



# Education

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## Notes from the Editor

by Arthur Jones, EdD, RRT

*If you think education is expensive,  
try ignorance*

– Derek Bok, president,  
Harvard University

There has been a lot of chatter recently in the respiratory care media regarding professionalism among our populace. For example, several scenarios exemplifying unprofessional behavior on the part of practitioners were described not long ago in the *Education Digest*. Unfortunately, many of us have observed such behavior in colleagues, often to the extent that we have considered covering our name tags to conceal our departmental affiliation.

Observations like these have caused some individuals to bemoan the fate of RC as a profession. Citing these observations along with other ailments plaguing the RC profession, some letters to the editor in a recent *Advance for Respiratory Care Practitioners* suggested that we can now see “the handwriting on the wall.” However, that particular handwriting is written in disappearing ink.

Those of us who have been around for a year or two know that unprofessional behavior is nothing new. In fact, I shudder to recall the effect that the OJT mentality had on our departments back in the '70s. Furthermore, unprofessional behaviors are not limited to personnel from RC. Anyone who doubts this should visit some of the other hospital departments and watch for awhile. Many times have I heard similar lamentations from friends in nursing; less frequently, from physicians.

In my humble opinion, with the increased educational standards, professionalism among our RC colleagues is on the rise, overall. As a site visitor for CoARC, I have been impressed and encouraged by the professional commitment evidenced by several educational institutions and RC communities. My commitment to confidentiality regarding

CoARC affairs prevents me from identifying these shining examples.

Of course, there are geographical pockets, institutions, and individuals that will resist the advance of education and professionalism to the last. These are the places and people who will discourage RC students and provide periodic rainfall for all of our parades and ants for our picnics. They are our antiprofessionals. These antiprofessional pockets are a nightmare for educators who are committed to providing a high-quality, comprehensive education for students. After all, a comprehensive education includes molding professional behaviors, as well as instructing on procedures and information. Where do students in such communities find role models?

Another aspect of these antiprofessional pockets strikes at the heart of our readership; that is, there are RC educators who have established and perpetuated them. This is easily accomplished by being satisfied with the community status quo, making no attempts to import current standards of practice. This also makes teaching easy because one only needs a single set of notes for each course for 20 years until retirement.

Communities that are being underserved by antiprofessional educators are relatively easy to recognize. First, clinical practice lags behind the rest of the country by at least five years. Practitioners in the community acquire the minimal amount of knowledge and skills necessary to keep their jobs. Where continuing education is required for state licensing, there is a general panic to “get the hours in on time,” just to keep the job. Anyone with an advanced degree of any kind is suspect and an unlikely job recipient. Indeed, the RCPs in this community will ask students, “Why do you want to get a BS degree?” Sound familiar anyone?

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Those who read this publication give evidence that they are not described by

the previous paragraph. The so-called educators described therein are unlikely to even belong to the AARC. Therefore, I am preaching to the choir. But if you know any of these antiprofessionals,

please share these notes with them. And then share your experiences with me. (In other words, how come I never get any letters to the editor?) ■

## Notes from the Chair

by *David W. Chang, EdD, RRT*

The city mayor was dining with his peers at a restaurant one evening. The waiter served them dinner rolls with pats of butter. The mayor asked the waiter if he could have more butter for the rolls. The waiter replied that it was the restaurant's policy to serve only one pat of butter per dinner roll. The mayor was somewhat irritated and said, "Don't you know

who I am? I am the person in charge of the city!" After a brief moment, the waiter said, "Don't you know who I am? I am the person in charge of the butter!"

In higher education, we often need to ask for additional resources so that we may continue to provide quality education and training to our students. At times, we are required to justify our needs. The above story illustrates the importance of taking charge of a situation and getting the right person on your side.

Certainly, it is not enough to simply run a successful RT program (i.e., high enrollment, low attrition, high pass rates, and high job placement rates). It is crucial to have friends and allies in times of need as well. It is also essential to cultivate relationships with those around you on a continuing basis. We should offer our time, talent, and effort to others as often as necessary. Who knows? You may want to have an extra pat of butter some day. ■

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## Favorite Web Sites

by *Tom Baxter, RRT and Arthur Jones, EdD, RRT*

### *Translating text*

If you ever need to translate text from one language to another, these are a couple of useful web sites that provide this service for free. The first one is <http://officeupdate.com>. Once you reach this site, just double click on Language Translation, select the type of translation (i.e., English to Spanish), paste your text in the box, and then click on Translate. It is helpful if you already have your text copied (from a word processor such as Word) and ready to paste. Word is the only word processing program text I have used thus far.

The second site is <http://babelfish.altavista.digital.com>. This site immediately goes into the language translation, so all you have to do is select the form of translation (i.e., English to Spanish), paste your text, and click on Translate. Again, it is helpful if you already have the text copied and ready to paste. — *Tom*

*Baxter, director of clinical education, University of Southern Indiana*  
**HISS goes online as WHISSL**

A few years back, I introduced the Health Information System Simulation (HISS) to the RC educational community at the AARC Summer Forum. It is also described in the Spring, 1996 *Education Bulletin*. HISS includes a set of electronic patient records that can be used in a variety of courses wherein patient medical records are applicable and useful. At that time, the courseware was available only on CD-ROM. Now it can be accessed on the web at <http://intercol.utmb.edu/WHISSL/> under a new name — WHISSL. In addition to the electronic patient records, there are instructions on how to use the simulations. I've used these as instructional adjuncts for pharmacology and patient assessment and in neonatal courses. It's worth a look. — *Arthur Jones* ■

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# A Literature Review Comparing Dornase Alfa and Hypertonic Saline in the Treatment of Retained Secretions in Cystic Fibrosis

by Steven Guy Sheils

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*Editor's Note: Steven Guy Sheils is the 1999 recipient of the ARCF Robert M. Lawrence, MD Education Recognition Award. He was recognized at the AARC International Respiratory Congress held last December in Las Vegas, NV. Steven is a student in the cardiorespiratory care program at the University of South Alabama in Mobile, AL. To obtain information on this and other competitive awards for RC students, contact the American Respiratory Care Foundation at (972) 243-2272.*

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Cystic fibrosis is the most common lethal, autosomal recessively inherited disease in the Caucasian population, with an estimated incidence of one in 2,500. The gene responsible for the development of cystic fibrosis is found on chromosome 7.<sup>1</sup> The most common mutation of this gene is the deletion of three base pairs in the DNA. This mutation is known as  $\Delta$ f508 and accounts for 75% of the genetic abnormalities responsible for cystic fibrosis. The mutated gene encodes for a protein named cystic fibrosis transmembrane conductance regulator (CFTR), which allows transport of chloride across cell walls.<sup>2</sup> As a result of this mutation, cystic fibrosis patients have a malregulation of the salt composition in their secretions.

Cystic fibrosis is characterized as a generalized exocrinopathy. Virtually all exocrine glands of the body are affected by the disease.<sup>1</sup> The classic triad of exocrine abnormalities consists of pancreatic insufficiency, chronic recurrent pulmonary infections, and an elevated sweat electrolyte concentration. Diagnosis of cystic fibrosis is confirmed by a sweat chloride concentration of greater than 60 mEq/liter in children and greater than 80 mEq/liter in adults.

Although generalized as a disorder of the exocrine glands, 95% of the mortality associated with cystic fibrosis results from bronchopulmonary disease characterized by bronchial and bronchiolar

obstruction.<sup>3</sup> Factors contributing to the progression of lung disease include increased viscoelasticity of infected sputum and dehydrated secretions. The increased viscoelasticity of sputum is caused by large amounts of DNA from vast numbers of degenerating neutrophils existing in the airways. The large amount of neutrophils are present in response to inflammation caused by chronic infection of retained secretions. The relative dehydration of the periciliary fluid, produced from an osmotic gradient created by the retention of chloride ions within the respiratory epithelium, leads to thickened, dehydrated secretions. Both factors inhibit mucociliary clearance of secretions, and the retention of these abnormal secretions promotes further infection and the progressive destruction of airways and adjacent lung tissue.<sup>4</sup>

The ultimate cause of pulmonary complications in cystic fibrosis is inhibited mucociliary clearance. Two approaches to therapy will be discussed in this paper: (1) nebulized dornase alfa and (2) ultrasonically nebulized hypertonic saline. An explanation of their roles in aiding mucociliary clearance and their effect on pulmonary function (Table 1) will be provided, along with a comparison of their cost.

Human DNase is an enzyme found in the pancreatic and duodenal secretions and in the serum and urine. The protein sequence was first cloned and produced in the ovaries of Chinese hamsters to create dornase alfa or recombinant human DNase (rhDNase), marketed as Pulmozyme.<sup>5</sup> The drug works by producing an enzymatic reaction that hydrolyzes DNA in infected sputum. In vitro studies demonstrated a dose-dependent reduction in sputum viscosity in which sputum was converted to a flowing liquid state within minutes after administration of dornase alfa. But only infected sputum was shown to be affected. The reduction in viscosity was consistent with a decrease in DNA chain size.<sup>5</sup>

Clinical trials performed in six different studies indicated similar results among patients receiving nebulized dornase alfa.<sup>3,5,6,7,8,9</sup> Clinical trials reviewed by Cramer and Bosso concluded that dornase alfa appeared to produce small but sus-

tained improvements in lung function in patients with cystic fibrosis.<sup>5</sup> In a placebo-controlled, double-blind, randomized trial lasting 10 days, 2.5 mg of dornase alfa was administered twice daily to 36 patients with cystic fibrosis and similar improvements in lung function were demonstrated. Forced expiratory volume in 1 second (FEV<sub>1</sub>) increased an average of 13.5% in the dornase alfa group, but declined an average of 0.2% in the placebo group. Forced vital capacity (FVC) did not change significantly between the two groups. The FVC rose 7.2% in the treated group and 2.3% in the placebo group. The pulmonary function test results declined to baseline within three weeks after termination of drug treatment.

Cramer and Bosso stated that dornase alfa may also slow the progression of pulmonary disease and reduce infection rates, which may well have important long-term benefits. Implementation of a trial of dornase alfa in patients with cystic fibrosis was thought reasonable, but continued treatment should be based on clear clinical response.<sup>5</sup>

J. Davies, et al. summarized that trials of dornase alfa in mixed groups of adults and children with cystic fibrosis had demonstrated improvements in lung function and well being.<sup>3</sup> The effects of dornase alfa during the first year of therapy in 65 children receiving the drug were retrospectively reviewed. Outcome measures included changes in lung function, oxygen saturation, use of intravenous antibiotics, and subjective improvement.<sup>3</sup> Median baseline lung function (% of predicted) was 45% for FEV<sub>1</sub> and 58% for FVC. Three to four months following the initiation of therapy (2.5 mg of dornase alfa given once daily) the group displayed median increases of 14.2% in FEV<sub>1</sub> and 7% in FVC. Within the wide scatter of responses, one-quarter of children deteriorated, but almost 50% showed improvements of greater than 10%. A similar pattern was seen at nine months, with median increases for the group of 11.1% in FEV<sub>1</sub> and 5.6% in FVC, again with approximately one-third of the group deteriorating and one-half improving.

Intravenous antibiotic use also

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decreased. Almost all of the children (89%), including those with a fall in lung function, described subjective improvement and an increased ease of sputum expectoration while on dornase alfa. No predictive markers at baseline indicated a good response to the drug. However, a positive correlation existed between lung function response at three months and lung function response at six, nine, and twelve months. The conclusion stated that children respond to dornase alfa at least as well as adults, and a therapeutic trial is justified in those over five years of age with significantly impaired lung function. Davies, et. al. stated that response is highly variable, making careful individual assessment mandatory. The conclusion also mentioned that baseline characteristics are not useful in predicting who will respond well to treatment, but long-term response to the drug can be predicted on the basis of spirometry improvements at three months.<sup>3</sup>

Dornase alfa has been approved for clinical use for over five years. A large number of cystic fibrosis patients with varying severity of disease are currently receiving this drug. Many patients report decreased cough, easier expectoration of sputum, fewer pulmonary exacerbations, and an overall improved sense of well-being while receiving dornase alfa therapy.<sup>3,5,6</sup> Although dornase alfa seems to have many beneficial effects on pulmonary symptoms associated with cystic fibrosis, whether or not treatment with this inhaled drug will have a positive impact in the long-term course of the disease remains unclear.<sup>8</sup>

Not only do excessive amounts of DNA from degenerating host neutrophils play a pivotal role in the retention of viscous secretions in cystic fibrosis patients, but so does the dehydration of these secretions, which impairs mucociliary clearance. Several approaches have been taken to correct the disordered electrolyte and water content of the airway surface liquid in cystic fibrosis. A defect in the control of chloride ion channels on the apical surface of the respiratory epithelium results in reduced chloride secretion and excessive absorption of sodium and water from the airway surface.<sup>4</sup>

Hypertonic saline is administered to rehydrate secretions in cystic fibrosis patients. When applied to the surface of the respiratory epithelium, hypertonic saline increases the amount of sodium

and chloride ions in the airway surface liquid. As a result, the osmotic gradient is increased and water is pulled back onto the airway surface, rehydrating the periciliary fluid.<sup>4</sup>

A prospective, open-label, placebo-controlled parallel group trial with 52 cystic fibrosis patients was performed by Eng, et. al.<sup>4</sup> Children age seven years and older, and adults who had clinically stable lung disease (FEV<sub>1</sub> between 30% and 70% of predicted), were enrolled in the study. Further inclusion criteria were the ability to perform reproducible pulmonary function tests, persistent cough with daily sputum production, regular performance of chest physiotherapy at home, and a stable medication regimen for at least 14 days. Using random tables, eligible patients were selected to receive 10 ml of either normal isotonic saline (0.9%) or hypertonic saline (6.0%). Ultrasonically nebulized hypertonic saline was inhaled twice daily for two weeks. Before saline administration, 600 µ of albuterol from a metered dose inhaler via a large volume spacer were given to prevent bronchospasm. All patients were evaluated at baseline, on day 14 following the two weeks of therapy, and on day 28 after two weeks off therapy, via spirometry and to assess cystic fibrosis related symptoms.

After two weeks of administration of nebulized hypertonic saline, pulmonary function improved. There was a mean increase in FEV<sub>1</sub> of 15.0% in the hypertonic saline group compared with a 2.8% mean increase in the isotonic saline group. On day 28, two weeks after discontinuation of saline administration, the mean FEV<sub>1</sub> returned to baseline, with no difference between groups. The effect of hypertonic saline on changes in FVC was smaller than the effect on FEV<sub>1</sub>. At the end of 14 days of hypertonic saline therapy, a mean rise in FVC of 8.0% occurred in the treatment group compared with a 2.6% increase in the control group. On day 28 the FVC had returned to baseline in both groups.

The patients reported a subjective improvement in the effectiveness of chest physiotherapy after hypertonic saline inhalation. The administration of hypertonic saline significantly improved the quality of sleep and exercise tolerance. Hypertonic saline also improved the effectiveness of cough, both as a protussive agent and by eliciting a change in mucus factors.<sup>4</sup> Sputum expectoration approximately doubled when ultrasoni-

cally nebulized hypertonic saline was inhaled before chest physiotherapy as compared to isotonic saline. Since hypertonic saline is known to induce cough in some patients, the effect of cough alone on mucociliary clearance was also studied to eliminate a possible confounding effect. The difference between cough alone and hypertonic saline remained significant. The conclusion was that hypertonic saline is likely to change the osmolality of the airway surface liquid.<sup>4</sup> Over the two-week study period, Eng, et. al. reported that hypertonic saline was well tolerated. Approximately 30% of patients with cystic fibrosis who have asthma-like symptoms will develop bronchoconstriction following inhalation of hyperosmolar saline.<sup>4</sup> Administration of 600 µ of albuterol prior to saline inhalation was effective in preventing significant bronchospasm in this study.

Robinson, et. al. studied the effects of increasing doses of hypertonic saline on mucociliary clearance in patients with cystic fibrosis. The study concluded that there was a significant increase in the amount of secretions cleared from the airways with differing concentrations of hypertonic saline compared with control.<sup>10</sup> In a study of 10 patients, mucociliary clearance was measured using a radioaerosol technique for 90 minutes. Interventions were comprised of 5 mg of albuterol in 2.5 ml of saline with the following concentrations: 0.9% NaCl with voluntary cough (the control), 3.0% NaCl, 7.0% NaCl, and 12% NaCl. A significant increase in the amount of secretions cleared from the lungs occurred with all concentrations of hypertonic saline compared with the control. The amount cleared at 90 minutes on the control day was 12.7% compared with 19.7% for 3% hypertonic saline, 23.8% for 7% hypertonic saline, and 26.0% for 12% hypertonic saline.<sup>10</sup> The improvement in mucociliary clearance was not solely caused by coughing, as the number of coughs recorded on the control day exceeded the record on days when hypertonic saline was received. Robinson, et. al. stated that within the concentrations examined in this study, the effect of hypertonic saline appears to be dose-dependent. Inhalation of hypertonic saline remains a potential useful treatment for patients with cystic fibrosis. Other potential benefits of hypertonic saline are the topical antibacterial effects,

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which are well established.<sup>4</sup>

Dornase alfa is now being used as an adjunct to standard therapy for cystic fibrosis patients and has been shown to improve lung function in both short- and long-term studies.<sup>4</sup> The results from studies using dornase alfa are not unlike the results from studies using hypertonic

saline. Similar study designs using hypertonic saline and dornase alfa both resulted in mean increases in FEV<sub>1</sub> of about 13% and mean increases in FVC of about 7%, both of which returned to baseline two weeks after terminating therapy. Subjective improvements, although difficult to measure, were similarly observed with both forms of therapy. Similar concerns were expressed in many studies regarding

the cost-effectiveness of dornase alfa.<sup>3,4,5,6,8</sup> The cost of dornase alfa therapy is approximately \$10,000 per annum compared to approximately \$450 per annum for hypertonic saline therapy. Determining if hypertonic saline can provide a lower cost alternative while achieving similar long-term results remains a question. ■

**TABLE 1. Summary of Clinical Trials**

Reference	Treatment dosage/frequency	Change in <sup>a</sup> FEV <sub>1</sub>	Change in <sup>b</sup> FVC	Subjective change	Duration of trial
Davies, et. al. <sup>3</sup>	dornase alfa 2.5mg/ qd	+14.2%	+7%	improvement	4 months
Eng, et. al. <sup>4</sup>	6% NaCl/600mg Albuterol 10 ml/bid	+15%	+8%	improvement	2 weeks
Cramer <sup>5</sup>	dornase alfa 2.5mg/bid	+13.5%	+7.2%	improvement	10 days
Kanga <sup>6</sup>	dornase alfa 2.5mg/qd	+9.4%	+12.4%	improvement	12 weeks
Bush <sup>7</sup>	dornase alfa 2.5mg/bid	NA	+20%	improvement	1 year
Eisenberg, et. al. <sup>9</sup>	dornase alfa 10mg/bid	+9.1%	+5.1%	improvement	14 days

<sup>a</sup>FEV<sub>1</sub> = forced expiratory volume in 1 second expressed as a mean % change from baseline.

<sup>b</sup>FVC = forced vital capacity expressed as a mean % change from baseline.

+ = indicates an increase in % above baseline

NA= specific % was not available

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## Submission Guidelines for Bulletin Articles

All section members are encouraged to share information about their programs through articles in the *Bulletin*. Here are our guidelines for submission:

**Article length:** *Bulletin* articles may be between 500 and 1,000 words.

**Format:** In addition to a paper copy, all articles must be submitted on a 3 1/2 inch floppy disk saved in Microsoft Word or TEXT ONLY (ASCII) formats, or e-mailed to the editor in one of those

formats.

**Deadlines:** All articles must be submitted to the editor according to the following schedule of deadlines—

- Jan.-Feb.: December 1
- Mar.-April: February 1
- May-June: April 1
- July-Aug.: June 1
- Sept.-Oct.: August 1
- Nov.-Dec.: October 1

**Article Review:** All authors may

review a copy of their article before it goes to press. If you would like to review a copy of your article, please include a FAX number when you submit it to the editor. It is the responsibility of the author to: 1) request the opportunity to review the article before it goes to press, and 2) contact the editor by the stated deadline if any changes need to be made before the article goes to press. ■

