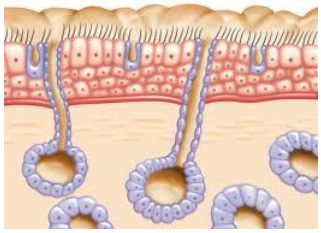
You think its mucus…but it's not!

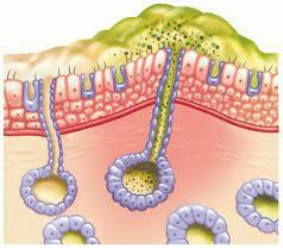
By John R. Goodman BS RRT

Mucus, snot, phlegm, spit, boogers, hocking a lugie, snot rocks….there are many different names to describe the slippery liquid that lines our upper and much of our lower respiratory tract. Mucus is secreted in many areas of the body, but we will confine our discussion to just the respiratory tract. You might be surprised to know that we produce about 100-150 cc of mucus per day. To better picture this amount, remember a standard shot glass hold about 30cc of the liquid of your choice. In the absence of disease this virtual constant production is swallowed, spit or coughed up and out. Let's start out with a review of the normal anatomy and physiology of mucus.

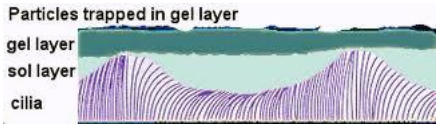
Normally mucus is about 95% water, with the remaining 5% made up of glycoprotein, carbohydrates, lipids, DNA, and some cellular debris. Commonly referred to at the "mucus blanket" it rests on the surface of millions of tiny hairs called *cilia*. The cilia have one chief function and that is to move the mucus blanket like an escalator down from the nose and throat, and up from the lower lungs to the area of the glottis and epiglottis. Here again there are basically only two choices…you can spit or cough it out, or simply swallow it and be done with it till next time. In health, much like breathing, we simply aren't aware of these processes as they happen automatically.



Mucus glands and Goblet cells produce normal mucus



Infected mucus increases in volume and changes color



Cilia beat like a wave propelling mucus and anything trapped in it to be coughed up

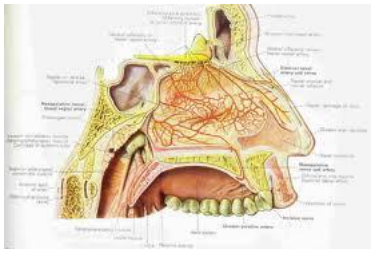
Mucus is produced by large mucus glands, and other specialized secretory cells called goblet cells. In this way the mucus blanket is constantly being supplied with newly made mucus and it is secreted directly over the top of the cilia. The cilia actually "beat" about 1,300 times a minute, the forward motion is 3x faster than the return motion, so the net effect is always in one direction. The mucus blanket is made up of two layers. These are sol layer and the gel layer. Together they function as part of the body's vacuum cleaner system and continuously sweep for

foreign particles, allergens such as pollen, dusts, sand, irritants, bacteria, viruses, the occasional mosquito that gets past the nose, and other possible agents of harm. It is estimated that our "mucociliary blanket" protects our lungs from some 20 billion particles of foreign matter a day!

Let's start at the very beginning which in this case is the nose. The nose serves three chief functions. They are to warm inspired air, humidify inspired air, and filter inspired air. The warming occurs because we have a vast capillary network throughout our nasal area. The blood being at 98.6 degrees F, very quickly brings the room temperature air we breathe up to body temperature in a fraction of a second. The filtration is accomplished by both the mucus blanket, plus the many, many nasal hairs we all have in our noses. Not much gets past the nose. In fact particles down to 10 microns in size are normally stopped by the nose. So where does the humidification come from? Well the very same capillary network that warms the air we breathe also supplies water to the mucus blanket. Remember we said mucus is 95% water? Well, that's where the water for humidification comes from. Essentially then, every breath we take enters the lungs at body temperature, fully humidified, and for all intents and purposes…sterile. A big reminder here about the importance of adequate water intake for all of us. The normal viscosity (thickness) of our mucus is almost solely determined by our overall daily fluid intake. Of course, if you have mucus producing lung disease this becomes even more important.

No matter what your nose


looks like on the outside…


inside we are all the same
See the dense capillary network

Some years ago scientists did some experiments to test the efficiency of this system. Healthy volunteers were subjected to temperatures as low as -75 degrees F. They had temperature and humidity probes inserted into their tracheas, just above their carina (the point at which the trachea splits off into each lung). Much to everyone's amazement, in the time it took the inspired breath to go from the nose to the carina, it was already at body temperature (98.6F), and 97%

humidified. I find this rather amazing as it was a temperature swing of just over 173 degrees F!

So now we have a basic understanding of the mucus blanket, mucociliary escalator, and three basic functions of the nose. Everything we talked about so far is in regard to normal everyday function of these structures in healthy, disease free lungs. Now might be a good time to fine tune our definitions a bit. Words like mucus and phlegm are used interchangeably all the time. Is there a difference between the two? Well, contrary to some misconceptions and misuse over the years, mucus and phlegm **are not** always the same animal. The word phlegm comes from the Greek translated as "inflammation, or humour caused by heat." Around the time of Hippocrates (400BCE) it was believed that the human body was made up of 4 basic substances called" humours." Basically, Hippocrates taught that all disease or disability were the results of an excess or deficit in black bile, yellow bile, phlegm, and blood. Hippocrates teachings were so respected and revered; the idea of the "4 humours" influenced medical thinking for 2,000 years and was not finally discredited until the scientific revelations of the 19th century.

I've already identified the main component of mucus as 95% water. Normally mucus has either no color at all, or leans perhaps toward a "whitish" color. This makes sense as the other 5% of components have no real color associated with them. Phlegm however is more related to a disease process. Phlegm normally contains mucus, but in addition bacteria, cellular debris, and sloughed off inflammatory cells. To complicate things a bit further, once phlegm is coughed up and out, it is called sputum. Sputum can vary in color from pale or dark yellow or green, to light to dark brown, or even a grey color depending on the different constituents found in the sputum. It may be blood tinged, or bright red if there is an active bleeding site. Coughing up any significant amount of blood is **never** normal. Patients who find this to be the case should seek appropriate medical attention as soon as possible.

Problems with Excessive Mucus

There are many pulmonary diseases and conditions that cause an increase in the volume and viscosity of mucus. We've all had the common cold many times in both our younger and later lives. Besides a big box of tissues, and some over the counter medications to treat symptoms, there is not much more we can do except to ride the cold out. Yes we may be miserable for a few days, but colds are typically self-limited in that they come when they come, our body fights off the invasion,

and we get better. The problem with excess mucus is much more apparent in chronic respiratory diseases.

By far the most common of these is Bronchitis. By definition, this is an inflammation of the very small airways and one of the lungs responses is to not only make more mucus, but also more viscous mucus. Historically, chronic bronchitis has been defined as chronic cough with excessive mucus production occurring most days for at least 3 months in each of the last three years. This type of mucus may well have color to it depending on the "bug" that caused it. Antibiotic therapy is virtually always required to get things back to normal and prevent something like pneumonia from developing. If we think for a moment of the ideal conditions for bacteria to grow and multiply, it is a warm, dark, and moist place. Sure sounds like the lungs to me. You may not have thought of it this way, but the lungs are the only major organ system of the body exposed to the outside environment.


Coughing is

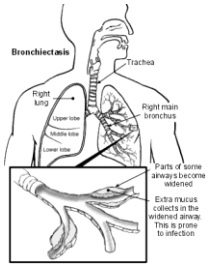

hard work for many patients


Recently, coughing into your elbow has been suggested

Excess mucus makes you work harder to breathe. Excessive coughing takes energy and can wear you out if these "coughing jags" persist. Also, excessive explosive coughing fits can cause the tiny capillaries in your respiratory tract to rupture and bleed, leading to bloody looking mucus. It is not always a serious problem, but it will scare a patient the first couple of times it happens. Asthmatic patients have a triple whammy to contend with. Not only do they have true bronchoconstriction, but also inflammation and thick sticky mucus to contend with.

There are some disease like Cystic Fibrosis and Bronchiectasis that are especially well known for excessive production of sticky, thick, and often infected mucus. Remembering that Cystic Fibrosis is a disease that affects all mucus secreting glands in the body, the pulmonary component is among the most important. Treating or preventing recurrent infection, as well as simply mobilizing secretions on the day to day basis are of paramount importance in the treatment of CF. The

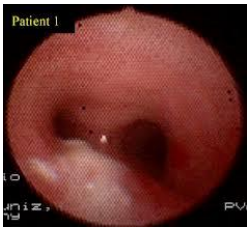
same is true of Bronchiectasis. Although not an inherited disorder such as CF, repeated infectious episodes over time cause dilations or pouches to develop in the very small airways.



Bronchiectasis


Pt. with Cystic Fibrosis wearing percussive vest to mobilize secretions

Typical mucus plug



Mucus plug in airway

Where there are pouches…there are likely to be collections of pooled secretions. Again, fertile grounds for bacterial and viral infections to take place.

It is also easy to forget that mucus from above larynx such as we see with sinusitis results in that very aggravating condition we call post nasal drip. Commonly seen with allergies, they are usually due to air-born allergens such as pollens and dust that irritate the nose and lungs. The result is predictably, more mucus produced, lots of sneezing, coughing and nose blowing as well. Any condition that increases mucus production will make life pretty miserable for the patient. The $64,000 dollar question is of course…how do I maintain the balance of all these factors to have normal or near normal mucus in terms of volume and viscosity? Additionally, many patients worry about thinning their mucus too much. Typically, mucus always gets thicker as the disease process progresses, not thinner. We normally don't notice that we are making more mucus until it begins to get thicker or more viscous. That is when we first feel it down there and have the urge to "hock it out."


Post nasal drip

Trigger factors


Allergy season can be miserable


Ahhhh-Chooo!

One misconception that many patients have is if their mucus is yellow or green in color they must have a particular type of infection. The misconception is that the color change is due to a *particular* bacteria. The green color is most commonly due to the white blood cells that rush to the area to begin to fight the invading organism. These disease fighting cells secrete a greenish colored enzyme and in very large numbers, they can cause the mucus to take on a green tinge. Thick gooey mucus is often greenish.

Mucus Management

Let's start our discussion with the most obvious agent which is of course, water. Remember again that mucus is 95% water to begin with. The water part of the mucus comes from the sub-mucosal blood supply, and that water comes from our daily food and fluid intake. So how much water should we drink per day? The "8x8" rule has been taught since 1945. It suggested we drink 8 glasses of 8 ounces of water per day. Unfortunately the second part of the recommendation never made it to the press. The second recommendation was *most of that water intake was already provided by the food we eat.* There is and never has been any scientific evidence that proved everyone needed to drink 8 glasses of water a day! The current and most up to date recommendation is to (get this) drink when you are thirsty and stop when you aren't thirsty anymore. Once again common sense prevails. Our body does a superb job of regulating water balance on its own.

Certainly patients with chronic sinusitis who are almost constantly blowing their noses want to minimize the tissue count as much as possible. This is also true of known mucus making diseases such as asthma, bronchitis, bronchiectasis, cystic fibrosis, COPD, pneumonia, seasonal allergies, and other bacterial and viral infections. As with most things related to the body, moderation is the key. There are a number of therapies you can utilize to reestablish a more normal mucus production schedule in your airways. Let's look at a variety of options most patients have.

Probably the three most common OTC drug groups that are used to treat excessive mucus are decongestants, antihistamines and mucoevacuents. Decongestants work by constricting the capillaries found in the mucosal lining of the nose. This reduces nasal congestion, stops the runny nose, and helps reduce mucus production. Decongestants typically work well with the common cold, but not so well with thick mucus in general. In fact, decongestants can actually make your mucus even thicker and may even make it harder to cough up. Decongestants also

have side effects such as anxiety, dizziness, and may even increase your blood pressure.

Anti-histamines as the name implies block the action of histamines. Histamines are released when triggered by allergic reactions. Histamine causes tissues to swell up, causes redness to occur, and produce a thinner, runnier mucus. They can also cause a very dry mouth, dizziness, sleepiness, and headache. Why do you think almost all OTC sleep helpers are antihistamine based? Read your labels carefully to see the word Benadryl (or its chemical name Diphenhydramine) name listed as the active ingredient.

That leads us to an old drug that has been rediscovered more or less over the past 20 years. The generic name for the drug is Guaifenesin and the over the counter brand name is Mucinex. Mucinex does a very good job of thinning mucus, making it much less sticky and easier to cough up. Mucinex is also expensive, and fortunately generic versions are available for about 1/3 the cost and work just as well.

Another drug that has been in use for over 40 years is an antioxidant called N-Acetyl-Cysteine or NAC for short. It has been used in a liquid form usually nebulized to patients for a very long time. NAC will break down certain long mucoid chains and thereby reduce the viscosity of mucus. Although originally thought to have only mucolytic properties, it is now being studied as an antioxidant, and possibly an agent that can reduce inflammation of the small airways.

Classic decongestant

Classic antihistamine

Works well but but is expensive

Many patients find NAC to be of benefit

There are many other ways to treat mucus problems. Some are tried and true with thousands of years experience, others involve some technologic application. Let's look at just a few. It is easy to overlook some common bronchodilators in the treatment of excessive mucus. While not having a direct effect on mucus, dilating the airways to make it easier to take a deep breath and cough is certainly

beneficial. One of the common home remedies is to breathe steam from a kettle of boiling water. We've all seen the commercial with the patient with a towel over his head breathing from a pot of boiling water. Probably helpful in some cases, but asthmatics should beware as bronchospasm may worsen upon breathing steam vapors.

Eucalyptus oil (Vicks VapoRub) can be used in conjunction with steam inhalation to decrease nasal congestion and help decrease mucus buildup. If you have postnasal drip and the mucus is irritating the back of your throat, a salt water gargle may help ease the irritation and help eliminate mucus from the throat. The same is true of salt water nasal washes. There are dozens if not hundreds of home remedies that have been passed on over many generations. While some "folk pharmacology" may work in some patients, there have been few if any rigorous studies of natural or homeopathic remedies. Always consult your primary phsycian or pulmonologist if you are an experimental type patient. Not only may you be wasting your time and money, but your home brew might interfere with the action of some of the medications your doctor has already prescribed.

Classic Mothers treatment of your chest cold


Gargling with salt water may help your sore throat

God knows what this really was


No worries drinking milk

Another myth we can eliminate right now is the so called milk—mucus syndrome. It was reported by many patients, especially asthmatic patients that drinking milk exacerbated their symptoms. A beautifully designed research paper out of Switzerland was published in 2005, putting that myth to rest forever. Unfortunately, it might take forever for physicians, clinicians, and patients to get that word.

Finally a word about room humidifiers. Most everyone has seen the small bedside table type of humidifier that generates and then blows a humidified stream of air out of the device and into the room. Obviously, these small devices are designed to provide a small increase in ambient humidity in say, an average size bedroom. They can't possibly add much moisture to the room air you are breathing. But, I have heard from many patients over the years that it does make them a bit more

comfortable, especially at night, and the heated versions do that much better a job. Small investment…small gain. Obviously, furnaces with built in humidification systems can provide a range of relative humidity values, but up goes the cost and maintenance of the unit. Infection control worries also begin to escalate.

Cool moisture

Heated moisture

Ultrasonic moisture


Large room humidifier


Steam breathing

In summary, whatever you call it, mucus and mucus management are pretty high on the list of jobs automatically performed by our bodies. It is all controlled by our brains, central nervous system, glandular secretions, various reflexes, and environmental factors. It is a delicate balancing act normally performed flawlessly and without any necessary tinkering by the individual. Aren't you glad our bodies don't trust us to handle any of the really important functions like breathing, heart rate and rhythm, kidney function etc?