HEALTH HAZARDS AND THEIR MEASUREMENT

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INTRODUCTION

Thank you for allowing me to be here again. The subject is the same, there's more emphasis on it, more people are showing concern, and more emotional reactions become evident; more scientific evidence is pointing out that all of us must use due respect in our efforts to maintain a safe and healthy place to work.

It would seem that it would be difficult to find 'new' hazards associated with the regular chemicals that are in our industrial environment. To some extent, this is true. We still have not been able to correct or control the old diseases. And, now we find new illnesses associated with the old chemicals.

What is really new, is the emphasis and the recognition that many of the older chemicals do have more hazardous and toxic effects than we previously realized.

Our emphasis is now on the suspected cancer causing agents, for example.....

For most of the occupational diseases that we recognize today, there is a cause and some effect consequence. This effect is usually singular, that is, a one type response. These responses have, over the years, resulted in the development of Threshold Limit Values (TLVs). These values are acceptable level limits for workers who are exposed for an 8-hour work day, each day. There are TLVs for over 400 compounds and new ones are being developed

each year plus some of the old ones are being revised as we determine the effects of over exposure and establish safe or "no effect" levels.

However, exposure to only one type of toxic material in the work place is more the exception than the rule. Exposure to several compounds is probably the more common phenomenon in industry. There may be a synergism of two chemicals. For instance, benzene exposures may be enhanced (more toxic) if toluene is in the same atmosphere. Exposure to lead fumes is serious enough, but it should be remembered that lead almost always has arsenic or cadmium as a contaminant. Both of these elements are very toxic materials. If this combination is inhaled, a most toxic effect can result; the toxic effects have been compounded.

If we examine the various dusts such as silica, we find situations where there are both asbestos fibers and silica in the same work environment. While there may be a lower safety limit for free silica exposure, the limit for safe exposure to asbestos is not really known. It is possible that there is no safe level.

Complicating an already complex matter is the simple fact that the particle size of any of the inhaled vapors or dusts may alter the effects. Depending upon how far into the lungs the material can penetrate, will depend the response.

The multiple effects of singular materials is well known; asbestos can cause pulmonary fibrosis as well as cancer of the lung, larnyx, stomach, etc. Radiation poisoning may produce blood anemias, fibrosis, and cancer. Vinyl chloride had been known to cause bone

degeneration (acroosteolysis) in the hands; and now, we see even more severe cancer manifestations.

Biological factors often influence the pathogenesis of diseases. Alpha-antitrypsin deficiency has been associated with some forms of emphysema. It has now been proposed that genetic defects may be the cause of some lung cancer response while not affecting others. Individual susceptibility along with industrial exposure may be a large factor in understanding why some people get a disease and others do not.

You have, in your body, an immunological surveillance factor - whereby abnormal cellular tissue are destroyed or kept in abeyance. It is estimated that 3-4 million cells are produced each day in our bodies. Of these, 1-2 million cells could be abnormal, cancer prone, tumorogenic. As long as immunological factors are high, these cells are destroyed.

If some toxicants cause a suppression of this factor, there is greater risk that some cancerous cells may take hold and grow.

Outside factors or exposures or employee habits coupled with industrial exposures cause interactions which can be fatal. The use of carbon tetrachloride and drinking alcohol may increase the severity rate of developing hepatic cirrhosis. Inhalation of isopropyl alcohol along with drinking ethyl alcohol can cause severe narcosis. Isopropyl alcohol is excreted as acetone which has narcotic-like effects. IPA is used by nurses, masseurs, doctors and athletic clubs. We know very little about such phenomena, but we are learning.

The use of chemicals that produce urethane foams such as tolylene diisocyanate (TDI) have been known to cause sensitization in

some people. The indications are now that there may be other materials in the work atmosphere which are necessary to create this sensitization reaction. In other words, two compounds are necessary before effects are seen.

All of the common chlorinated solvents are under heavy suspicion regarding their effects on human health. Under the correct conditions, they can breakdown to form phosgene, vinyl chloride, ethylene dichloride, allyl chloride, and a host of other chlor-compounds, all of which have very low exposure level limits compared to the original parent compound. Where the worker smokes on the job, small amounts of solvents or metal vapors drawn in through the cigarette can be converted to extremely toxic compounds. In some instances, cancer has been linked to chloro-hydrocarbon exposures. As simple a job as walk in cooler 'repairs' can be hazardous. Freon leak-detection, using a leak (Halide meter) detector, may cause development of HCl and HF in air - very irritating gases.

Again, venturing into coolers without forwarning of leakage may be fatal - asphyxiants - Freon, CO_2.

Welders Rods of Tungsten - Carbide use Binders of Cobalt.

Cobalt fumes cause their own peculiar pneumoconiosis.

Feto-toxins

We could discuss many toxic materials and their effects on the workers. All of our standards are based on the adult worker. All have been based, in fact, on the adult, male worker. Our socio-economic climate has and is changing rapidly. We now have the rightful obligation to offer equal employment opportunities to all

people including, of course, females and persons who are handicapped. It is now established that the female adult has the guaranteed right to work anywhere that the male adult can work. In most instances, this does not present undue problems.

Problems do arise if the female worker becomes pregnant. Many of the compounds that are used in industry are known to be feto-toxins. That is, at some level, they may cause mutagenic (genetic changes), teratogenic (abnormal tissues), or carcinogenic (cancer) effects to the unborn child. We do not know what the level is, thereby, placing an extreme burden on industry to either take the risks or to remove the female during the first trimester of pregnancy. Of course, the major problem is, the mother-to-be may not know she is pregnant.

We have gathered a list of compounds from the literature which have been reported to be feto-toxic. It is long, yet we do not know the precise levels which produce the adverse effects. We may never know. The risks appear to be greater the more we learn. Even noise may cause abortion in some females. There are new areas of concern constantly being discovered. Known causes are being reviewed and better techniques and approaches to these problems are being developed.

Lead has been shown to cause chromosomal breaks in male germ cells, therefore, is being considered a teratogenic and mutagenic material. Trivalent chromium salts are being linked to cancer similar to hexalent chromium.

In addition to feto-toxicity, all of our standards are based upon eight hours of exposure, five days per week. This allows for

the 16 hours off the job, which is considered as time to clear the body of poisons and to return to normal. Unvortunately, many of our workers are now working double shifts, 16 hours of exposure, back to back. This is bad enough from a safety standpoint with reduced efficiency and increased accident rates; but the exposure levels have also indirectly increased by a factor of 2. This means that the overall exposure must be reduced by a factor of 3-4. For example, toluene at 100 ppm TLV, must be reduced to 25-30 ppm and not exceeded.

Biological Measurements

Since we are discussing hazards and measurements, it is only fitting we discuss measuring the biological system also. A close working relationship is necessary between the industrial physician and the industrial hygienist to obtain accurate results from this type measurement.

A number of biological tests can be done which are indicative of the person's health and the effects of exposure, long before we see signs of any outward manifestations. Obviously, if an employee comes down with lead poisoning, or mercurialism, or a pneumonconiosis, it is too late. What we want to detect is extremely subtle changes. Changes which are not harmful to the individual, but which do tell us that some exposure has taken place and it is at a level which shows a biological response.

Electromyographic Measurements

If a chemical is known to affect the nervous system in some way, at some exposure level, this detection can be made where the

exposure is very low. For example, we know that elemental mercury can affect the central nervous system. What we do not know is at what level we begin to see this. How much exposure can an individual be subjected to without a manifestation, and are the present Threshold guides correct?

Electromyographic measurements are taken by having the exposed worker lift a standard 15 lb. weight while sitting down and having electrodes attached to the muscles of his arm. Specific nerve impulses are generated and recorded on a tape. These tapes are fed into a computer and compared to other individuals of similar character with the exception of the exposure to mercury. Any differences are indicative of a positive response to mercury.

Along with this test, several agility tests are conducted to note the dexterity of the worker. Both blood and urine samples are also analyzed for mercury. When the total picture is put together, and all data analyzed, we can see any very minor neurological changes which might take place at a given exposure level.

This type testing is now being considered for lead exposure, CS_2 exposures, and possibly other areas where central nervous system involvement is indicated.

Respiratory Function Study

A great many of the materials used in the chemical industry affect the lungs in some way. Ammonia, chlorine, TDI, solvents, many dusts, epoxy resins, amines, etc. all cause some difficulty in some people. But just who these people are and when they complain, is it real, is not easy to determine. Some people are

allergic to many materials.

As a routine test, all new employees should be given a respiratory function test to determine the character of their lung capacity and vital capacity as a part of pre-employment physical examination. This test should be given annually for those who work in suspected areas. Many gases cause irritation to the respiratory tract and result in difficult breathing. This in turn can affect the heart, causing it to work harder.

These tests are simple and should be done routinely.

Stress EKG

We recognize that heart disease is still the greatest incapacitator to all people. Normally, people having physical examinations are given what is called a resting EKG. This is fine - if all you do is rest.

The newest concept is to test the heart under measured, controlled stress. The inclined walking tread is one way. This gives a measure of strain resistance the heart can take. It will show quickly if there is the slightest deviation from the normal rhythm.

With this type of physical examination, specific heart problems can be detected and safeguard the health of the employee.

SMA-12

Blood tests - specific, for detecting the subtle changes reflected in early cancer, liver diseases, heart abnormalities, are recommended for industrial workers at least once each year.

Hospitals are industries which are not a great deal different than many factories...only the products are different.

One of the more common hazards to nurses is the exposure to anesthetics in operating rooms. In Michigan, 33 nurses/600 showed malignancies, three times the normal rate. The American Society of Anesthesiologists has reported that their members have experienced 1.3 to 2.0 times over the normal spontaneous abortion rate. Generally, the problem is that the gases are vented into the operating room and inhaled for long periods of time.

Certain nitrosamines are regarded as potent carcinogenic agents. Recently it was reported that some of these nitrosamines have been found in cutting oils. If there are ethanolamines and nitrates added to the oils, there is a possibility that nitrosamine type compounds will form. Many of our industries are presently screening all cutting oils, bluing agents, and certain pesticides for nitrosamine chemicals.

Some chemicals, when spilled into the environment, may undergo bio-transformation and possibly become more harmful. We are not sure, but are highly suspicious of nitro-toluenes being converted by soil bacteria to Di-amines which in some instances have been shown to be cancer causing agents.

Slides

- What I'm showing is only TYPICAL.

- There is no endorsement; we've tried them all. There are new ones every week.

- Some can be made; others purchased.

- The displays show several types.

I show these for two reasons:

1) For you to control any hazardous condition - you must:

   A. RECOGNIZE IT.

   B. MEASURE IT.

   The concentration must be known. Instruments and techniques are needed.

2) To develop a Base of Data for protection against unfounded liability claims. Negative Data, the basis for all sampling - to prove that the area in question is a safe place to work - and over the years has been so.

Let me warn you - to collect data is one thing - to interpret it is another.

After Slides:

Every industry today must recognize that they have a product stewardship responsibility. A philosophy whereby every company that produces an item, bar none, must be sure that their customer is using that product safely; that all proper warnings are given, that their salesman does tell the customer all about the material, (i.e., whether they must use it with ventilation,) use safety equipment, and must provide a product data manual which is totally complete.

And it follows, that if your company contracts out to other companies to have chemicals, materials, or intermediates made for you to be used under your company label, that that company makes

the product under the same conditions your company uses. If not - no contract. This is third party liability.

Finally, I would suggest to you that worker health and safety cannot be left alone to the specialists. While the specialists are necessary, there is also a demand for individuals who are trained in the broad terms of the art or science of occupational health.

Every work place is unique, unprecedented, and unrepeatable. It follows that our testing and measuring procedures may need to be unique and not necessarily fall into a standard pattern. We become complacent and secure, feeling that what we do is the only way to do it because we have always done it that way.

In 1970, Willard Wirtz, then the Secretary of Labor in the United States predicted, "as knowledge expands, more diseases will be traced to the workplace!!"

And so it is.

LAK/jac