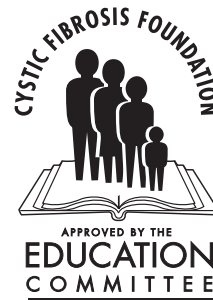


Respiratory

Which Nebulizer for Which Drug?



Many of the drugs used to treat lung disease in cystic fibrosis (CF) are aerosols or mists that are inhaled so the drug goes right to where the problems exist. In CF these lung problems include thick mucus, muscle spasm, inflammation and infection. There are inhaled drugs that fight each of these problems, and sometimes many inhaled drugs are needed to keep the lungs healthy. Drugs can be made into mists or aerosols by a number of devices, including puffers (metered dose inhalers), powder inhalers, ultrasonic nebulizers and jet nebulizers. Of these, jet nebulizers are used for many of the CF drugs. A jet nebulizer is powered by an electric compressor to make an aerosol. There are many kinds of nebulizers and compressors. Which system is right for you? For ease, some people want to use the same system for all their inhaled drugs. Others want the fastest system. But different drugs work best with different equipment. This handout will help you choose the right equipment for your medicines.

Nebulizers Differ!

Jet nebulizers are specially designed medicine cups that make a liquid drug into a mist by forcing air through a thin film of the liquid and smashing it into small droplets. Droplets that are too large to be inhaled hit baffles inside the nebulizer and return to the liquid to re-circulate. When using nebulizers, drug is wasted if (1) the droplets are too large to inhale (larger than 5 microns in size), (2) drug is nebulized while you exhale, and (3) there is still drug in the nebulizer at the treatment's end.

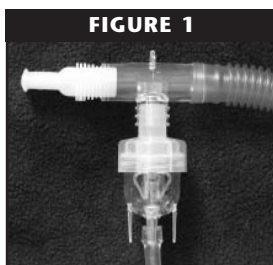


FIGURE 1

T-piece Nebulizer
The most common type of jet nebulizer is a "t-piece" or unvented device (Figure 1).

When the aerosol is inhaled, extra air is inhaled through the back of the t-piece. This dilutes the aerosol.



FIGURE 2

Sidestream Nebulizer
The Sidestream® nebulizer is approved for use with Pulmozyme® (dornase alpha) (Figure 2).

When used with the MobilAire® compressor, the Sidestream® makes very small aerosol droplets, which go deep into the lung. Treatment time is shorter with this system. For these reasons, some use this system for all their inhaled drugs. They should not. The Sidestream® wastes drug because it draws extra air into the nebulizer all the time. This means you may get more drug when you inhale but waste more drug when you exhale. With drugs like Pulmozyme® and albuterol (salbutamol), that is okay, but with antibiotics like TOBI® (tobramycin solution for inhalation), the Sidestream® nebulizer is not a good choice.

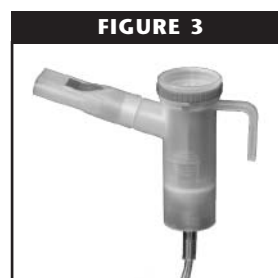


FIGURE 3

Breath-Enhanced Nebulizer

A breath-enhanced nebulizer draws extra air into the nebulizer only when you inhale. You get more drug when you inhale and waste less drug when you exhale. The PARI



FIGURE 4

LC PLUS® (Figure 3) and PARI LC STAR® (Figure 4) are breath-enhanced nebulizers. They can give 2-4 times more drug to the lung than t-piece or Sidestream® nebulizer. The PARI LC PLUS® is the nebulizer approved for TOBI®, and both PARI devices also work well with colymycin (sterile colistimethate sodium, USP), albuterol, Pulmozyme®, and Pulmicort Respules® (budesonide inhalation suspension).

Compressors... What's the Big Deal?

Some compressors are more powerful than others.

- Most common compressors perform the same (PulmoAide®, PRONEB® Turbo, PRONEB® Ultra, Passport® Aerosol Compressor).
- Some are very powerful (MobilAire®, CR60) and can generate high pressure and airflow. Higher airflow from a compressor smashes the drug into smaller droplets that go deep into the lung. Treatment time is shorter. But more drug is wasted when you exhale. Some

Respiratory • Which Nebulizer for Which Drug?

WHICH NEBULIZER FOR WHICH DRUG?	
NEBULIZER	DRUGS
t-piece (Figure 1)	As recommended by your physician
Sidestream® (Figure 2) Use with 50 psi compressor, i.e. MobilAire®	Pulmozyme® (dornase alpha) Albuterol (salbutamol)
BREATH-ENHANCED NEBULIZER	DRUGS
PARI LC PLUS® (Figure 3) Use with 25 psi compressor, i.e. PulmoAide®	TOBI® Colymycin (sterile colistimethate sodium, USP) Albuterol Pulmozyme® Pulmicort Repsules® (budesonide inhalation suspension)
PARI LC STAR® (Figure 4) Use with 25 psi compressor, i.e. PulmoAide®	Colymycin Albuterol Pulmozyme® Pulmicort Repsules®

of these powerful compressors are very expensive and may not be covered by insurance.

- Some people like battery-operated portable compressors for travel. They make less pressure than common compressors. Low pressures make larger droplets. Therefore the drug may not work as well and treatment time is longer.

How Does the Drug Change Things?

It makes sense that the more drug that gets into the lung, the better it works. This is true for some drugs, but not all. For example, Pulmozyme's® effect does not depend very much on the total dose, but there is a small increase in benefit if the drug is inhaled as smaller droplets. One study showed a small benefit using the Sidestream® nebulizer and MobilAire® compressor. But compared to the Sidestream®, the PARI LC PLUS® makes twice the amount of smaller droplets of Pulmozyme® and the PARI LC STAR® makes 3-4 times the amount, even with a mid-power (inexpensive)

compressor. Is the larger dose of Pulmozyme® better? We don't know. But you don't need a costly compressor for good results with this drug.

The antibiotic TOBI® works best when a large dose gets into the sputum to kill *Pseudomonas*. People using the Sidestream® get a third less drug in the sputum than people using the PARI LC PLUS® nebulizer and PulmoAide® compressor. Using a Sidestream® with TOBI® may decrease the effect of the drug.

What's the Bottom Line?

For Pulmozyme®, the Sidestream® is the fastest nebulizer by 2-3 minutes. The MobilAire® compressor and other powerful ones like it make small droplets quickly with almost any nebulizer, including the Sidestream®. But if you don't have a MobilAire® or other 50 psi compressor, the PARI nebulizers (especially the PARI LC STAR®) make a great aerosol with Pulmozyme®. Bronchodilators like albuterol and ipratropium bromide are also not dose-dependent. They can be used with the same nebulizer system as

Pulmozyme®. Don't mix the drugs in the same nebulizer, though.

The PARI LC PLUS®/PulmoAide® system is the only system approved for use with TOBI®. Different nebulizers should not be used. But compressors similar to PulmoAides® can be used. If you already use a MobilAire™ or other 50 psi compressor, it can be used with a PARI LC PLUS® for TOBI® by changing the pressure to 25 psi. Reasonable nebulizer choices for colymycin include the PARI LC STAR® and LC PLUS®, and Sidestream®.

What is Coming?

Aerosol research will continue to seek better tools for giving inhaled drugs. New drugs are being made. New aerosol devices are being developed also. An example is the eFlow®, which operates by forcing the liquid drug through a small, vibrating mesh, creating an aerosol. No compressor is



needed, and batteries can operate it. The eFlow® is used

with some CF drugs that are still being studied and are not yet approved for use. The eFlow® is 2-4 times more efficient at creating small particles than current systems, and is available on a limited basis. Since it is so efficient, the dose of some drugs may need to be reduced to avoid side effects. Other inhaler systems in development show a lot of promise, and may make inhaled drugs a lot easier and faster to take in the near future.

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