, cancer and other health problems[18] and even alters our DNA[19]. Recent studies show that in homes where smokers live, nicotine and other particles penetrate and hide below the visible surfaces, remaining long after the smokers have moved out. Samples of children's urine exhibit significant absorption of these chemicals.[20]

If we cannot “see” the dangerous particles on our walls and other surfaces, how can we see it in our filters?

Only a comparison of particles captured at the filter vs. a valid estimate of particle count in the room would be solid proof of an air cleaning unit's effectiveness. We do not, as yet, have the tools to provide that comparison.

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SEVEN

Assumption: Aiming to clean the air in the whole room is the best practice.

Reality: Focusing on the breathing zone is the most effective practice we can currently recommend.

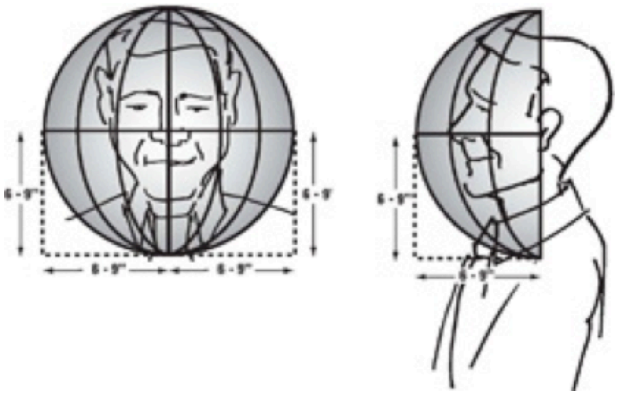


Fig. 8 *The Breathing Zone Source: OSHA*

We have explained why direct capture and removal of all harmful particles is simply not possible for any fan-driven devices. From their 2013 examination of 16 studies on health benefits of particle filtration, Fisk, W.J. et al concluded that "Delivery of filtered air to the breathing zone (see fig. 8) of sleeping allergic or asthmatic persons may be more consistently effective in improving health than room air filtration.[21]

Normal rooms are simply too big for the devices on the market to handle. The EPA states, "... for typical rooms larger than 200 square feet (small master bedroom), most portable air cleaners on the market do not have enough CADR value to remove large particles effectively."[22] Yet some companies claim their portable devices cleanse the air up to 1500 square feet! For reasons we have elucidated, even a large unit with a noisy, high-powered fan would fall far short of having a meaningful impact.

Add to this the fact that people move about during the day, and it makes it even more challenging to remove enough particles to impact their breathing zone. In a large study involving subjects living in 150 residences, the average concentration of particles smaller than 10 microns (PM10), measured in individuals' breathing zones, was about 50% higher than researchers' previous assumptions.[23] Charles Schulz wasn't far off with his scruffy but lovable "Pig Pen" character. We all have a “personal cloud” of particles around us because our activities generate particles (e.g., cooking) or re-suspend particles (e.g., walking).[24]

The Institute of Medicine concurs with Fisk. In their studies of allergic or asthmatic subjects, they found improved outcomes by supplying filtered air over the bed. They suggest that "supplying cleaned air to the breathing zone may be more effective than attempting to clean the air in entire rooms or buildings."[25]

Aim to create a safe breathing zone, especially during the sleeping hours.

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Summary

The air purifier industry is many decades old, yet little progress has been made toward creating safer breathing environments. ***Why has the industry fallen so short of its goals?***

We have labored under an overarching but false assumption that air purifiers remove harmful particles to a significant degree. Now, we are able to see what has been before us all along: current technology has enabled only *minimal* particle capture.

What is the culprit? The very thing that enables air to move through the filter: the fan itself, a design that has remained largely unchanged for over a century.

Arriving at the same conclusion, a recent, exhaustive literature review on fan-driven air purifiers concludes that "None of the reviewed technologies was able to effectively remove all indoor pollutants and many were found to generate undesirable by-products during operation." They summarize that, "Although there is evidence that some air cleaning technologies improve indoor air quality, further research is needed before any of them can be confidently recommended for use in indoor environments."[26]

We noted earlier that the Institute of Medicine is calling for "revised recommendations regarding the selection of air cleaners by allergic and asthmatic individuals, and air cleaner manufacturers should respond by providing new air cleaning products."[27] Current methods of calculating particle capture, relying on CADR, are simply insufficient to provide us with meaningful measures of air purifier effectiveness.

The direct and indirect costs of preventable or mitigable disability from allergies and asthma are getting higher each year. The treatment and lost productivity from asthma alone amounted to a $56 billion expenditure in the U.S. in 2011.[28] The environmental challenges of reducing pollutants and the medical challenges of bolstering healthy immune responses to a changing planet are daunting. Far-reaching solutions are barely on the horizon. What is within reach, however, is the ability to provide people with safe breathing zones to help protect their health.

Future Focus: Improve Capture

We can conclude from this research that the secret to better technology lies in infusing the tired technology of the common fan with superior capabilities. This more effective solution would:

a) prevent the diversion of air to the exhaust vent
b) increase capture velocity and depth (removal of particles, not dilution)

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We know that based on the capture zone defined earlier, fans are restricted to capturing dust no farther out than the diameter of the vent opening. This limits the reach of conventional air purifiers to just inches. ***What if this reach were substantially extended?***

We also know that the fan on conventional air purifiers create a powerful low pressure system on the outlet exhaust side. ***What if we projected a more powerful vortex in front of the unit?*** Would this enable the capture of many more particles in the filter, including more of the heavy, capture-resistant ones like pollens?

Would the power and placement of the low pressure system we generate also prevent air diversion toward the exhaust vent?

Finally, could we do this in such a way that the high energy expenditure and noise problems dogging the industry would be avoided?

With these questions in mind, we set out to design a portable, table-top product that would meet all these challenges and answer the overdue call to create a revolutionary air cleaning product.

Captura

Often, transformational inventions come from simple observations of nature. Our solution began with the question, “How does a powerful tornado suck everything into its funnel, even heavy cars?” The answer is the huge pressure differential generated by the vortex phenomenon, which creates a vacuum-like effect. This makes for a high capture velocity, drawing in and capturing what, for our purposes, we can think of as giant "particles" -- some, in fact, weighing multiple tons!

We set out to recreate this phenomenon, miniaturized to room unit proportions. This required a design that generates a large, powerful vortex to increase capture velocity, and then projects this vortex out in front of the unit to extend the capture zone.

The power and placement of the vortex would, by nature, address the third challenge of diversion to the exhaust vent. On top of this, the unit would need to be both quiet and energy-efficient.

The result of this quest is Captura, a product that employs our Swirler Vortex Technology (SVT). The SVT creates a low pressure system more powerful than any of the best-selling air purifiers, past or present, and a capture zone that finally breaks past the inch and foot marks. Yet the unit is quiet and uses less than a quarter of the power of an ordinary light bulb.

The fact remains that no device can draw in all the dust in an entire room, so creating a clean breathing zone is the only promising solution that guards people at work, at their home office, or by their

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bedside at night. Built with superior capture velocity that allows the maximum volume of harmful particles to reach the filter, Captura is intended to be a person's own portable "safe breathing zone."

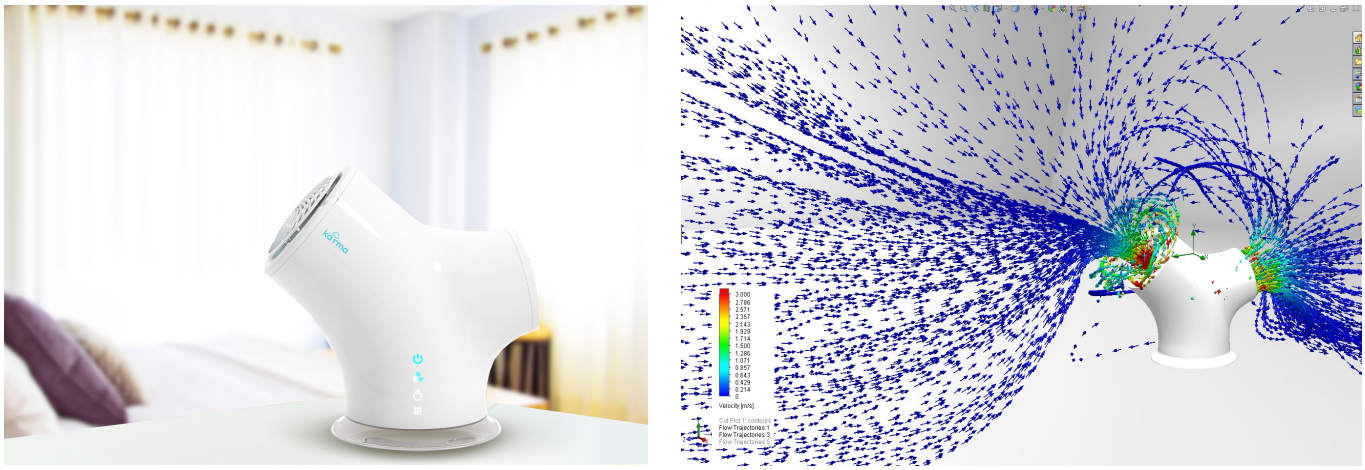


Fig. 9 *Captura turns on and off automatically and controls the fan speed by monitoring the air quality through an onboard PM 1.0 sensor. This allows a longer filter life and lowers energy consumption. Four color displays (blue, green, orange, red) calibrated to the globally recognized AQI index provide real time indoor air quality readings. A 3-stage filter system, consisting of a washable pre-filter, a hybrid activated carbon+catalyst filter, and an H13 true HEPA filter (99.97% efficiency) supply clean air freely while directly capturing dust, particles, and VOCs.*

For the nighttime, when allergy and asthma symptoms seem to be worst, it features a soothing nightlight and a USB port for phone charging, making it is ideal for bedside use.

Call to the medical and scientific community

"It *may* help" is not a product recommendation anyone is comfortable providing. In the paper, we have taken a large scale approach to the literature review. We found that the research all points to the same conclusion about fan-driven air purifiers: they don't capture an appreciable quantity of the very particles that cause allergy and asthma patients to suffer.

This is not a situation that should be acceptable to the medical and scientific community of the 21st century. Understandably, we expect better answers, more effective product solutions. Only when we have these, can physicians confidently prescribe air purifiers for improving symptoms.

The call is clear: the scientific and medical community should develop revised recommendations regarding the selection of air cleaners by allergic and asthmatic individuals. Air cleaner manufacturers should then respond by providing new air cleaning products.

We are asking you, as the community of people who study and treat allergies and asthma, who work in immunology, pulmonology, cardiology, endocrinology and primary care, to share this paper, engage in conversations about our ideas, contact us!

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With no end in sight to the surge in allergies and asthma[29], there has never been a better time for this conversation.

About Kairma Technologies: Kairma is a Silicon Valley-based company, with roots in the semiconductor industry. We believe we must apply first principle thinking to the improvement of air quality in our residential and commercial environments. From this belief arose the development of vortex-powered air purification solutions with the power to capture and remove allergens, particles, dust and more.

Credits:
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