INTRODUCTION

I am Dr. Deane Hillsman, a physician who has practiced Internal Medicine and the specialty of Pulmonary Diseases. My particular interest is Pulmonary Rehabilitation, and breathing training to help people with COPD.

In the early 1960's during my residency training, quite by accident, I was privileged to see two British trained Physical Therapists work with a patient suffering from Emphysema, and achieve significant dyspnea (shortness of breath) relief. I was later told by many that "breathing exercises" were not of value. However, when you see such positive results it is difficult to ignore what you have seen. This lead to a lifelong interest in trying to understand, and improve the technology that is generally known as Chest Physical Therapy (or Chest Physiotherapy).

A major part of Chest Physiotherapy is "breathing pattern" training to more efficient patterns of how to breathe. To this end I invented a sophisticated computer program to define breathing patterns, and to see patients breathing and interacting with these breathing templates. The Breathing Trainer is a simple version of that original development, designed for home use.

It is quite astonishing, but true, the scientific pulmonary community has never defined, even to this day, in any comprehensive manner the most efficient way for a COPD / Emphysema patient to breathe. Because of this lack of scientific guidance as to how to program my breathing training system, I had to rely of the general guidelines provided by the Chest Physiotherapy community. And then I observed a few patients in my practice with very advanced Emphysema, but with only mild complaints of dyspnea. I collected their breathing patterns, and observed they correlated well with the Chest Physiotherapy techniques. Indeed, these few patients appeared to be a model of natural adaptation to the altered breathing mechanics of COPD. The lessons learned from these few very instructive patients have substantially guided my design of breathing patterns for others with COPD.

The first prototype of my breathing training invention was presented in 1978 before the California Thoracic Society. Since then there has been a great deal of experimental adjustment of the various parameters that go into characterizing a breathing pattern for individual patients, in trying to understand the optimal manner for the COPD patient to breathe. I am impressed how small adjustments can make a significant difference in breathing comfort to these patients.

Chest Physiotherapy is substantially a creation of British Physical Therapists, beginning in the mid-1920's and quite mature by the mid-1930's. Also quite astonishing is the general lack of awareness of this technology in North America. Surveys of general Physical Therapy training programs have documented usually only minimal time devoted to the subject. In fact, today there are only about 100 credentialed Cardio-Pulmonary Physical Therapy specialists in the United States. If COPD patients seek Chest Physiotherapy training, they are not likely to find these services.

Please do not think that the techniques that I will be showing you are a substitute for proper instruction from a qualified therapist. However, if you do not have access to a qualified therapist, the modules of instruction I am providing may be of use to you. And if you are receiving instruction in "breathing exercises" or "diaphragmatic breathing" perhaps your therapist might be interested in a few of the techniques and tips in these instruction modules.
It is my hope this series will provide information to patients that will empower them, in a self-help manner, to use these lessons to gain dyspnea control and relief in their activities of daily living. And when you have mastered dyspnea control, that you will then be able to be even more active, and more comfortable.

Remember, I can't do dyspnea control for you. Only you can do dyspnea control for you.

THE FIRST STEP

At the end of the consultation with a new COPD / Emphysema patient I usually told them: 
"I can't help you, but I can show you how to help yourself."

This was a rather harsh, but realistic technique to hopefully set the stage for the pulmonary rehabilitation program to follow. Patients are usually oriented to the belief that their doctor is simply going to provide them with some pills, and that by taking these medications their health problems will be resolved. True, taking medications in many disease conditions will resolve their problems. However, for the COPD / Emphysema patient nothing could be further from the truth. Effective therapy for these patients is critically dependent on patient understanding, cooperation, and various respiratory skills. It requires the patient to become a part of a team effort, with their doctor and therapists.

I then told them the first crucial lesson to be learned is:
"Every breath of air first begins by getting the old stale air out, to make room for the fresh air."

This is a very counter-intuitive message to patients, as their natural focus is to get air IN, to relieve their dyspnea. To persuade patients as to the importance of properly exhaling their last breath, it is helpful to describe the residual last breath in derogatory terms such as "dead air" or "foul air" or "old bad air" and similar terms. The object is to change the patients focus from inspiration to expiration. Indeed, and as you will learn in greater detail in lessons to come, the expiration phase of breathing is the most crucial and difficult to learn.

And finally, I gave them some simple instructions for a much abbreviated breathing control program. Most of the time patients obtained at least some measure of dyspnea relief, and if they did it was an excellent beginning as I could then advise them this was a favorable sign for better things to come, when they had developed more advanced breathing control skills. The instructions are:

"Sit back in a comfortable easy chair (or if in bed, propped up on at least three pillows). Relax, you can't breathe properly if you are tense and anxious. Breathe gently, and rhythmically. Slow down your breathing. Concentrate on breathing OUT, and MAKE YOUR EXPIRATIONS LONGER. When you breathe in, take in a gentle larger breath, and try to place, and try to feel the air going down to your lowest lateral ribs, directly in line with the anterior portion of your arm pits."

Try it. It may not work the first few times, but keep trying. A friend or spouse coaching you with these instructions may help.

And if you do have some success with these primitive instructions this is indeed a sign of better things to come.

UNDERSTANDING BREATHING ATTACKS

There are several reasons why you might be haveing a "Breathing Attack" or "Acute Dyspnea Attack." Essentially this is an exacerbation of dyspnea on top of whatever background of chronic dyspnea you might have. The five commonest reasons for these dyspnea attacks are:
- Exertion
- Coughing up mucus
- Bronchospasm ("Asthma") exacerbation
- The Rescue Breathing Pattern
- Dynamic Hyperinflation

1.) EXERTION
This is the commonest cause of a dyspnea attack. You have exerted yourself beyond the point where your lungs can provide the necessary increased ventilation to meet the increased metabolic needs (i.e. taking in more Oxygen and getting rid of more Carbon Dioxide) of increased activity. Essentially you must learn measured pacing of yourself at a slower and lower effort level of the particular activity you are doing. We will discuss this in detail in another module.

2.) COUGHING UP MUCUS
Coughing is normal and necessary to clear mucus ("phlegm") from your lungs. However, should you cough up a larger blob of mucus from deep within the lung and it sticks in the larger airways, this can precipitate a more violent coughing and choking spell. This is particularly common in the hour or two after waking up, as mucus has been accumulating overnight, and tends to be thicker and stickier. We will discuss this in detail in another module, and show you the Huff Cough technique.

3.) BRONCHOSPASM ("ASTHMA") EXACERBATION
Bronchospasm refers to a spasm of contraction of the muscles in the bronchial tubes, thereby making them narrower and therefore more restrictive as to being able to move air freely. It is commonly called an "Asthma Attack," but technically Asthma is a separate entity from COPD, though indeed there is some overlap of the two conditions. It is better to use the term "bronchospasm" if you have COPD, because directions for treating true Asthma that you might hear of may not be appropriate for COPD. We will discuss this in detail in another module, and show you the Metered Dose Inhaler (MDI) technique to inhale "Rescue Medications" into your lungs for fast relief.

4.) The RESCUE BREATHING PATTERN
This is a very common breathing pattern of rapid breathing when patients get upset or panicky, and is often seen if they develop further dyspnea. Rapid breathing is very detrimental to COPD breathing control. We will discuss this in detail in another module, and show you techniques to control this problem.

5.) DYNAMIC HYPERINFLATION
Dynamic Hyperinflation refers to overinflation of the lung, because the air you have inhaled does not have sufficient time to fully exhale, and therefore your lungs progressively inflates into a position where breathing becomes much more difficult. It is commonly seen with a bronchospasm attack, and with exertion. Dynamic Hyperinflation prevention and/or correction is the major reason why breathing control techniques work in COPD. It is therefore crucial you understand the concept. We will discuss this in detail in another module, and show you techniques to control this problem.

BREATHING CONTROL OVERVIEW
Breathing training with the Breathing Trainer for COPD must be put in perspective, and the following diagram briefly summarizes some of the major components.

The Breathing Trainer is only part of the equation in breathing control, though certainly a very important part. It can show you very effectively how to breathe, but no breathing is possible without an effective chest and diaphragm so-called "Bellows" mechanism to make the lungs actually move. All active lung movement is totally dependant on an
effective Bellows mechanism to enable breathing pattern training. In another module we will describe how the COPD chest becomes deformed into the so-called "Barrel Chest" deformity, and how to deal with that problem.

The Bellows mechanism is composed of the "Chest Wall" as noted in the center of the diagram. The Chest Wall in turn has two distinct components, the "Ribs" of the chest, and the "Diaphragm," which is a thin curved muscle between the chest and the abdomen, attached to the lower ribs. The diaphragm is the major driving force of breathing, and in COPD it's function is typically severely compromised. It is critically important that diaphragm function be restored, in order that you can then effectively use the Breathing Trainer to learn more efficient breathing patterns.

The breathing pattern parameters are defined in the center of the diagram, by adjusting:

- **Tidal Volume** (i.e. the breath volume of air)
- **Respiratory Rate** (i.e. the number of breaths per minute)
- **Inspiration : Expiration Time Ratio** (i.e. the relative time of the Inspiration and Expiration components)
- **End-Inspiration and End-Expiration Pauses** (i.e. slight breath hold times at the end of inspiration and expiration)
- **Inspiration and Expiration Waveforms** (i.e. the shape of the inspiration and expiration breathing pattern. NOTE: The complexity of waveform considerations has been omitted from the Breathing Trainer.)

As noted in the small diagram on the right, it is critical the breathing pattern achieve a minimal adequate degree of "Alveolar Ventilation," i.e. the ventilation breath that actually gets down to lung alveoli (air sacks) where gas exchange takes place.

However, as noted in the small diagram on the left, it is also critical that the breathing pattern produce the minimal degree of "Work of Breathing" i.e. a measure of the effort and energy to breathe, as dyspnea is most closely related to the Work of Breathing. It should be apparent that there are conflicting needs involved in developing an optimal breathing pattern, and that balancing these different breathing parameters is a delicate and often not an easy task.

Considerable experimental adjustment may be needed to achieve the optimal compromise. I am impressed as to how small adjustments may make substantial differences in patient comfort. The Breathing Trainer is designed to permit very subtle adjustments to permit you to seek out the breathing pattern that is best for you. Another module will go into detail as to how to adjust your Breathing Trainer to make a "Breathing Prescription" individualized for your particular needs.

Be aware there are many therapists who strongly advocate for one or another type of breathing pattern. I would suggest that frequently a strong advocacy position does not take into account the fact that most every breathing
parameter adjustment has both positive benefits, and also undesirable negative factors. The trick is to find the optimal balance between these conflicting parameters.

Please do not skip directly to the module on Breathing Trainer adjustment. It is suggested you proceed to the Barrel Chest module, to better understand the underlying problems that must be corrected. The more you know, the better the results you will achieve.

**THE BARREL CHEST DEFORMITY**

COPD / Emphysema classically produces the "Barrel Chest Deformity" as noted in this diagram from Dr. Frank Netter.

Note the chest is generally overinflated. This is because the lungs are overinflated, and pushing the chest wall out.

Also note the humped back deformity, called *Kyphosis*, pushing the upper chest and neck forward. Poor general posture is a significant result, and it impacts unfavorably on your ability to breathe.

When pushed out in this manner the normal outward rib movement becomes limited, and with limited movement comes stiffness and further movement limitation. As a result the chest wall becomes "frozen," and the entire chest now is less capable of expanding and therefore permitting larger breaths. Also, the "frozen" state results in the chest moving as a single unit, so-called "unit movement," instead of the two distinct chest movements noted below.

The result is a shift to inefficient abnormal upper chest breathing, and a decrease in the normally dominant outward lower chest breathing. The diaphragm is attached to the lower ribs, and normally has a coordinated and synergistic movement with these ribs. Without this coordinated movement, diaphragm function is significantly impaired. It is therefore very important to restore proper outward lower chest movement in order to allow better diaphragm function.

Remember, the diaphragm is the major muscular organ that drives breathing, and therefore restoring that function is critically important.

To give you understanding of the two distinct chest movement, consider the anatomy of the ribs, as taken from Grant's Atlas of Anatomy.

Note the upper ribs are short and relatively straight. The muscles that move these ribs are centrally placed, and therefore pull the chest directly upward, in the so-called "Pump Handle" movement. With the "frozen" chest, this is what pulls the chest upward with the so-called "unit movement."

The lower chest movement is more complex. Other than for the straight "short ribs" 12 and 11, the lower ribs are sharply curved. Between these ribs are the "External Intercostal Muscles" which that slant forward and downward to the ribs below. When these muscles contract, the ribs are
pulled in an upward and lateral direction, which expands the lower chest. This is the so-called "Bucket Handle" movement.

This outward and lateral Bucket Handle movement is what stretches the attached diaphragm muscle into a more favorable position of movement, and what restores some of the important synergistic movement between ribs and diaphragm.

This diagram taken from Cherniack and Cherniack's text "Respiration in Health and Disease" brilliantly illustrates the complex rib movements of the "Pump Handle" and Bucket Handle" movements.

As the large majority of lung volume is in the lower chest, and considering this illustration of the Bucket Handle movement, can there be any doubt as to the importance of lower / lateral / outward chest movement in restoring diaphragm function?

We will now move on to the topic of chest mobilization, chest movement training and coordination, and chest strengthening. And then the all important topic of Dynamic Hyperinflation. We will then be in a better position to learn about effective breathing pattern training.

And in other modules we will elaborate on general posture improvement, including neck positioning, as well as some specific posture tricks that will assist your breathing.

CHEST PHYSICAL THERAPY

Mobilizing, Coordinating and Strengthening the Chest

Your chest must first be mobilized because, as you have learned, it is out of correct positioning and stiffened. Next it must have corrected and coordinated movement, because it is not moving properly. And finally the chest muscles must be strengthened, because the immobilized chest has permitted weakness to develop in your breathing muscles.

This is a complex task, and ideally would require a skilled professional Physical Therapist to use "hands on" techniques to augment chest movements and teach corrective and coordinated movements, and enhance joint flexibility with local massage and supplemental heat or diathermy. However, as previously indicated, these services are difficult to find in North America, as indeed there are presently only about 100 credentialed Cardio-Pulmonary Physical Therapists in the United States. We will provide you with self-help instructions that will cover the major points of this technology, but regardless of these instructions, you are encouraged to use them in conjunction with your physician and other health care providers.

However, there is another option you might consider, and that is Yoga. Dr. Vijai Sharma, a practicing clinical psychologist and credentialed Yoga instructor with a particular interest in COPD, has developed a training DVD...
video designed specifically for home use by people with COPD. Dr. Sharma is currently offering two DVDs and instruction manuals:
"Stretching Breathing Exercises adapted for people with severe COPD" and
"Stretching Breathing for COPD For all levels of fitness" for people who are weaker and frailer.
The various Yoga spine and neck exercises, coupled with Yoga breathing exercises, seem well suited to substituting for traditional Chest Physical Therapy. Dr. Sharma has a web site with many helpful COPD instructions, and the instruction videos may be purchased at Dr. Sharma's web site

Physical Therapy is much involved with so-called "trick movements," which basically is the use of different muscular groups to assist the function of impaired neuro-muscular groups. There are "good trick movements" which are productive, and "bad trick movements" which are not productive, and any time one is doing neuro-muscular training it is important to watch out for bad trick movements, and to correct them. In diaphragmatic breathing training there is one common bad trick movement called the "Belly Puffing Artifact" that must not be allowed to happen.

The BELLY PUFFING ARTIFACT

Normally when one inhales the diaphragm descends toward the abdomen, and as a result the abdomen rises. However, it is important the abdomen rise naturally because of proper diaphragm movement. Belly Puffing, which is not due to diaphragm movement, can mimic normal abdominal protrusion due to correct diaphragm movement. And unfortunately, Belly Puffing can be easily learned. Try this exercise in Belly Puffing on yourself.

While standing, breathe in deeply, and at the same time suck your abdomen IN. Then exhale fully, and while doing so, puff your abdomen OUT. Note this is 180 degrees out of phase with the normal abdominal movement due to diaphragm action. Now, lying flat on your back, do the same Belly Puffing maneuver, and note how easy it is to do. Belly Puffing is not simply a shifting of thoracic-abdominal contents by gravity.

There are two commonly practiced diaphragmatic breathing techniques that should not be done, because they are in fact teaching Belly Puffing, not true diaphragmatic breathing training.

Note one hand placed on the upper chest, and the other on the abdomen, just below the ribs. Typically this exercise is done from the sitting or lying position.

The patient is instructed to not move the upper chest while breathing in (i.e. to correct the abnormal "Pump Handle" movement, and at the same time to have the abdomen come out with inhalation, to teach diaphragm movement.

Note however, these instructions are in fact teaching Belly Puffing, not true diaphragm breathing.

The proper instruction is to have the patient direct their inspiration breathing to the lowest rib margin, directly beneath the anterior margin of the arm pit. This will make the chest move outwards and upwards because of the "Bucket Handle" movement. There should be no abdominal movement for about one third to one half of inspiration, and at that point the abdomen will then begin to protrude outwards, but this time as a result of true diaphragm movement. All abdominal movement on inspiration should flow naturally from correct "Bucket Handle" chest movement.
Note in the supine position the weight on the upper abdomen will rise with inspiration. By focusing on making the weight rise, again, this is obvious Belly Puffing training.

However, this technique can be a useful one, provided the therapist uses two flat sand-bag type weights, each positioned along the lower-lateral rib margin, with no more than half the weight lying on the abdomen. If the patient watches the weights move in this position, they will now have a visual biofeedback prompt to perform the Bucket Handle chest movement.

The correct hand position for diaphragm breathing training is as noted.

Note the hands on the lower rib margins, directly below the anterior portion of the arm pits. The fingers, preferably only the distal half of the fingers, are over the lowest ribs and on the abdomen. The inspiration breath should be gently directed towards the palms of the hands, and you should try to feel the air moving into this region. Learn to recognize this feeling of correct breathing.

As the ribs swing outward and upwards, with a little practice about half way through inspiration you should be able to feel the diaphragm gently rising against your finger tips. And about one third to half way through inspiration the abdomen should gently rise, but this time because of true diaphragm movement. The hand positioning is providing the signal to train you in correct diaphragm breathing. With only a month or two of diligent practice you should be able to do this type of breathing naturally, and without using the hand prompting signal.

Note that I have made no mention of inhibiting the abnormal upper-anterior "Pump Handle" chest movement causing the upward "unit movement" of the chest. This is seldom needed. If indeed you correctly focus on the correct "Bucket Handle" movement this upper chest movement will gradually disappear. Occasionally however, some directed voluntary suppression of this upper chest movement is needed.

However, you should teach yourself to recognize this abnormal upper chest movement, and to voluntary suppress this upper chest movement. You will need this skill to help correct the Rescue Breathing Pattern. More on this subject in a later module.

**BREATHING BELT EXERCISES**

The Breathing Belt is a simple device used by Chest Physical Therapists to apply directed pressure to the ribs for chest mobilization and breathing enhancement. And as you will see, it has other usefull purposes. But first you must know how to construct a Breathing Belt.

**How To Make a Breathing Belt**
Take an old sheet and cut a piece 16 inches wide down the entire length. The eventual length will be approximately from floor to shoulder height, but you can correct that length later. Place the two edges together lengthwise, and sew them along the edge, to make an 8 inch wide piece. Then fold the edges together again, and sew them along the edge to make a 4 inch wide belt. You can make the belt a little fancier by inverting the entire piece after sewing the edges. To keep it from getting distorted during use, run two or three evenly spaced stitches down the middle. And a zigzag or wavy crosswise stitch will further prevent the material from distortion during use.

The Safety Belt

The Breathing Belt may also be used as a Safety Belt. This is an old technique used by Physical Therapists to help ambulate frail patients safely.

Tie the belt snugly around the lower waist of the patient, just above the brim of the pelvic bones, and secure it with a knot (no safety pins or insecure clasps). Then, the person assisting the patient should firmly grasp the belt with one hand in the mid portion of the back. The other hand may be used to otherwise assist the patient.

The Safety Belt may then be used to assist the patient in getting out of bed, getting up from a chair, or walking.

Always maintain the belt hand, as this is the controlling hand should the patient lose their balance, or look in danger of falling due to weakness.

Most of the falling accidents happen because a frail patient loses their balance. However, with the controlling hand on the Safety Belt even a small helper can easily control most patient acts of incoordination and stumbling.

And should the patient actually fall, the controlling hand on the Breathing Belt can ease the patient to the floor without serious injury.

Positioning the Breathing Belt

The Breathing Belt is best used in the sitting position, though it could be used both standing and lying down.

Place the belt behind you, at the level of the lowest ribs. The lowest portion of the belt should be positioned about an inch below the anterior lowest rib, directly below the collar-bone (or Clavicle). It is important the belt not be lower than this, or you will only be compressing the abdomen, and therefore deriving no rib mobility benefit.
Now, take your right hand and grasp the left belt, just below the anterior portion of the arm pit. And cross your left hand over to the right belt at this same position below the arm pit. Many patients find it convenient to grasp the belt as though one is holding the reins of a horse.

You are now ready to do chest mobilization. Relax. As with all breathing techniques it is important that you do them in a relaxed manner.

Take in a slow, deep and gentle breath, and then totally relax your chest and let the air gently fall out of your chest.

Then, about half way through breathing out, apply chest pressure by pulling your hands towards each other, directly across your chest. As you are pulling, increase the pressure gradually and firmly. Do not pull suddenly or forcefully, as this type of pressure could crack or even fracture a frail rib. Try to get the sensation as though you are wringing water out of a wet bath towel. Make your exhalation time prolonged, at least two to three times your normal time of breathing out.

Then, simultaneously, release the belt pressure and breathe in gently and fully. Direct this inspiration breath down to the bottom of your lungs, and laterally, directly below the anterior portion of your arm pits. This is critically important, as this action is training your rib muscles to do the Bucket Handle movement. Try to feel the air moving into these lower regions of your lungs.

If you have done this correctly, release of the belt pressure should cause your compressed ribs to spring out, and you should feel a satisfying rush of air into your lungs. Repeat this compression cycle, and try to get a rhythm to your chest compressions.

Patients frequently get confused as to when to apply the belt pressure, as indeed the combination of breathing phase and belt pressure is somewhat counterintuitive. If you get these movements mixed-up, the application of the breathing belt pressure will work against your breathing, and your breathing then will immediately get worse.
Remember:
Pull and Squeeze to breathe out;  
Relax and let go to breathe in.

Done with skill, and **without excessive compression force**, this can be a **useful trick to relieve an acute attack of dyspnea**.

For rib mobilization exercises, three to five minutes, done twice or at most three times a day, should be sufficient. Done more than this the exercises can become unpleasant and boring, and you may lose interest. But during these brief practice times you should **concentrate on technique perfection**, and particularly where to place your inspired breath of air down in the lower-lateral lungs.

A **warning**. Stiffened ribs that are being mobilized often complain by producing a general aching type of pain, and this discomfort usually takes about five to six weeks to slowly resolve. Local low-level gentle heat and simple pain relievers such as Aspirin may help. However, a sharp localized pain may indicate a cracked or broken rib, and you should stop further belt exercises until you have been checked by your doctor. Be patient. You will find that this discomfort is well worth the trouble if you re-gain the capacity to take in deeper breaths, and **being able to take in deeper breaths easily is what this is all about**.

**CHEST WALL COORDINATION**

Muscular movement is seldom as a result of a single muscle moving in one direction. Muscles act together in groups, that support the activity of one another in a coordinated and synergistic manner. Much of that coordination and synergism of breathing has been lost in the development of the "Barrel Chest" deformity of COPD. As noted previously, much of the abnormal COPD chest movement is the stiff upward "Unit Movement" involving the "Pump Handle" action. And because of the overinflated positioning and chest stiffening of the lower chest, the crucial "Bucket Handle" movement is now minimal, which results in a failure to provide synergistic support for the all important movement of the diaphragm. Remember, the diaphragm is the major muscle of breathing, and restoring its function as much as possible is the major objective of chest physiotherapy. This is why this type of therapy is generally known as "Diaphragm Breathing Exercises" or "Diaphragmatic Breathing Training" or just Diaphragmatic Breathing."

To provide the crucial synergistic support from the lower rib cage structures for optimal diaphragm movement the "Bucket Handle" movement must be restored. To achieve this, the focus of your inspiratory breath must be on the lowest-lateral ribs, at a point directly below the anterior portion of your arm pits. Placing your hands, or having an assistant place their hands in the correct position (as shown in the diagrams in the last module) is helpful in getting started. You should try to feel these lower ribs moving outward and upward, and also try to feel air moving into this region. After some initial practice you should be able to perform this chest movement naturally, and without needing to have hand placement to remind you. And as your ribs become more mobile with Belt Exercises you will find this easier to do and with improved rib excursions.

And what about teaching specific diaphragm movement? Most of the time this is not necessary. Remember, the diaphragm and the rib cage muscles performing the Bucket Handle movement act as a synergistic muscle group. By activating the Bucket Handle movement, the diaphragm movement will naturally follow. Note the synergistic progressive flow of group movement. First is the rib cage Bucket Handle movement, and then soon after the upper abdomen begins to rise due to diaphragm movement into the abdomen. At this juncture, **do not** attempt to puff your upper belly out to aid inspiration. Continue to focus on the Bucket Handle movement, and the abdomen will rise on its own with further diaphragm movement.
And what about reducing the abnormal upper chest movement? Almost always that movement will gradually go away if you simply maintain focus on the lower rib, Bucket Handle movement. I do not advocate, and in fact discourage the popular "Two Hand Technique," with one hand on the upper chest (to encourage minimal movement) and the other hand on the central upper abdomen (to encourage maximal diaphragm movement) as this technique unfortunately tends to teach the abnormal trick movement of Belly Puffing.

However, with very large breaths you will note the upper chest now moving upward. This is normal, as you are now activating the so-called "Accessory Breathing Muscles" driving the "Pump Handle" movement. This is a normal emergency breathing movement to provide maximal breathing. It can be easily seen as the "heaving" upper chest of an athlete who has just finished an exhausting race. Think of this movement as an emergency breathing reserve, to be encouraged. However, it is important to maintain focus on the lower Bucket Handle movement as is the dominant movement. Let the upper chest movement flow from the lower Bucket Handle movement.

Note the synergist flow of muscle group activity. First the lower chest Bucket Handle movement, then the abdomen rises with diaphragm activity. Then, with larger breaths there is more Bucket Handle movement and more diaphragm activity and a further rise of the abdomen, and the upper chest now starts to rise with Pump Handle movement.

The "Pump Handle" upper chest movement is basically a defensive, emergency type of breathing. This is certainly how it became ingrained as part of the abnormal "Unit Movement" of the "Barrel Chest" deformity.

However, it is very interesting to note that anxiety will frequently trigger this type of upper chest movement, and it does so both in people with with COPD as well as those with perfectly normal lungs. Presumably this is because tension and anxiety is part of the overall defensive, emergency reaction.

In distressed patients with COPD having an acute dyspnea attack it may be impossible to tell if upper chest movement is at least partially due to this anxiety based type of breathing. Most likely most such upper chest movement in this situation is a part of a desirable muscular recruitment to assist breathing (i.e. due to deranged pulmonary mechanics resulting from Dynamic Hyperinflation). To resolve this problem it is best to focus on the lower chest "Bucket Handle" movement, and if in doubt about residual upper chest movement, try to voluntarily limit same.

Some people will immediately display upper chest breathing when starting the Rescue Breathing Pattern. These people should immediately try to limit upper chest breathing while calming themselves.

In people with normal lungs suffering an anxiety attack and an overbreathing condition known as the "Hyperventilation Syndrome" very frequently exhibit a heaving upper chest manner of breathing. The link between acute anxiety and this type of breathing seems so compelling that many therapists make elimination of upper chest movement a priority in reducing anxiety and establishing breathing control.

And what about expiration? Expiration is mainly about timing of the length of breathing out. Generally speaking, expiration should be entirely relaxed and passive, to permit rest of the respiratory muscles. However, if you do need to provide some muscular force to exhale, it is best done by tightening the upper abdominal muscles, and from there there will flow some activity to the lower ribs. Remember, if you do forcefully exhale, do it as gently as possible, in order to minimize any Dynamic Bronchial Compression.
**RESPIRATORY MUSCLE STRENGTHENING**

The rib muscles of breathing, having been encased in the stiffened Barrel Chest deformity, have undergone at least some measure of atrophy and weakness. And unfortunately, when liberated from the stiff Barrel Chest they initially may be so weak they tire very easily. Most patients will gradually improve this muscle strength with increased activity made possible by breathing control, and progress well with their rehabilitation process. However, occasionally some initial post chest mobilization muscular strengthening is needed to speed the rehabilitation process. If so, a modification of the Breathing Belt technique can be used for this purpose.

To strengthen the rib muscles, perform the Belt Exercise as noted above. However, instead of suddenly releasing the belt and allowing the chest wall to spring out, gradually release the belt tension as you inhale. This requires a little practice to do properly, as maintaining a steady pressure as the chest moves out on inspiration is a subtle skill. Initially the pressure applied should be gentle, and as your strength improves, increase the inspiration belt tension until you are using a firm tension and working fairly hard to breathe in. These strengthening exercises should be done only two or three times a day, and never more than five minutes at a time. The amount of fatigue you feel at the end of this exercise will be your indicator as to whether or not you should increase or decrease the amount of belt tension.

Another useful option are the commercial "**Inspiratory Muscle Training (IMT)**" devices. These simple devices are quite economical. Your doctor will need to prescribe one for you, and if so, be sure to get a so-called "threshold" training device. The inspiration pressure needs to be set, and start with about 10 to 15 cm water pressure, and gradually work up to between 30 and preferably 40 cm water pressure. Some advocate using these devices for 15, 20 or even 30 minutes 3 or 4 times a day. I believe these are excessively prolonged, unpleasant, and unnecessary exercise sessions. Again, as with belt exercises I would suggest that your exercise sessions with these IMT devices be limited to five minutes, and only two or at most three times a day.

**The RESPIRATORY SQUEEZE**

The Respiratory Squeeze is basically an exaggerated Breathing Belt exercise. The object is to squeeze as much air out of your lungs as possible, in preparation for a better inspiration breath. The method can be used for rapid lung decompression of an overinflated lung causing an acute attack of dyspnea. It may also be used to advantage in clearing retained bronchial mucus (phlegm) as part of the "Huff Cough" technique. More on this aspect in another module.

The Respiratory Squeeze is performed in the sitting position, with the knees touching. The Breathing Belt technique is then done as described above, but with a longer time spent on expiration, at least four or five or more times longer than your usual exhalation time.

However, instead of maintaining an upright posture, lean your body forward on expiration as you are applying belt pressure. As you near the end of expiration your hands should now be together in the center of your upper abdomen, and by leaning against your legs, your hands will assist in pushing your diaphragm upward for enhanced lung emptying. Then, on inspiration release the belt pressure and return your body to the upright position.

For correction of even severe lung overinflation, properly done, only one or two Respiratory Squeezes should be needed. For clearing stubborn sticky retained phlegm, repeating a Respiratory Squeeze before each Huff Cough maneuver can be very helpful.

Your chest should now be mechanically ready to learn how to breathe. We will now move on to bad breathing patterns, and why and how to correct them.
BREATHING CONTROL

Breathing control is regulated by many sensors in the body that feed information into the Respiratory Center in the brain, which in turn sends out feedback regulatory signals to the diaphragm and rib muscles to tell them how to move to make a Breathing Pattern in order to breathe in and out. The system is very complex, with mechanical sensors in the lung and chest wall that sense pressure and tissue stretch, and the position of the lung. There are also chemical sensors in the central blood vessels that sense Oxygen and Carbon Dioxide levels in the blood. The Respiratory Center must make a constant delicate balance of breathing to be certain enough Oxygen in breathed into the body, and that the waste Carbon Dioxide of body metabolism is removed. This system is very dynamically active and constantly changing to adapt to changing metabolic needs, for example when you go from a resting to exercising condition.

However, the respiratory regulatory system is unique among all the major body systems in the ability of the individual to voluntarily control their breathing patterns. Higher centers in the brain can easily override the normal automatic regulatory system of the Respiratory Center. Think of this as a manual override button, which allows you to take larger or smaller breaths, or vary your breathing rate and pattern in subtle ways. This ability to voluntarily control your breathing, and to train your breathing into a new pattern, is the marvelous tool that you can use to correct your COPD Breathing Pattern and minimize your breathing distress.

The COPD / Emphysema Breathing Pattern

The person with COPD typically breathes at a relatively rapid rate and with a small breath volume. This is due to abnormal mechanical factors within your lungs and chest wall. The lungs are stretched-out near their elastic limit and therefore more effort has to be expended to make the lungs move. The chest wall and chest muscles of breathing are also stretched-out near their elastic limit, and furthermore are involved in the stiffening problem related to the Barrel Chest deformity, thus making the chest wall even harder to move. The result is a small breath volume (the Tidal Volume), because taking in a larger breath is just too hard to do, and would require too much so-called Work of Breathing. Shortness of breath (Dyspnea) is related to a number of factors, but is most closely related to the Work of Breathing. And because of these smaller breaths, in order to provide enough air, the respiratory rate of breathing must speed up, hence the COPD breathing pattern of rapid and shallow breathing.

Unfortunately however, using smaller breaths to breathe more easily has a serious downside. Not all of the air you breathe in actually does you any good. Only the air that reaches the alveolar air sacks can participate in the Gas Exchange of Oxygen and Carbon Dioxide. This air, at the beginning of the breath, that penetrates down deepest to the alveoli is called the Alveolar Ventilation. The air at the end of a breath in does not penetrate the lungs deep enough to reach the alveoli and participate in Gas Exchange, and appropriately is called Dead Space Ventilation. The smaller your breath, the smaller will be your relative Alveolar Ventilation that is actually doing you some good. Yes indeed, smaller breaths are easier to do, but they carry a serious breathing penalty of having relatively more of your breath as Dead Space Ventilation. Being able to take a larger breath with relative ease is crucial to optimizing your breathing. You now know why we have spent so much time discussing the chest wall, and the mobilization and strengthening of the chest wall, in order that you may take in a larger breath of air, and doing it more efficiently and easily.

This also introduces you to the concept of balancing, and trading-off various parts of your breathing, in order to best optimize your breathing pattern within the constraints imposed by the disordered mechanics of COPD and Emphysema. Later you will learn more about other apparent contradictions that may be used in a balanced manner to optimize your breathing, and how the Breathing Trainer may help you in fine tuning these balancing factors to advantage.

But first you must understand the concept of lung overinflation, and in particular the all-important concept of Dynamic Hyperinflation.
Lung Overinflation or Hyperinflation is a critically important component of both COPD and Emphysema. In fact, recent evidence suggests that correction of Hyperinflation is apparently more important in the relief of dyspnea than is the correction of airway obstruction with bronchodilator therapy. Said another way, if you use so-called Rescue Drugs such as Metered Dose Inhalers to relieve airway bronchospasm, the majority of relief felt comes not come from bronchospasm relief, but rather as a result of relieved bronchospasm now permitting correction of hyperinflation.

There are two general types of overinflation. The first is so-called "Anatomic Hyperinflation" seen in Emphysema, where there is actual destruction of alveolar lung tissue to create cystic overdistended spaces. The second general type of overinflation is so-called "Physiologic Hyperinflation" seen in both COPD and Emphysema. The underlying problem here is the airway obstruction common to both conditions. With increased airway obstruction causing increased resistance to air flow, the lung may not have enough time to empty before the next inhaled breath. As a result, the lung will overinflate.

The old term "Physiologic Hyperinflation" is now evolving into the name "Dynamic Hyperinflation," and more recently has generally been used as a phenomenon related to patient exertion. However, this is not entirely correct, as it is now clear that this type of hyperinflation is commonly present while patients are at rest. Dynamic Hyperinflation therefore is of two general types, "Resting Dynamic Hyperinflation" and "Active Dynamic Hyperinflation."

**ACTIVE DYNAMIC HYPERINFLATION**

Active Dynamic Hyperinflation in COPD occurs most commonly:

- With Exertion
- After a Coughing spell
- With the Rescue Breathing Pattern
The Rescue Breathing Pattern

The Rescue Breathing Pattern ("RBP") may be briefly characterized as "...trying to pump air in and out of your lungs as fast and as hard as you can...." It is a basic cognitive reflex (i.e. controlled by a persons thoughts), generated by a persons conscious will to try and breathe in a manner to relieve acute dyspnea distress. It is not a part of the complex traditional mechanical feedback reflexes from the lung, or the blood chemical (Oxygen and Carbon Dioxide) feedback mechanisms that automatically control breathing via the Respiratory Center in the brain. This cognitive reaction to dyspnea distress is seen commonly, in both normal people and those with disease problems.

If you have an acute breathing attack, the more you struggle to catch your breath by breathing rapidly, the worse your problem will become. This is a so-called "Vicious Circle" phenomenon, and it is physiologic disaster because it makes Dynamic Hyperinflation worse. It is also a sad paradoxical reality that your natural instincts to help yourself should in fact be turned against you, to make your breathing attack worse.

It is very important you clearly understand, if you have a mild episode of increased dyspnea, and then become anxious and upset, you may trigger the Rescue Breathing Pattern and rapidly make your dyspnea attack much worse. This is because the increased breathing rate of the RBP produces Dynamic Hyperinflation. Remaining calm and not allowing yourself to become upset by your dyspnea is a critically important component of COPD breathing control to prevent or minimize acute dyspnea events.

Typically in this situation, patients use their Rescue Medications, usually a Metered Dose Inhaler, to relieve acute dyspnea exacerations. This is desirable treatment, but rescue drugs are only the beginning of the process to obtain full dyspnea relief. This is because, even after complete, 100% maximal bronchospasm correction achieved by medications, the patient is still left with their original underlying problem of severe airway obstructive disease. It should therefore be obvious that it is imperative that you learn breathing control to prevent and/or correct this problem of Dynamic Hyperinflation.

In another module we will show you how to control Dynamic Hyperinflation in these various circumstances.

RESTING DYNAMIC HYPERINFLATION

A recent bronchodilator study involving some 20,000 patients revealed that 48% of these patients had Resting Dynamic Hyperinflation. Clearly, Resting Dynamic Hyperinflation is a major problem in the COPD population.

What is not clear is, how many patients among those 48% had their Resting Dynamic Hyperinflation fully resolved by their bronchodilator therapy. Until this question is answered, it would seem prudent that all patients with symptomatic COPD have breathing control skills to determine whether or not these skills can enhance their overall resting breathing comfort.

This study makes it very clear, that almost half of the COPD population, even while stable and at rest, are critically vulnerable to any increase in their breathing rate, and that any increase in their breathing rate may precipitate them into acute Active Dynamic Hyperinflation.

Well, since the emptying of the lung on expiration is generally by passive elastic recoil of the chest wall and lung, why not solve the problem of hyperinflation by simply exerting voluntary muscular force to expiration and force the air out? Sadly, the answer to that question varies somewhere between "Yes" and "No." To understand this problem we will explain the subtle and important problem of "Dynamic Bronchial Compression" in the next module.

As to Dynamic Hyperinflation therapy, always remember, it is mainly a TIME problem, that is, manipulating your breathing pattern to generate enough time to allow emptying of the lung on exhalation. We will show you later how to
adjust the breathing time constraints with the **Breathing Trainer** to balance some conflicting constraints and give you enough time to breathe out in an optimal manner.

**DYNAMIC BRONCHIAL COMPRESSION**

The lung has no muscles (other than the muscles surrounding the larger bronchial airways) to cause it to expand and contract to pump air in and out. The lung in fact is a totally passive elastic structure that for **inspiration** depends on the chest wall and diaphragm to literally suck it outwards, and therefore expand the lung to pull air into the alveoli. This is essentially what we have been discussing under diaphragmatic breathing.

The act of **expiration** under normal conditions simply involves the chest wall and diaphragm to relax, and the elastic forces within the the lung and chest wall that have been stretched out by inspiration now retract to their resting state, and the lung therefore collapses and pushes the stale air out.

There are muscles within the chest wall that can actively cause the rib cage to contract, and push air out. And if the muscles of the abdominal wall contract they cause the diaphragm to be pushed up into the chest cavity, and press on the lungs and thereby further cause active expiration. Normally however these expiratory muscles are not used, except during conditions of exercise where they are used to literally pump air in and out of the lungs.

So, if **Dynamic Hyperinflation** correction needs to get air out of the chest, why not use these expiratory muscles to easily get that stale air out? The answer is, they can assist in expiration, but in COPD and Emphysema there is a very special problem with so-called **Dynamic Bronchial Compression**.

This diagram simplifies the lung down to one alveolus and one bronchial tube within the chest wall, and the bronchial tube leading to the outside air.

When the lung exhales, the chest wall retracts and moves in and therefore applies pressure and **everything** within the chest gets smaller. The pressure applied to the alveoli is desirable, because that is what pushes the stale air out.

However, this same pressure applied to the bronchi also makes them smaller, and that is **not** desirable, because the bronchial tubes also become narrower, and therefore impose a greater degree of airway obstruction for the stale air trying to get out. In the normal lung this is not a problem, but in COPD, and particularly with Emphysema, the bronchial walls are diseased and narrowed, and they are less well outward supported by diseased and deficient elastic structures. These bronchial tubes therefore are much more susceptible to collapse, and collapse prematurely at particularly weak areas when the so-called **Critical Closing Pressure** is exceeded.

If you apply muscular pressure on expiration the internal chest pressure will be higher than normal, and the problem of Dynamic Bronchial Compression will be exacerbated, and the problem of getting stale air out of your chest made worse. And furthermore, forced exhalation increases the expiratory Work of Breathing and can be very exhausting. Once again you can see the problem of contradictory actions within the physiology of breathing, and the need to balance these conflicting forces.

Forced active exiration is seldom used as a routine technique, because it usually exhausting.
However, as a "Rescue technique" to help correct Dynamic Hyperinflation, gently forced expiration, applied in a very controlled manner at approximately two thirds to three quarters of the way through expiration, can be a very helpful technique. The controlled force should be likened to gently wringing water out of a wet bath towel. With the Breathing Trainer it is easy to see where to apply this controlled force.

So far you have spent a lot of time learning about the underlying complexities of breathing training. If you understand why various breathing recommendations are made, you will better be able to utilize, and work with these recommendations, and to fine tune them yourself for increased comfort. The more you know, the better you will do in breathing training.

We will now show you some COPD breathing patterns, and what to do about them.

THE COPD BREATHING PATTERN

This series of pictures are patient breathing training records using the advanced Biofeedback Incentive System®; ("BIS®") designed for research. The Breathing Trainer v1.0 is a simplified version of this system, designed for home use.

The pictures are "screen dumps" taken directly from the computer display. In the upper picture, the patient's computer screen is turned off, in order to obtain their native breathing pattern, and to follow these breathing patterns to see if the therapeutic breathing pattern was in fact being learned properly. The lower picture shows a patient training session. Note there are two traces. One is a "Breathing Prescription," a visual template of how to breathe in and out, for the patient to follow. The other is the patient's real time breathing signal. The object of the training session was to have the patient superimpose their breathing signal on top of the prompting template. If the patient signal was above or below the Breathing Prescription, they then had a visual biofeedback signal to instruct them how to breathe correctly. This system permitted the operator to literally see the patient breathe, in both a quantitative and qualitative manner, in comparison to the prescription template. This ability to see patients breathe provided much insight in working with patients to tailor a Breathing Prescription suitable to their needs.

The patient shown was lady with very severe Emphysema, and when she began the program in 1987 when she was 73 years old. She never smoked, but had an alpha-1 antitrypsin deficiency (alpha AT 7 micromoles). She was in Cor Pulmonale with evidence of right heart failure. Her FEV 1 was 0.5 lpm and her PCO2 in the mid 50's and she required oxygen supplementation at 2 lpm. Her Total Lung Capacity was 5.18 L (109% of predicted) with a Functional Residual Capacity of 3.99 L (146% of predicted) and an RV / TLC ratio of 59%. Her CO Diffusing Capacity was 3.8 (predicted 20.0).

In this upper screen of native breathing, obtained on her first lesson August 5, 1987 her inspired breath volume, i.e. the Tidal Volume is 500 cc (these documentation screens of native breathing are always calibrated full scale 1000 cc volume on the vertical axis).

After one full breath in and out, it may be seen that she is breathing at a rate of about 19 breaths per minute (these documentation screens are always calibrated full scale 10 breaths per minute on the horizontal axis, for comparison purposes).
Note carefully, her inspiration time and expiration time are almost identical.

This is a typical COPD and Emphysema breathing pattern, i.e. the Tidal Volume is relatively small (it should have been about 600-650 cc); the Respiratory Rate is rapid (it should have been about 10-12 per minute); and the expiratory time phase is shortened (in the normal person it should be about 60% of the breathing time, and even longer for the COPD patient).

Remember, **rapid and shallow breathing, with a shortened expiration time is characteristic of COPD.**

In the lower screen, the Breathing Prescription had been set with the full scale Tidal Volume increased to 800 cc, and with a Respiratory rate reduced to 11 breaths per minute. The Inspiration : Expiration Ratio is now set to 1:2.4 (in the normal it is 1:1.4), i.e. the Expiration time in now almost three times longer that the Inspiration time. Note how well the patient is following the Breathing Prescription, even though her native breathing pattern has been drastically altered.

Note that despite the significant 300 cc increase in her Tidal Volume breath, she is still able to easily achieve full exhalation volume, and not develop Air Trapping and Dynamic Hyperinflation, simply by breathing slower and with a longer exhalation time.

She was given a photocopy of her native breathing and breathing training prescription and told to practice only twice daily, for only five minutes each session. And she was to concentrate on her breathing and "put the breathing picture in your mind." She was also started on chest mobilization and diaphragm breathing training.

On her next office visit November 13, 1987 (about three months later) her native breathing pattern now shows her Tidal Volume at 750 cc (it was set at 800 cc), and her breathing rate now starting to slow, and expiration time now starting to get longer. This degree of improvement was somewhat longer than most patients.

Note carefully that her breathing pattern is smooth and regular, not hesitant or irregular. This indicates good breathing coordination, and is a hallmark of patients who do well with breathing training. This **qualitative** aspect of breathing evaluation is very important.

As on her initial training session, she followed her Breathing Prescription training with a high degree of skill.

There was still no sign of Air Trapping, even though her Tidal Volume was increased to 950 cc. This was done as it was anticipated that her chest physiotherapy and improved chest mobilization would allow for a greater breath volume.
Her next office visit was on January 28, 1988 (almost six months after starting breathing training). She was doing well.

Her native breathing pattern had now settled into a comfortable 675 cc Tidal Volume, with her Expiration time phase now further prolonged to about two and a half times longer than the Inspiration time.

Her breathing training skills remained excellent. The Tidal Volume was lowered to 800 cc.

At this juncture she seemed well trained in breathing skills, and essentially had completed the training program. She was seen in routine follow-up about four times a year, and generally was doing well, though it was apparent her Emphysema was progressing. Her dyspnea became slowly worse, and she was having more dyspnea attacks, which she generally controlled fairly well with Dynamic Hyperinflation breathing tricks.

The last time her breathing skills were evaluated was on October 2, 1990 (about 39 months after starting breathing training and 33 months since last evaluated).

It seems clear that her Breathing Prescription has been well preserved as a native breathing pattern.

It is also clear that her breathing skills in following her Breathing Prescription remained very high.
In March 1992 her condition was deteriorating, as is typical with patients with alpha-1 antitrypsin deficiency. She developed dyspnea with even slight effort, but did find relief with breathing control. Her Cor Pulmonale and heart failure became difficult to control, and she died in November 1992, some five years after starting her rehabilitation program.

Again, this was a very severe case of progressive Emphysema. Based on this example, we will show you in another module how to use the Breathing Trainer. If this patient can do it, you can do it, to optimize your breathing pattern and gain maximal breathing control and comfort.

**THE DYNAMIC HYPERINFLATION BREATHING PATTERN**

This is an example of a breathing pattern causing Air Trapping and resulting in Dynamic Hyperinflation. It is rather unusual example because the patient has only moderate airway obstructive disease, and her Respiratory Rate is slow, at about a normal 11 breaths per minute. This patient was a rather anxious lady, and at the time this record was obtained she was upset about her breathing comfort. This is probably the main reason for this breathing pattern.

Patients with severe airway obstructive disease, who are breathing more rapidly (frequently about 15 to 20 breaths per minute) are much more susceptible to developing Dynamic Hyperinflation.
This upper record is one where the patient's computer screen was turned off, to obtain a record of the unprompted, native breathing pattern.

Note that her inspired Tidal Volume breath is only about 425 cc, and that she does not properly exhale this breath back down to the zero level. The amount of Air Trapping in this case is about 250 cc. Two or three more breaths of this type and she would certainly have significant Dynamic Hyperinflation. Note my hand written notation "You are not getting the breath out."

This bottom picture shows the Breathing Prescription prompting the patient. The time record shows it was obtained only 8 minutes later, and during that interval she did not take any medications.

Note that she follows the Breathing Prescription very well, and has easily increased her Tidal volume breath from 425 cc to about 1150 cc. And that she is now fully exhaling back down to the zero level. Note the encouraging notations directly showing her with her own breathing record "You can breathe deeply" and "You can get the breath out." Her Breathing Prescription has a slightly prolonged expiratory time with an Inspiration : Expiration Ratio of 1:1.7, to insure lung deflation. This Breathing Prescription is essentially to PREVENT Dynamic Hyperinflation.

Using this patient example I have drawn some lines to indicate strategies to CORRECT Dynamic Hyperinflation.

The basic corrective strategy to allow sufficient TIME to empty the lung is:
Slow down your breathing.

Prolong the exhalation time

The first technique is the most desirable one, the:

**Gradual Deflation Technique.**

This is simply a natural prolongation of your usual expiration breathing pattern, which should always be relaxed, or at most, with very minimal effort.

Note the line extending to the right of the diagram. A 25% prolongation is about correct, as it will cause your lung volume to go below the beginning zero point, the so-called Functional Residual Capacity (FRC) by about 100 to 150cc.

Then, on Inspiration, the trick is not to breathe in more deeply than what your Breathing Prescription indicates. It is very tempting when you are short of breath to breathe in deeply, but if you do you will re-inflate your lung and have to start all over again.

If you do this consistently for about five to ten breaths you should be fully deflated, and then you can start to take in some larger breaths. And when you do, be sure that you are exhaling all the way out.

The second technique is a "**Rescue technique**" for urgent lung deflation, the:

**Forced Expiration Deflation Technique**

This should begin about two thirds to three quarters of the way through expiration, and at this juncture you apply breathing force with your chest muscles, and also by tightening your upper abdomen. As noted in the second line below the diagram, this should abruptly force air out of your chest. Then, as before, be sure not to take in a deeper inspiration breath to re-inflate your lungs.

Unfortunately this technique has a penalty, and that penalty is the aggravation of **Dynamic Bronchial Compression**, which makes it much harder to breathe out, and makes breathing very exhausting. When done, it should be done with the minimum force needed to do the job (Remember, like wringing water out of a wet towel). Save this technique for emergency use, such as acute dyspnea after a prolonged coughing attack.
The final deflation technique is the:

**Inspiration Limitation Technique**

This technique can also be used in conjunction with the other deflation methods for rapid lung deflation. After exhaling, breathe in only about 70 to 80% of your usual inhalation breath, and then promptly do the exhalation maneuver again. Do this no more than two or three times, as it is rather uncomfortable to do.

**Changing Breathing Patterns**

The breathing pattern you define initially will not be ideal as your condition changes, and re-definition of your breathing pattern may be needed. For example:

- If you were initially ill and decompensated, your resting medically stable breathing pattern needs to be re-defined.
- As your chest mobility improves with physical therapy, you may find you can take larger breaths.
- If you develop a "Bronchitic Exacerbation" or an Asthmatic attack, you will need to re-define your program.
- As you get older, or develop various medical problems, you may need to adjust your program.
- You may want to define an exertion breathing pattern.

It should be apparent that breathing is a very dynamic function, and needs to be adjusted to your lifestyle and various medical conditions.

**What If Your Normal Breathing Pattern Changes**

Let's assume that your medical condition is stable, and that you have defined a breathing pattern that is providing you with as much dyspnea relief as possible. That is, you anticipate a certain level of dyspnea comfort from that particular breathing pattern.

Now, over the course of a few days, perhaps one day, or as many as three or four days, your breathing comfort is now worse with the same breathing pattern. What does this mean? It means that some problem is developing in your lungs, and the usual reason is a so-called "Bronchitic Exacerbation." More later on this very important topic. Basically this is a low grade infection in your bronchial tubes causing excessive mucus ("phlegm") plugging-up your airways and also causing increased asthmatic bronchial spasm. If allowed to progress this condition can become very serious, and early detection and treatment is imperative.

If you detect any deterioration of your expected breathing comfort while using your usual breathing pattern, it is critically important that you closely monitor your health. Should you detect **progressive deterioration** over the next day or two of your expected breathing comfort with the same breathing pattern, it is critically important that you receive **immediate medical attention.** Bronchitic Exacerbations treated early are usually treated quite easily. Treated late they are often difficult to treat and may evolve into Pneumonia, and Respiratory Failure, and other life threatening problems.

Knowing your baseline breathing comfort with a defined breathing pattern is one of the most important uses of the Breathing Trainer. Used in this manner, the Breathing Trainer can be a sensitive diagnostic tool, and your early warning signal as to Bronchitic Exacerbations and other lung complications.

We will show you in other modules various various tricks and tips of use in COPD and Emphysema.
Pursed Lip Breathing ("PLB") is a very popular and excellent "Rescue" technique for acute dyspnea. This dyspnea is usually related to COPD, Emphysema and Asthma. However, in some cases of severe COPD and Emphysema, and chronic severe Asthma, it may enhance breathing comfort if used in a chronic long term manner. Generally however, breathing control techniques are easier and more desirable for chronic, long term breathing comfort.

First, you need to understand some theory as to why this technique works. Refresh your memory on the concept of Dynamic Bronchial Compression, and the collapsing of your airways on expiration, as your lungs are getting smaller as you breathe out. And recall that this is a particularly serious problem in people with Emphysema, as the elastic supporting lung structure helping to keep the airways open is deficient. Pursed Lip Breathing simply imposes a slight obstruction to air flow at the mouth, which generates a back pressure throughout the airways, and therefore a stenting effect to help prop open the airways and assist expiration and lung emptying. It must be emphasized, the amount of pressure supplied by you by pursing your lips together must be minimal, or gentle. Specifically this mouth back pressure must be in the range of only 5 to 10 cm water pressure, and that isn't very much. If you compress your lips too much and exceed this minimal pressure you will actually provide an airway obstructive situation and impair air flow and lung emptying.

As generally taught, breathe in through your nose (to warm and humidify the air, and remove particles and bacteria), and then on expiration pucker your lips together as though you are whistling, to provide the desired mouth back pressure, and breathe out through your pursed lips in a "prolonged" manner. The length of prolongation is often stated to be two or three times (and occasionally four times) longer than inspiration. To practice correct lip pursing people are instructed to place a candle about 4 to 6 inches away, and to make the flame gently bend or flicker, but never so hard as to blow out the flame.

Practicing in this manner is not very precise as to the all important length of expiration. A more realistic and precise way of practicing is by using the Breathing Trainer in conjunction with candle blowing. For normal breathing, use your regular Breathing Trainer prescription. For "Rescue" practice from acute overinflation dyspnea, set the Respiratory Rate two or three breaths less than your usual, and also set the Inspiration Time 5 or up to 10% less than your usual (i.e. your desired expiration time prolongation will therefore be set 5 to 10% longer). Five or ten breaths of this Rescue pattern should get your lungs deflated, and you can then resume your normal breathing pattern. This Rescue pattern is also a good technique to be used temporarily during exertion such as hurrying to cross a street or climbing stairs.

There is a common and serious problem with Pursed Lip Breathing, and that is the frequent reaction for people distressed by shortness of breath to perform tight-lipped PLB and therefore excessively high PLB pressures. This will immediately make their breathing situation worse. This is a very tragic paradox, as it is a natural tendency for people to believe that if PLB works beneficially, then harder PLB will work better. And unfortunately lip puckering in the whistling position makes it very easy to switch into a tight, high pressure breathing.

A better solution to this problem is not to make the "whistling pucker," but instead to gently press the center of the lips together, and permit the air to escape through both sides of the lips. To do this more effectively, the cheeks should be relaxed. Doing PLB in this manner it is more difficult to switch into a tight, high pressure PLB situation.

And there is another major advantage to this modified PLB technique. By placing a straw through the central portion of the lips the mouth pressure can now be easily and directly measured with a suitable pressure guage. By watching the guage one is now able to do direct biofeedback training to achieve the desired 5 to 10 cm H2O back pressure, and to learn specifically what that pressure feels like, and therefore how to sense when they are pursing their lips too hard. A suitable pressure guage may be obtained at Dwyer Instruments, Inc. http://www.dwyer-inst.com/ (Standard Magnehelic® Pressure Gage - Series 2000-25 suggested for Pursed Lip Breathing, i.e. 0 to 25 cm H2O - 4″ dial -
Price $66.50). No respiratory clinic or pulmonary physician's office should be without a gauge of this type for training purposes.

Recently some fascinating insight into Pursed Lip Breathing has come from Dr. Roberto Bianchi and colleagues (Chest Wall Kinematics and Breathlessness During Pursed-Lip Breathing in Patients with COPD. Bianchi B, Gigliotti F, Romagnoli I, Lanini B, Castellani C, Grazzini M, Scano G - CHEST 2004; 125: 459-465). This Italian research group used a sophisticated technique of multiple optical sensors placed on the body to separate chest and abdomen (i.e. diaphragmatic) breathing of COPD patients while doing PLB.

This diagram is from their paper.

The middle graph shows chest movement, and the lower graph abdominal (mainly diaphragmatic) movement.

The upper graph is the summed movement of overall breathing. Focus on this graph. Inspiration is going up, and expiration going down.

On the left, the small excursions reflect regular quiet breathing ("QB") in and out.

Note that immediately on starting Pursed Lip Breathing expiration becomes much prolonged, and after breathing in again the result is a much slower, and larger (and therefore more efficient) alveolar ventilation breath.

This graphically shows why you can obtain prompt breathing relief using PLB.

And note carefully, this PLB breathing pattern is exactly the same breathing pattern we have been instructing you with for efficient COPD breathing, namely a slow, deep breath, with a long expiration phase.

In my personal practice I did not teach PLB very often, and in fact if patients referred to me were doing PLB I usually asked them to stop it. I did this because I found it was more natural and easier for patients to use breathing control techniques to help their chronic dyspnea problems, and by focusing on breathing patterns I could fine tune their Breathing Prescriptions for greater efficiency. However, I did indeed sometimes use chronic Pursed Lip Breathing as an advanced technique, usually in patients with very severe Emphysema, as it did appear to give some measure of improvement. And some patients found PLB was a useful adjunct to their breathing control techniques for acute dyspnea attacks.

Turning again to the diagram, a great weakness of the Pursed Lip Breathing technique is revealed. Note carefully that on inspiration the patients breath volume returns to almost the exact same starting point. While lung deflation has certainly occurred during that breath, on breathing in again the patient returns to the same overinflation point and has to start lung deflation all over again. The solution to this problem is **inspiration limitation**. For at least three to five breaths in a row, the overinflated patient should limit their inspiration effort to about 75 to 80% of what they would normally inhale. By then they should be properly deflated, and can then assume their regular breathing pattern.

The diagram also reveals another very interesting observation. Note that all of the breaths, other than the last one, have an abrupt transition between inspiration and expiration. Is this important? I believe probably so, and this relates
to the observation in 1963 by Dr. H L Motley that slow, deep breathing improved the oxygenation levels in COPD patients. The only way this could have happened was for fresh oxygen rich air to have come in contact with poorly ventilating alveoli that had a good blood supply to pick up that oxygen. The process is known technically as Ventilation / Perfusion Matching, and it occurs mostly in communications between the alveoli known as the Pores of Kohn. The End-Inspiration Pause will provide increased time for better fresh air circulation at the alveolar level, and therefore better blood oxygenation. Yes, the End-Inspiration Pause in the Breathing Trainer is important, and adjusting it with Oximeters assessing blood oxygen levels should be considered in patients requiring long term oxygen therapy. We await further research to see if this abrupt inspiration / expiration transition is confirmed in a larger series of COPD patients.

THE HUFF COUGH TECHNIQUE

Coughing is one of the most important lung defense mechanisms, and unfortunately it is significantly impaired in COPD. While the nasal passages provide a mechanism to warm and humidify the incoming air, and trap dirt particles and germs, inevitably some undesirable foreign material penetrates down into the lungs. Coughing is needed to clear undesirable material from the bronchial tubes. This module will teach you a more efficient way to do a COPD cough, called "Huff Coughing." To understand Huff Coughing you first need to have some understanding of normal coughing.

The Normal Cough

With normal coughing you take in a deep breath, then close the vocal cords in your throat "Voice Box" (called the "Glottis") to shut off air flow from the lungs. Then, straining with your chest and abdominal muscles you build up a high expiration pressure on your. At this juncture the "Cough Center" in the brain initiates an abrupt opening of the Glottis, which then produces an explosive blast of air from the lungs that propels the mucus ("Phlegm") out as an expectoration.

The Impaired Cough of COPD and Emphysema

Unfortunately with COPD / Emphysema the cough is typically weak. Not only are the muscles building up pressure usually weakened, the airways are narrowed and distorted. Therefore the necessary explosive rush of air for effective mucus clearing cannot be generated. In addition, and very important, your airways are particularly prone to premature collapse. High pressure straining therefore causes rapid and excessive bronchial closure, further impairing the rapid blast of air flow necessary for an effective cough. The Huff Cough technique will teach you a new and more efficient method of coughing.

The Huff Cough for COPD and Emphysema

Huff Coughing is a low pressure cough, which uses a series of multiple "mini-coughs" instead of a typical single big cough. Here is how it is done.

First, it is crucial that you get an adequate volume of air deep into your lungs, past the mucus or phlegm. Without an adequate preparatory volume of air deep and behind the phlegm, to force the phlegm out, your cough isn't going to move much phlegm. To get a good breath in, remember the basic rule, that every breath of air must begin by first getting the old stale air out of your lungs. Here there is a special need to get an adequate breath in, though it is not necessary to take in a maximal inspiration breath for coughing. A comfortably large breath should be adequate. If you are feeling the need to cough, it is commonly associated with the condition of lung overinflation. This is why it is particularly important for you to first have a good exhalation, and then take in that initial deep breath of air for the Huff Cough.
In addition, these deep inspirations and expirations have a massaging or "milking" effect on the bronchial tubes, to further loosen-up and dislodge the phlegm, and prepare it for the Huff Cough to finally remove it from the lungs.

**The Huff Cough Technique**

To deflate the excess air from your lungs, slow your breathing way down, and do a gentle and prolonged exhalation over three or four breaths. In doing this series of preparatory deflation breaths, don't breathe in a full breath, or you will re-inflate your lungs again. Breathe in only about 75 to 80% of a normal inspiration breath. "Breathing Belt" exercises and the "Respiratory Squeeze" technique, described elsewhere, may be used to advantage here.

Now, take in a slow, comfortably deep breath (but not a maximum deep breath).

At this juncture you must now concentrate on keeping your Glottis ("Voice Box") open, and with your mouth shaped like a loose "O." With the Glottis kept open, it is now impossible to build-up a high pressure cough.

Now, give a short, abrupt, relatively gentle "mini-cough" by a sudden contracting of your upper abdominal muscles. Try to imagine contracting centrally, from just below your ribs down to your umbilicus. If you do this correctly you should produce a soft exhalation sound like "huff," hence the name Huff Cough. Note how different this is from the typical sharp, barking, explosive sound of a normal cough.

Remember, the moment you produce the Huff Cough you will also initiate some excessive bronchial compression, which will immediately impair phlegm clearing. **This is why the Huff Cough must be kept very short.** But this bronchial compression is not as bad as with a traditional hard cough, particularly if it is a repetitive cough, as this "normal" cough will cause much more dynamic bronchial closure, and therefore wasted energy with little further mucus production.

Now, at the end of the Huff, take in a quick partial breath of air, and try to feel this being sucked into the bottom of your chest. This is to again put some air out past the offending mucus, and to open up the collapsed airways, in preparation for the next Huff Cough. Do not take in a deep breath as you did at the beginning of this exercise.

Now, repeat the Huff Cough a second time, this time with the smaller breath.

Again, abruptly take in a still smaller partial breath, and repeat the Huff Cough for a third time. (Some times you may feel difficulty in that third Huff Cough, and if so then do only two Huff Coughs.)

At this juncture, at the end of the Huff Cough sequence, with progressively smaller cough volumes, you should feel that most all of the air is out of your lungs. This is because you were not taking in the same sized deep breaths between the Huff Coughs. This decreasing changing lung volume you have produced will help to further "milk" and squeeze phlegm from your lungs.

Next, take in a forced, full (but not maximally full) breath of air deep into the bottom of your lungs.

Now, keeping the Glottis open, give a single, hard, **FORCED Huff Cough.** This forced breath should result in phlegm being produced to where it can be expectorated.

What has happened here is, the two or three (preferably three) Huff mini-coughs have loosened peripheral small bronchial mucus, and progressively brought it into the large bronchial tubes, and the larger forced HUFF cough results in final expectoration.

**Failure to finally expectorate your phlegm**

28
Sometimes the final forced Huff Cough brings sticky mucus only part way up, where it "hangs-up" in your large airways and causes a further coughing attack. This can be hard to control and very distressing. If you are in this situation, don't panic and try to force the phlegm out with a series of hard coughs.

Stay calm, and try to suppress your coughing spasms. Concentrate on doing slow, deep breaths with a long expiration time. You may also do Pursed Lip Breathing to help your dyspnea. Rest yourself, and regain your strength. A sip or two of water often helps with cough control.

Almost always this situation produces a temporary state of lung overinflation, so it is very important for your recovery that you concentrate on lung deflation as noted above. Then, repeat the Huff Cough sequence as needed.

As sticky phlegm is often the culprit causing this problem, increase your clear fluid intake for the next few days, until your urine becomes consistently less yellow. This is done to moisten the phlegm and encourage looser sputum.

Remember, always immediately examine your sputum at least twice a day, and particularly the first morning sputum. This should be done in a tissue to enable close inspection. If you suspect you are developing a "Chest Cold" bronchial infection you should examine all of your phlegm for signs of progressive infection. It is very important that you know what your "normal"phlegm looks like. This must be done to permit recognition of early bronchial infections. Examine all sputum if it is getting less in amount, or thicker or stickier, or if it becomes slightly opaque, or dirty yellowish or greenish appearing. This may be the warning signal of early bronchial infection, a "Bronchitic Exacerbation." This may require prompt medical attention. More on this important topic in another module.

**Huff Cough technique Summary**

In summary, the sequence of the Huff Coughing technique is:

- Lung Deflation (several breaths, or with Breathing Belt and/or Respiratory Squeeze assist).
- Deep breath in.
- Huff Cough #1, with lung deflation, followed by rapid partial inspiration.
- Huff Cough #2, with further lung deflation, followed by rapid partial inspiration.
- Huff Cough #3, with still further lung deflation, down to near the bottom of your lungs.
- Deep breath in.
- Single abrupt and forced HUFF COUGH for final expectoration.
- Repeat as necessary after a brief rest if clearance is not complete.
- Examine your sputum in a tissue, at least twice a day.

We will now go on to discuss your getting more active, and increasing your exercise tolerance.

**DYSPNEA POSITIONS**

If you are having an acute dyspnea attack it is important that you know how to position you body for maximal use of your respiratory muscles. This module will show you dyspnea positions while standing, sitting, and lying.

These positions utilize gravity effects, and positioning to permit use of not only your regular muscles of breathing, but also your so-called *Accessory Muscles of Breathing.* These muscles are generally not used in regular breathing, but can be emergency adjunct muscles to assist your breathing. In fact, if properly positioned and braced, most of the external muscles of the chest are accessory breathing muscles, and properly used the anterior abdominal muscles can also assist.
As a general rule, moderate forward bending will assist your breathing. However, excessive forward bending must be avoided, as this will impair upper abdominal movement on inspiration. And with this forward bending there should generally be some moderate tensing of the entire shoulder muscles, to provide bracing for the accessory breathing muscles.

**STANDING DYSPNEA POSITIONS**

**Unassisted Standing Positions**

The simplest standing dyspnea position is to stand erect, leaning slightly forward, and let your shoulders and arms hang slightly forward. You can use this position in a public place where you do not want to appear conspicuous. During this time, relax and calm yourself, and concentrate on your breathing training skills, and/or do Pursed Lip Breathing.

This position will be assisted by leaning further forward and placing your hands on your upper thighs, and then using your arms and shoulders as a brace to further engage your accessory breathing muscles. Try sliding your hands down to about mid thigh and see if this improves your breathing, and if this works to advantage, then try placing your hands on your knees. You should not try placing your hands past your knees, as in fact knee placement may be too far for some.

**Assisted Standing Positions**

The simplest assisted position is to lean forward and place both hands on an object about three to four feet high, such as the back of a chair, a low fence, etc. Then moderately tense your upper arms and shoulders to use them as braces for your accessory muscles. Again, relax and calm yourself, and concentrate on your breathing training skills, and/or do Pursed Lip Breathing.

Further recruitment of your accessory muscles may be obtained by leaning further forward, and placing your elbows or forearms on an object four or five feet high.

**SITTING DYSPNEA POSITIONS**

**Unassisted Sitting Positions**

The simplest sitting position is to just lean forward. This is an inconspicuous position. However, it is important that you keep your back straight, otherwise you might curl-up and cause your lower chest to impair upper abdominal inspiratory movement. Also, keep your knees moderately spread, so your abdomen can hang freely and not have inhibited motion. These precautions about keeping your back straight and spreading your knees apply to all sitting dyspnea positions.

**Assisted Sitting Positions**

Assisted sitting may be initiated by simply placing your hands on thighs or knees, and then bracing the upper arms and shoulders.

Further assistance may be obtained by placing your elbows or forearms on your thighs. This requires more exaggerated forward leaning, and you must be particularly careful to keep your back straight to avoid curling-up and causing lower chest and upper abdominal restriction. Obese people, and those with a "pot belly" may find this position uncomfortable, and if so this position should not be done.
A good resting sitting position would be to place one or two pillows on a regular table (or on top of a **high** bed, if you have a hospital type bed), and then leaning forward while wrapping your arms about the pillows. In this manner you can rest, or take brief naps. If you are having unrelieved dyspnea at night you might try sleeping in this position. If so, you must realize there is some danger of falling while sleeping, and you take precautions such as supporting pillows or padding about the floor.

**LYING DYSPNEA POSITIONS**

The simplest lying position is just to be propped-up on two, three or four pillows. Again, if propped-up very high there is some danger of you falling out of bed and injuring yourself. If you feel you would like to try sitting up, it is best to do this in a comfortable easy chair, with your feet on a foot stool or similar object.

A precaution here. If you find over a fairly sudden time period, over perhaps three or four days, that you are feeling the need to be up high while sleeping, it may be a sign of cardiac weakness and water congestion in your lungs. If you think you may be having this problem it is important that you check with your physician and possibly get medications to clear water in your lungs.

**High Side Lying**

This is the preferred lying dyspnea position in COPD. Lie on your side, propped-up on three of four pillows. Or you might consider a large triangular shaped foam rubber cushion plus a single pillow. Place a single pillow in front of you, so you can hold on to it and minimize slipping off the high support. Cross your upper knee over in front of you. Then relax, and calm yourself, and concentrate on your breathing training.

Persons with severe COPD are working hard to breathe, even when they are sitting quietly and doing nothing to exert themselves. Rest is therefore an important part of a COPD program, and getting a reasonable night's rest is indeed important.

**INCREASED ACTIVITY AND EXERCISE**

The shortness of breath that comes with COPD typically limits a persons ability to be active, let alone to be involved in an exercise program. You have most probably noted a gradual reduction in the activities you enjoy that involve physical effort. And even if your COPD is only moderately severe you probably have noticed a reduction in the so-called "Activities of Daily Living." Understandably, you probably attribute this decline due to your dyspnea, and this is correct. However, this decline in your exertion ability is much more complex.

Exertion requires muscular effort, and muscular effort requires a steady supply of Oxygen, which is an essential metabolic source of energy. And muscular effort also produces waste products of metabolism, among them Carbon Dioxide ("CO2") which must be disposed of by the lungs. Yes, the lungs are critically important in taking in Oxygen and getting rid of waste Carbon Dioxide, and your breathing impairment will certainly limit your Oxygen delivery and CO2 excretion.

However, Oxygen and CO2 are carried to and from the muscles by your **blood**, and if your **heart muscle** has become deconditioned by inactivity or disease and can't pump blood efficiently, this may also be a significant factor limiting your exertion capability.

And then there are the **peripheral muscles** themselves, and whether or not they are efficiently metabolizing Oxygen and producing required energy. Unfortunately, perfectly normal muscles, if they become deconditioned by inactivity, become inefficient at the cellular level in the production of required metabolic energy. **Severely deconditioned muscles are very inefficient in processing this vital metabolic energy, and muscle deconditioning is frequently a**
serious limitation to activity of the person with COPD. Ironically, these deconditioned muscles require more Oxygen and give up more CO2 for a given work load, thus producing an even greater burden on the lung and heart components of this complex overall system.

Typically the person with COPD progressively limits their activity because of exertion related dyspnea. As a result of this decreased activity the heart then becomes relatively deconditioned, and it therefore becomes a less efficient pump that has to work harder to achieve the same task level. Fortunately cardiac function limitation is usually not a major problem, but improving cardiac performance with an exercise program will provide some help to your overall exercise capability.

Peripheral muscle (i.e. mainly the muscles of the arms and legs) deconditioning frequently is a major culprit leading to severe weakness in COPD. Note, this is a "vicious circle" type problem, where inactivity leads to deconditioning and deconditioning leads to muscular weakness and inefficiency, which in turn now requires more effort by the heart and lungs for the same level of muscular effort.

Learning breathing control can improve your lung efficiency, and this will help you to feel better. But to achieve full rehabilitation benefits it is essential that you also rehabilitate your cardiac and peripheral muscle function. Unfortunately there is no medication that can do this for you. There is only one way to do this, and that is by a progressive exercise program.

Many pulmonary rehabilitation programs have a heavy emphasis on exercise, with formal classes of exercise training using exercise equipment such as bicycle ergometers, or treadmills, or structured walking and stair climbing protocols supervised by experts. And without question these programs have documented considerable patient rehabilitation benefit. Indeed, this is an excellent way to efficiently begin your rehabilitation program.

But unfortunately there are some problems with these formal exercise programs. First, they may not be available to you, or if available, they may be inconvenient to attend. Second, exercise ideally should be done every day for efficient rehabilitation, and many programs meet only two or three times during the working week, and rarely on weekends. Third, most formal programs are limited to only two or three months by insurance payments, and long term follow up is not paid for by most insurance plans. And finally, formal exercise is frequently boring and unpleasant, and particularly so if you are not doing exercise you enjoy in a supportive environment. For these reasons most patients stop exercising within a year or so, and this is very unfortunate, as what you have initially gained by exercise will now be gradually lost.

However, there are effective alternatives to formal exercise programs, and for long term follow-up exercise.

This is based on the simple premise that if you have breathing control skills and can control your exertion dyspnea, you will then not be afraid of becoming short of breath. And if are not afraid of developing uncontrolled dyspnea you will become more active, because you want to become more active, and therefore do the many desirable things that you previously could not do.

And as you regain your ability to do more and more activities of daily living, you will develop more and more strength doing these activities, and you will then want to be even more active.

Many home bound people with COPD can progress to activities outside of the home, doing things they enjoy such as visiting friends or going shopping. All of this involves progressive exercise, which is a natural part of simply becoming more active. And this form of exercise is neither boring or unpleasant.

However, some structured home exercise is desirable, and to achieve this I would recommend the Yoga training videos developed by Dr. Vijai Sharma. Dr. Sharma is a Clinical Psychologist and credentialed Yoga teacher with a special interest in COPD. He has developed two training videos "Stretching Breathing Exercises adapted for people
with severe COPD" and "Stretching Breathing for COPD for all levels of fitness." These videos are carefully designed to first provide safe training for a frail person with severe COPD, and secondly to provide more strenuous exercise for less disabled individuals.

The Yoga movements provide excellent stretching and posture maneuvers to mobilize the spine and chest wall, and improved general coordination and balance training permeates the exercises. And Yoga is intimately related to breathing exercises, and there are good breathing instructions directed to COPD needs. Teaching coordination of breathing with general body movements is well done, and this provides a bridge to more efficient movement for performance of activities of daily living. Dr. Sharma has a web site with many topics of interest for COPD patients, and you may purchase the videos at that site at http://www.mindpub.com/

If you are considering a home exercise device I would recommend one of the simpler and inexpensive SSstationary Bicycles. Generally these devices are stable, and there is minimal danger of falling. And if you become short of breath you are already seated, and you simply stop peddling, and brace your arms on the handles for rescue breathing control. Adjust the tension so you can peddle with only minimal effort, and be able to maintain that peddling effort continuously for about two minutes. As you get stronger, try to gradually extend your peddling time to five minutes. When you can achieve that level of activity, then try applying a slight further increase in peddling tension. Then, try to gradually work up to ten minutes of continuous peddling, and do this preferably twice a day. To avoid boredom, do your exercise in front of your television, or listening to news or music.

As with all exercise programs, the trick to enabling progressive exercise success is learning how to recognize your dyspnea level that you know you can control with slow / deep breathing, or Pursed Lip Breathing. When you reach that point you should stop, regain your breathing comfort, and then continue with your exercise activity. Continuing beyond this breathing control point to levels of severe dyspnea makes it very difficult to control and regain your breathing comfort. Be patient, and gradually push your breathing control point to further effort. As your peripheral muscle strength improves you will find that you are capable of more exertion, and this increased exertion capability done within dyspnea levels that you know you can control. If you know you have the skills to exert yourself and be able to recognize your dyspnea control level, and then to be able to manage your dyspnea, you will now have the confidence to become progressively more active in whatever activity your are doing.

I would not recommend treadmills or stepping devices for home use because of the danger of falling. As to arm weight training, I would avoid heavy weights. A pair of dumb-bells for upper extremity exercises is convenient, but they should not weigh more than five pounds, and one to two pounds is adequate for most individuals. You are basically not training for strength, but mainly for reconditioning and endurance.

Beginning exercise for the frail person with COPD.

Some persons with severe COPD are so severely debilitated and weakened they are confined to bed, or so weakened they have great difficulty occasionally getting into a chair. Ideally such individuals should have initial professional help from a Visiting Nurse service, who in turn may be able to arrange for a temporary visiting Physical Therapist.

Even if bedridden, such individuals can and should begin their rehabilitation with chest mobilization and corrective breathing training, as well as developing Pursed Lip Breathing skills. This should provide some dyspnea relief, and having some breathing control skills will be helpful later when you are exerting and needing more ventilation.

Exercises that anyone can do, are called "Isometric Exercises." This is simply tensing muscle groups against one another. This type of exercise can be done by anyone, even those with severe arthritis problems, as there is little or no movement of joints involved.

Upper Extremity Exercises
Upper extremity exercises for those confined to bed, may be done by clasping your hands in front of you, next to the chest. Then press your hands firmly together, and hold them together firmly, to the count of five. Then pull your hands apart firmly, and maintain this tension to the count of five. Repeat this cycle two or three times until you can do this exercise fairly easily. This will strengthen your shoulder muscles.

Do this exercise (and all of the other exercises) at least every two hours, and preferably every hour. Then build up your strength by a combination of stronger pressures, longer times of applying pressure, and more cycle repetitions. Decide what is best for you, but initially stay with pressure times of about five seconds until you are stronger.

Another shoulder muscle exercise is to place your hands by your side, palms down, next to your hips. Then press your hands firmly into the bed to the count of five, relax to the count of five, and then repeat the cycle two or three times. Extend this exercise in a manner as noted above as you get stronger.

**Lower Extremity Exercises**

The major muscles of concern here are the Quadriceps Muscles, which are on the front of your thighs and run between your knees and hips. These muscles are critically important as they stabilize the knee, and are essential to enable safe walking and getting up out of a chair. Quadriceps deterioration happens particularly rapidly in people confined to bed, and restoring their strength is a crucial component in preparing to get out of bed to a chair, and to walk safely.

The Quadriceps may be exercised by having your legs flat in bed, and then tensing the upper leg muscles firmly for five seconds, then relaxing for five seconds, and then repeating the cycle for two or three times. As above, build up this exercise as your strength improves.

Another lower extremity exercise, this time to strengthen the muscles about your hips and lower abdomen, is to have your legs flat in bed, and then press your heels firmly into the mattress for five seconds, relax for five seconds, then raise your heels an inch or two off the mattress for five seconds, then relax for five seconds, and then repeat the cycle two or three times. As above, build up this exercise as your strength improves.

**Getting from Bed to Chair**

If you have been confined to bed for some time, or feel weak, you should never attempt to initially get out of bed without assistance, and preferably with professional supervision by a Nurse or Physical Therapist. The initial chair should be a firm plain wood chair with a high back (which you can use for arm support) and preferably with side arms. A Walker device (either a Jump Walker or Rolling Walker) for additional arm support should also be used so you can assist in the transfer from bed to chair. Preferably two should initially assist, one to directly assist you, and the other to position and steady the chair. And you should definitely wear a stout Safety Belt (see the section on Breathing Belts) until you are well mobilized.

When ready, do not attempt to directly stand on the floor. Many weak patients develop a problem called Postural Hypotension, where your blood pressure abruptly falls on standing up, which can lead to dizziness, fainting and falling. First, dangle your legs for a couple of minutes, and if no dizziness is felt, then place your feet on the floor for a minute or two. If there is any hint of dizziness or excessive weakness, you can easily be slid back into bed from this position. Progress to the chair only when you feel able to do so. Initially don't spend more than five or ten minutes in the chair.

As your strength improves and you and your assistants gain confidence in your capabilities, you may spend more time in the wooden chair, and then progress to an easy chair. Remember, getting out of a deeper easy chair is more difficult, so be sure your standing up strength and skills are adequate.
Chair Activities

When safely mobilized to a chair, and particularly if you are spending extended periods of time in the chair, it is important that you continue with your isometric exercises, to further prepare you for walking and performing activities of daily living.

Upper Extremity Chair Exercises

Continue with hand clasping exercise as before. For shoulder strengthening you may now grasp the seat of the chair and push down and pull up.

Another useful activity are the so-called Broomstick Exercises. Use the full length of an old broomstick, and use it to both mobilize and strengthen the upper extremities, and to develop neck and spine mobilization.

With the broomstick in your lap, and holding it palms up, bring the broomstick up to your chin, and then extend it in front of you, and then back to your lap.

Or, holding the broomstick palms down, bring the broomstick from your lap up to your chin, and from there extend the broomstick over your head, and then back again.

Or, palms down, place the broomstick over your knees, and then with arms extended swing it up and over your head, and back down again.

Or, with the broomstick over your head, rotate the broomstick and your head slowly as far as you can to the right, and then to the left.

Or, with the broomstick held at chin level, bring the broomstick straight down towards the left hip, and then to the right hip.

Or, with the broomstick held at chin level, touch the right end of the broomstick to the left knee, and at the same time look up over your left shoulder. Repeat this exercise touching the left end of the broomstick to the right knee, while looking up over your right shoulder. These neck and spine mobilization exercises may be difficult at first if your neck and spine are stiff. Be gentle, and gradually mobilize your neck and spine.

As your strength improves, light weight dumb-bells might be used. Again, one or two pound weights are adequate for most, and never more than five pounds.

Lower Extremity Chair Exercises

The Quadriceps exercises should be done from the chair one leg at a time. Straighten your right leg out, then lift it from the floor until it is straight out, and then tense the thigh muscles and hold the tension for five seconds. Relax, and lower your leg to the floor and rest for five seconds. Repeat the cycle two or three times. Then do the same for the left leg.

These Quadriceps exercises may initially be too strenuous for some. In that case, start out with both feet flat on the floor, and tense both thighs for five seconds, relax for five seconds, and repeat the cycles two or three times.

For hip strengthening, sit up straight, knees together, and then lift the right knee up, then swing it outward, put the foot down, then bring it back up, and return to the starting position with the knees touching. Repeat two or three times, and then do the same for the left leg. This is one cycle of this exercise. Repeat the cycle two or three times.
For hip, lower abdominal and lower spine exercise, place your heels directly in front of the chair, and then push your heels into the floor. As you do this, tense your lower abdominal and back muscles. Hold this tension for five seconds, relax for five seconds, and repeat the cycle two or three times.

If you have done these exercises faithfully for about two weeks, you should now be prepared to begin walking training. And if you have been further developing your dyspnea recognition skills and breathing control skills, you will be even better prepared for walking exertion, and controlling any dyspnea of increased activity.

Walking

Being able to walk about is the fundamental goal that liberates you from confinement to bed or chair, or from doing many activities of daily living. If you have reasonable walking capability you can get out of your home to shop, or to visit friends and relatives, and generally do many of the things you would like to do.

And walking itself is an excellent form of general exercise. But you will need to start slowly, and build up your walking capability gradually. Remember, in the race between the rabbit and the turtle, the turtle won.

Initially, and until your strength develops, you should walk with an assistant and with the aid of a Safety Belt. And if unsteady, you should use a Walker assistive device. Later, when you no longer need an assistant, continue to use the Walker, and otherwise keep it handy should you suddenly feel weak or unsteady.

Walk a bit further each week, and don't abandon the upper and lower extremity Isometric Exercises, which are best done while seated. And as you walk further, remember that you must be able to get back. Don't get yourself in a position where you need to stop and rest, or use a chair for resting, but cannot rest because you have gone too far. Pace yourself deliberately, and control your level of increased activity within your dyspnea control requirements. Never allow yourself to get so short of breath that you cannot control your breathing and recover from a dyspnea attack.

An excellent walking breathing control technique is called Paced Walking. Walk in a comfortable manner, and count your footsteps while breathing in and out. Breathe in - one - two (or one - two - three). Breathe out - one - two - three (or one - two - three - four). Note that breathing out must always be longer than breathing in, in order to prevent the problem of lung overinflation due to Dynamic Hyperinflation. Some require an even longer breathing out phase, up to five or six counts.

As you exercise there is a natural desire to breathe faster, which must be resisted, as breathing faster will cause Dynamic Hyperinflation and make you breathing acutely worse. Your best compromise is to breathe only slightly faster, about two or three breaths per minute over your resting breathing rate, while at the same time continuing to have longer expiration breaths. When this is no longer possible, stop and rest, and concentrate on breathing control and/or Pursed Lip Breathing.

Note that with shorter steps you may have more breath counts, and with longer steps you will have fewer breath counts. For example, with shorter steps your breath counting may now be Breathe in - one - two - three - four. Breathe out - one - two - three - four - five - six - seven. By adjusting your speed of walking and size of the steps you take you can make quite refined breathing timing signals suitable for your particular needs.

Stair Climbing

Stair climbing skills are usually required, even if you live in a one story home. You may need to climb a few stairs to get into your home, or climb at least a few stairs in many situations outside of the home situation.
For even the very short of breath person, you can still climb a few stairs quite easily, if done one step at a time, and if you have been doing your Isometric Quadriceps exercises. If possible, support yourself with one hand on a railing, and preferably have an assistant ready to help if needed.

Place one foot on the next step, take a deep breath, and then exhale while stepping up with the other foot. Then stop, and take a few gentle, deep breaths, remembering to breathe out all the way. When you are sure your breathing is controlled, take another step, and again be sure you stop and rest before proceeding. If your "step up" leg gets tired, switch to your other leg to make the step up. Don't make the mistake of feeling embarrassed by your slow climbing progress, and trying to rush your stair climbing beyond your breathing capability.

A good stair climbing technique for those who are stronger and have good breathing control skills is called **Paced Stair Climbing**. Here you climb three stair steps at a time. To get the timing right it is necessary for you to climb very slowly and deliberately. **On the first step up, breathe in** (Note this is opposite for the exertion portion of the "one step at a time" technique). **On the next two steps up, breathe out**, and then stop and rest.

Don't proceed to the next three steps unless you have good breathing comfort and breathing control. As you again strength you may find that you can take six stairs at a time, or nine stairs at a time. If you are climbing stairs in multiples of three steps, try to get a slow rhythm to your breathing and stair climbing. Again, be sure to stop and rest if your dyspnea is increasing and you are in danger of losing your breathing control.

It is surprising how many COPD patients can learn to climb stairs very effectively. And if you develop this skill, make a point of climbing stairs for exercise, rather than using an elevator. This one is a real confidence builder.

**Mall Walking**

Enclosed shopping malls are excellent for enjoyable walking exercise, as the problem of weather that is too hot, too cold, or raining is no longer a consideration. Plan to do this at least once a week, and preferably with friends, and make it into a social event. And you might consider forming a "**Mall Walking Club**" from members of your Pulmonary Rehabilitation class, or fellow members of a "Better Breathers" organization.

**BRONCHITIC EXACERBATIONS**

Bronchitic Exacerbations are acute or subtle sub-acute deteriorations in your COPD health, usually caused by an initial minimal bronchial infection. These initial mild infections may progress over several days into serious complications. Without question, your overall health, and in fact the length of your life, is substantially dependent on the frequency and severity of Bronchitic Exacerbations. It is therefore crucial that you understand this problem, and be able to recognize it early, and to know how to deal with it.

A **Bronchitic Exacerbation** is broadly defined as any acute deterioration in your COPD status. The reasons are multiple, but generally they are:

1.) **Bronchial Infection**, either bacterial or viral. This is the usual reason for an exacerbation.
2.) **Heart Failure**, with secondary accumulation of fluid in the lungs, resulting from worsening of respiratory heart strain called **Cor Pulmonale**, or following a "silent" heart attack.
3.) **Asthma** exacerbation.
4.) **Pulmonary Embolus**, a blood clot in the lungs.
5.) **Pneumothorax**, or air in the chest cavity, a usually painful, but sometimes a "silent" or painless process.
6.) And other rarer causes.

A fundamental rule in medicine states it is better to prevent a problem than it is to treat the problem. This module will give you some general health tips, and some specific things you should do to prevent Bronchitic Exacerbations. You
will also learn how to recognize, and minimize, COPD exacerbations. And you must always remember, this is possible only with your active and ongoing participation in your health program.

First and foremost, carefully and consistently follow the program provided by your doctor and other health care providers. This may seem like trivial advice, but it is surprising how many patients fail to follow their programs or take their medicines properly.

If you are still smoking, you must stop all forms of smoking, totally and permanently. The importance of preventing further lung damage, and further impairing lung defense mechanisms, cannot be overstated.

Maintain a balanced and nutritious diet. If you are uncertain what this means ask your doctor for an explanatory handout. Keep a record of your weight, at least once a week. The increased "work of breathing" in COPD requires extra food calories, and unfortunately loss of appetite in COPD is common. If you are unable to maintain your weight you may need an additional liquid food supplement. A dietitian can advise you about commercial dietary supplements, and may be able to provide you with a recipe for making your own liquid supplement very economically.

Vitamin supplements are generally not needed, but if you are marginal as to food intake they may be necessary. Ask your doctor for an economical generic multivitamin, and possibly with some of the more expensive supplements. Vitamin E is somewhat controversial, but as an "anti-oxidant" counteracting the "free radicals" of oxygen metabolism it finds many who recommend it, for a broad range of reasons. Generally about 400-500 mg twice a day is sufficient.

Maintain a good fluid intake, generally clear fluids, to the point where your urine is slightly paler than usual. This may help to keep the mucus in your lungs moister and softer and therefore easier to expectorate.

Stay active, and exercise as best you can, even if you become moderately short of breath. Make a point of going to the bathroom, and the kitchen or dining room for your meals, and the family room for general activities. As you learned in the exercise module, general deconditioning with weakness and debility is a common and serious problem in COPD. The more deconditioned you are, the more inefficient your muscles are, and the harder you must breathe to make up for this muscular inefficiency. Particularly important are the large anterior thigh muscles, the quadriceps muscles, that are crucial for getting out of a chair and walking. Ask you doctor to show you how to do "quadriceps exercises" and "isometric quadriceps exercises" that may be done even if you are temporarily confined to a chair or bed. Keeping these muscles "toned-up" is important for rehabilitation to an active walking condition. A Physical Therapy consultation may indicate a need for a more structured exercise program, or a so-called "Aquatic Exercise Program" in a swimming pool, or a Yoga Program.

Avoid dust and materials you find irritating to your nose and mouth, or that make you cough. A simple face mask may help. Be sure the filters in your home heating and air conditioning are changed at least monthly. Room air filters, and humidifiers seem to benefit some sensitive patients, particularly during the allergy seasons.

Be sure to get your "Influenza Shot" every year, and the separate "Pneumonia Shot" for bacterial Pneumococcal pneumonia prevention.

Regular bronchial medication sprays have been found to be beneficial in keeping your airways open, and in preventing Bronchitic Exacerbations. These are:

1.) **Long acting "beta" bronchodilators**, generally used regularly once or twice daily.  
2.) **Tiotropium**, a new drug that acts on a different part of the airways, used once daily.  
3.) And sometimes a **corticosteroid inhaler**, also acting in a different manner, used regularly as directed.

**Your short acting "beta" bronchodilator** such as Albuterol is generally used as a "**Rescue**" medication. It should be used for acute shortness of breath situations, and generally only if you cannot promptly normalize your breathing on your own with breathing control techniques or Pursed Lip Breathing. Excessive use of these rescue medications
can lead to heart palpitations and insomnia, and the medication may develop diminished effectiveness if used too much. If you find that you need more and more of your rescue medication you should notify your doctor, as this may be due to some underlying problem.

People with Influenza or Colds, or if there is any suspicion they are developing same, must have no contact with you. If these people are required to assist you, or prepare your meals, they must wash their hands and wear rubber or plastic gloves while handling the things you will touch. And they should use a face mask, and they must scrupulously avoid sneezing and coughing.

You should wear a face mask if these helpers are in the room, and you should also wash your hands before eating. Avoid visiting other parts of your home where visitors may have inadvertently contaminated the area during Flu outbreaks. And if visiting outside your regular room during vulnerable times, pay particular attention to mask and hand washing precautions. And always use tissues for coughing and sneezing, never handkerchiefs, as handkerchiefs become easily contaminated and further spread germs.

If you find that your ankles are swelling, or if you now have to sleep sitting up, this may indicate abnormal fluid retention. Be sure to notify your doctor and have this situation evaluated.

**Monitoring Your Sputum**

You must regularly monitor not only your general health, but particularly your sputum characteristics, for early signs of a Bronchitic Exacerbation.

You need to recognize a Bronchitic Exacerbation before the typical signs of a chest cold develop. These traditional signs are generally those of increased cough which produces dirty yellow phlegm, and fever, and feeling unwell or short of breath, and other signs of infection. This module will teach you how to recognize a Bronchitic Exacerbation in the beginning stages, before it causes serious deterioration of your lung function. And with early detection you have an excellent chance of treating this problem at home.

To do this you need to be familiar with the "silent area" of the lungs, the smaller airways deep in the lung that don't have cough sensors. An infection may quietly fester and progress in these small airways before dirty phlegm progresses to the point where it reaches the cough receptors in the larger airways. It is these receptors that help you recognize the need to cough, and therefore spit up dirty yellow or yellow-greenish phlegm.

It is up to you to recognize changes in your sputum, before the early silent infection later progresses to the larger airways and is now recognized. And because sputum quickly dries out and otherwise changes with time, you cannot wait for someone else to examine it.

Almost all patients with COPD have increased sputum, which frequently is thicker and sometimes colored yellowish or brownish, especially in the morning. This is mucus that has been accumulating during sleep. Because sputum, and particularly dirty sputum, is distasteful, you probably cough it into the toilet or sink, or into a tissue, without looking at it.

This is a mistake. You need to examine your sputum regularly, and particularly the early morning sputum, to become familiar with your "normal" sputum characteristics, so you can detect small hints of potential trouble. You should also examine your sputum at least one other time during the day, preferably late afternoon.

With a Bronchitic Exacerbation your phlegm typically becomes thicker and stickier, and harder to expectorate. Do not be fooled into thinking that a decrease in the amount of phlegm you expectorate means that all is well. This is often
**an early warning signal.** The infectious process may in fact be hidden in the smaller airways, and festering and progressively plugging-up your airways and robbing you of precious functional lung.

Should you manage to raise some phlegm early in a Bronchitic Exacerbation, typically it is slightly thicker, and stickier, and has a subtle opaque coloration. And within this opaque discoloration, if you closely examine this phlegm you may note some faint streaks of slightly yellowish coloration.

If you suspect by an absence of sputum, or the presence of sticky opaque sputum, that you are developing a Bronchitic Exacerbation, then it is very important that you watch for additional Common Cold or Influenza ("Flu") symptoms. Typically this is a stuffy nose with watery discharge, and a sore "scratchy" throat. You may even feel the scratchiness progressing downwards, now accompanied by a hoarse voice, vague central chest discomfort, and a non-productive cough. Even if these viral "Flu" illness do not produce a Bronchitic Exacerbation, they usually temporarily damage the protective lining of the bronchi, making you more susceptible to a bacterial infection a week or two after recovering from this initial event. Be aware of this possibility of a recurrence of your Bronchitic Exacerbation situation.

**Summary of Onset and Progression of a typical infectious Bronchitic Exacerbation**

1.) Signs of the Common Cold, or Influenza, or a "Flu-like" illness.

2.) Signs these viral or bacterial illnesses are progressing down into your lungs.

3.) A vague sense of being "unwell" (so-called prodromal symptoms).

4.) A vague sense of increased shortness of breath, usually first noted with effort, because your bronchial tubes are plugging-up and decreasing the amount of functional lung.

5.) A vague sense of general chest tightness, or heaviness.

6.) Increased time to recover from effort, or for those on oxygen, a feeling that more oxygen is needed.

7.) A decrease in your sputum volume.

8.) Thicker, and stickier sputum, possibly with a slight clear opaque tint to otherwise normal appearing phlegm, and sometimes with faint yellowish streaks.

9.) Signs of more obvious infection, with further malaise and mild fever, occasionally some chills, and often with an increased pulse rate.

10.) Progressive shortness of breath with effort.

11.) Increased breathing distress at rest.

12.) Increasing cough, now productive of thicker phlegm, which is usually yellow or yellow-green streaked, or with areas of dirty mucus.

It's important to initiate corrective measures before these last four late stages. With practice, you can detect early signs at least two or three days earlier, and begin home therapy that may prevent serious complications.

**A Matter of Life or Death**
If you have reached the stage of coughing up thick dirty phlegm, and particularly if you have progressive increased shortness of breath, you need immediate medical attention.

Call your doctor for an urgent medical appointment. If your doctor is not available or the receptionist tries to delay the visit to a later date, go immediately to the Emergency Room of the hospital where your doctor has admitting privileges. There you will be evaluated for a potential serious complication such as pneumonia, or other potential problems. And if your breathing is significantly failing you may even need use of ventilator support for respiratory failure.

Get this emergency medical evaluation, and do it now. Your life may depend on it.

**Recovery from a Bronchitic Exacerbation**

Bronchitic Exacerbations can be quite devastating to your overall health. Even with a mild exacerbation which was promptly treated, you will not feel your old self for at least two weeks. For more severe exacerbations, it may take several months, or even a year or more to fully recover.

It is obviously in your best interests to recognize Bronchitic Exacerbations early, and to treat them promptly and effectively.