# Environmental Exposure and the Toxicity of Metals,

# The South African vs Global problems

By

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**Introduction:**

South Africa, known throughout the world as a treasure trove, boasts an abundance of mineral resources, producing and owning a significant proportion of the world's minerals. Nearly 90% of the platinum metals on Earth, 80% of the manganese, 73% of the chrome, 45% of the vanadium and 41% of the gold are found here, making South Africa a world leader in mining.

While mining produces precious and much wanted metals, it proportionally produces poisonous waste. Mining accidents have been noted throughout mining history, but recent accidents such as the October 2010 spill of toxic red sludge from an aluminum plant in western Hungary, have created general awareness of mining dangers and the toxicity of metals. South Africa experienced its own tragedies.

Until a decade ago, only occupational medicine concerned itself with mining disasters. Occupational physicians and toxicologists are trained to deal with acute cases of toxic exposure, but they are not trained to recognize cases of long term or chronic environmental exposure. In fact, occupational physicians have difficulties accepting that chronic exposure to relatively low amounts of toxins creates another category of health problems, namely the environmentally-caused chronic diseases. Globally, these are on the rise.

All metals are toxic in excess, and careful monitoring of metal exposure at an early stage can be used to prevent serious illness. Careful medical monitoring is essential in identifying the type of metal overexposure, which can allows the physician to provide the proper antidote treatment. Examples are the so-called nonresponsive cases of skin problems (atopic eczema), the so-called nonresponsive cases of neurological diseases such as autism and Parkinson.

**A theoretical foundation: Metal detoxification, also called chelation: the emerging treatment for metal-based chronic disease**

About a decade ago, a new category of physicians concerned itself with toxic metals as one cause of chronic disease. In Germany, clinical metal toxicology is part of the German health care system. While the country's social medical system remains reluctant to financially cover treatment for cases of chronic metal exposure, a heightened public awareness and dissatisfaction with the conventional insurance system is resulting in a fast-spreading acceptance of a most promising approach. At the 2010 medical conference in Baden-Baden, physicians of a wide variety of medical specialties (dermatologists, oncologists, radiologists etc.) attended presentations provided through the German Medical Association of Clinical Metal Toxicologists (KMT) and showed great interest in the detoxification approach. www.metallausleitung.de

On an international level, IBCMT (International Board of Clinical Metal Toxicology) is involved in teaching and certifying physicians and allied health care professionals in treating metal-based ailments. www.ibcmt.com

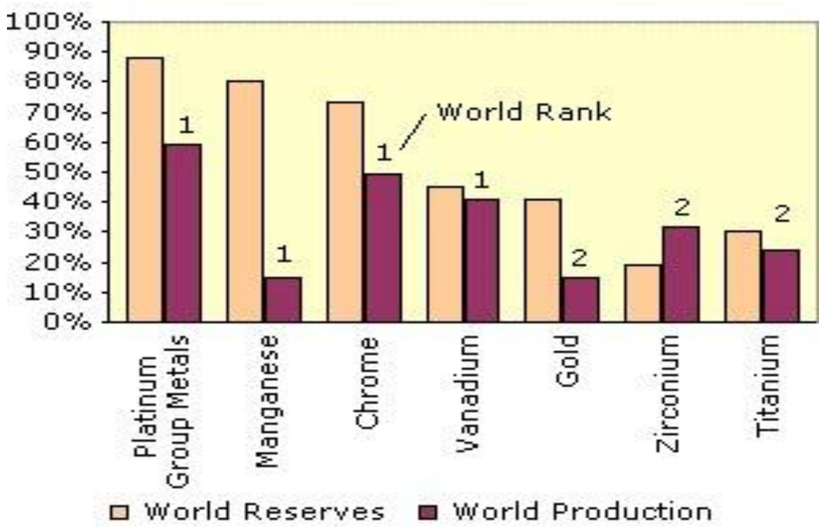
It is a model, South Africa could benefit from.

## 1. The Toxicity of Metals pertaining to South Africa

South Africa's economy had been shaped over several centuries by its abundant natural resources. For most of the twentieth century, its mineral wealth had surpassed that of almost any other country in the world, except the Soviet Union. South Africa produced nearly half of the world's gold and ranked among the top ten producers of a dozen other valuable minerals, including platinum, manganese, chromium, copper and gold. [1]

[1] The CIA World Factbook, U.S. Department of State, Area Handbook of the US Library of Congress

Table 1: Source: http://www.southafrica.info/business/economy/sectors/mining.htm




The mining industry has long provided the foundation for South Africa's economy and while mining produces financial gain, it also creates environmental issues, namely poisonous waste. A most recent reminder about the toxicity of mining waste is the October 2010 spill of toxic sludge from an aluminum plant in western Hungary. By October 15, 2010, the press reported that the incident killed at least eight people and seriously injured more than 150. [2] The death toll rose to at least nine, some may never be statistically mentioned.

Table 2: Source: www.enn.com/pollution

[2] guardian.co.uk, Tuesday 5 October 2010

About 35.3 million cubic feet of sludge, containing iron oxide, aluminum, silicon dioxide, calcium oxide, and titanium dioxide had leaked from the reservoir, seeping into an area spread over 16 square miles, according to the Hungarian Environmental Ministry. While the metals listed seem harmless, the waste, referred to as red mud, is also a mix of heavy metals such as cadmium, cobalt and lead, plus other processing chemicals. Costs are enormous: to the people who were evacuated and who may never be able to return, to the government which is expected to take care of the affected and to the mining company.[3]

South Africa had its own share of disaster. The 1960 Coalbrook disaster trapped 437 miners. Of those casualties, 417 succumbed to methane poisoning.[4] South Africa's mining history does not fall short of mining accidents. In 2007, 221 mineworkers died on South African mines, accounting for about four workers a week. This figure dropped to 165 by 2009, or just over three workers a week. Apparently, South Africa's deep gold mines are the most dangerous, mines in the North West are considered the deadliest.

Platinum mining had to deal with its own 2009 accident. The world's second-largest platinum producer, Impala Platinum (Implats) had to deal with the death of nine miners in an underground accident at its Rustenburg mine.[5]

Most reported mining accidents are physical in nature. Causes may be explosions or the collapse of shafts due to safety problems or other reasons. The resulting fatalities receive global attention and news coverage, but the spilling of mining waste into important waterways, the rising levels of toxin in grounds used agriculturally or the inhalation of industrially-caused metal fumes are rarely mentioned, even though excessive exposure of any kind is known to cause disease, even death.

[3] irishtimes.com Wednesday, October 13, 2010

[4] Int.J of Rock Mechanics & Mining Sciences 3(8) 1239-1246 (2000)

[5].miningweekly.com/article/south-africas-mining-fatalities-down-26-union-2010-10-04

## 2. Example: Manganese

Of the world reserves, nearly 80 percent is found in South Africa. Compared to world production, South Africa's production is around 60%. In 2009, South Africa produced 1,300,000 t of manganese ore, and prices are firm. [6]

The demand for manganese has not diminished. Manganese is needed to produce steel alloys to increase favorable characteristics such as strength, hardness and durability, hardened steel is important in the manufacture of construction materials like I-beams (24% of manganese consumption), machinery (14% of manganese consumption), and transportation (13% of manganese consumption).

Manganese dioxide is used to: manufacture ferroalloys; manufacture dry cell batteries (it's a depolarizer); to "decolorize" glass; to prepare some chemicals, like oxygen and chlorine; and to dry black paints. Manganese sulfate ($MnSO_4$) is used as a chemical intermediate and as a micronutrient in animal feeds and plant fertilizers. Manganese metal is used as a brick and ceramic colorant, in copper and aluminum alloys, and as a chemical oxidizer and catalyst. Potassium permanganate ($KMnO_4$) is used as a bactericide and algicide in water and wastewater treatment, and as an oxidant in organic chemical synthesis.

In minute amounts, manganese is important to human health. This trace mineral participates in many enzyme systems in the body, and was first considered an essential nutrient in 1931. Researchers discovered that experimental animals fed a diet deficient in manganese demonstrated poor growth and impaired reproduction. The human body contains a total of 15-20 milligrams of manganese, most of which is located in the bones, with the remainder found in the kidneys, liver, pancreas, pituitary glands, and adrenal glands and supplementation of manganese is rarely needed due to its widespread presence in food, particularly tea. Intoxication to an excessive dietary intake is rare, mostly limited to accidental intake but in 2000, the Institute of Medicine at the National

[6] mining-technology.com

Academy of Sciences established a Tolerable Upper Intake Levels (UL) for manganese between 2mg and 11mg, depending on age, sex and health status. [7,8,9]

In general, manganese toxicity is caused by excessive exposure in mining, ore extraction and other work involving industrial use of manganese.[10] Manganese poisoning among miners was reported as early as 1955, described as 'manganese madness', however the series of Couper's neurotoxicity case histories, apparently resulting from occupational manganese exposure, was documented as early as 1837.

Manganese overexposure symptoms were mental agitation, mood swings, followed by tremor and abnormal gait. [11],[12] The term 'Pseudo-Parkinson is now used for metal-based cases of Parkinson.

Most cases of Pseudo Parkinson are seen in industrial workers who are exposed to manganese dust. The 2007 University of Toronto study was the first in North America to draw a link between Parkinson Disease and manganese air pollution. The researchers suggested that industry-generated pollution posses a greater health risk than traffic-generated manganese.[13]

Worldwide, an estimated 10 million people are suffering from the disease. Parkinson incidence increases with age, but an estimated four percent of people with PD are diagnosed before the age of 50. Environmental factors are strong contributors.

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[7] Groff JL, Gropper SS, Hunt SM. Advanced Nutrition and Human Metabolism. West Publishing Company, New York, 1995 1995.

[8] Crowley JD, Traynor DA, Weatherburn DC. Enzymes and proteins containing manganese: an overview. Met Ions Biol Syst 2000;37:209-78.

[9] Institute of Medicine. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. National Academy Press: Washington DC, 2001.

[10] Keen CL, Ensunsa JL, Clegg MS. Manganese metabolism in animals and humans including the toxicity of manganese. Met Ions Biol Syst 2000;37:89-121.

[11] Statement from the Safety and Health Committee, Building and Construction Trades Department, AFL-CIO, no date

[12] Checkoway H. Documenting neurotoxicity from occupational manganese exposure, Occuo. Environ Med 2010; 67:362-363

[13] New-medical.net. 17 Jul 2007

South Africa and the USA report approximately the same number of Parkinson patients, namely over 1 million for each country. By comparison, the US population was estimated to be approximately 305 million in 2009, while South Africa's population was close to 50 million. In the United States alone, the combined direct and indirect cost for Parkinson patients, including treatment, social security payments and lost income from inability to work, is estimated to be nearly $25 billion per year. The Parkinson Foundation reported in 2010 that medication costs for an individual person with PD average $2,500 per annum, and therapeutic surgery can cost up to $100,000 dollars per patient.

A staggering amount, especially since manganese neurotoxicity is not included in the diagnosis or treatment of the disease. But University of Montréal researchers stated as early as 1997 that 'it is possible to detect early signs of neurotoxic function associated with environmental or occupational exposure to manganese.'[14]

It is easy to detect manganese overexposure at an early stage. Standard laboratory diagnostics include

- hair manganese analysis as a means to detect chronic overexposure
- blood analysis to detect immediate and acute manganese intoxication
- urine metal analysis to evaluate manganese excretion as a way to monitor detoxification treatments.

To reduce the manganese body burden is neither difficult nor costly. Antidote treatment is effective,[15] costing approximately US$150 per treatment. The number of treatments necessary is dictated by the severity of the intoxication.

## 3. The Governmental Dichotomy of Water Safety

When monitoring metal exposure, it is important to discuss water safety. Drinking water, if not regulated, can contribute to an already existing body burden and what is considered safe in one country may not be in another.

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[14] Mergler D., Baldwin M. Early manifestations of manganese neurotoxicity in humans: an update. Environ.Res 1997; 73(1-2):92-100

[15] Blaurock-Busch E. Toxic Metals and Antidotes. The Chelation Handbook. MTM 2010

Examples:

**Manganese Maximum Allowed Level (MAL) in Drinking Water**

Germany: <50mcg/l

South Africa: <100mcg/L

Also allowed is a MAL for limited duration): 100-1000mcg/L

USA: < 50mcg/L

**Iron Maximum Allowed Level (MAL) in Drinking Water**

Germany: <200mcg/l

South Africa: <200mcg/L

Also allowed is a MAL for limited duration): 200-2000mcg/L

USA: 300mcg/L

**Mercury Maximum Allowed Level (MAL) in Drinking Water**

Germany: <1mcg/l

South Africa: ??? (the author could not locate appropriate information)

USA: <2mcg/L

The data indicates that water safety is more strictly regulated in countries such as Germany where environmental exposure is a comparatively low threat to human health. [16] [17]

## 4. Gold Mining and the Mercury Connection

South Africa's gold mining history dates back into the late 1800s and until 2007, South Africa was the largest producer of gold. It is now second after China. In 1952, South Africa with the West Rand Consolidated mine scored another first, the extraction of uranium as a byproduct of the gold refining process.

Gold mining produces wealth for those in charge and toxic waste for the immediate environment. To capture gold, mercury has been, and still is used to capture or 'wash' gold

[16] Trinkwasserverordnung Umweltbundesamt 2010

[17] EPA, Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals, July 1992

particle. It is a practice dating back to 50AD where fine gold particles were extracted through heating or burning of the amalgam, resulting in high mercury emissions to the atmosphere. Asia, South Africa and South America have used this procedure.[18]

## 5. The Buyat Bay Tragedy

Mining companies are not necessarily cautious when dumping waste. The Buyat Bay tragedy of North Sulawesi, Indonesia is a reminder. In 2005, the author was invited to speak at the conference on *Mining, Environment, and Sustainable Development- A lesson from the gold mining controversy in Buyat Bay, North Sulawesi*. The conference was organized by the Sam Ratulangi University (UNSRAT) and sponsored in part by Newmont Mining, the company who was considered responsible for the Buyat Bay tragedy. Newmont was being sued by the Indonesian government for allegedly polluting the bay, which caused various diseases in the 220 villagers of that tiny town near the mining area and bay. After the conference and after a public outcry, the author was asked to provide a proposal for an *International Pilot Program to Biomonitor And Effectively Remove the Heavy Metal Burden of the Mercury- and Arsenic Intoxicated People* of Buyat Bay.

The author complied. The proposal was presented October 12, 2005. It involved toxicology specialists from various countries, included laboratory testing, antidote treatment and orthomolecular supplementation and the presence of medical doctors who would have been in charge of the proposed 12 week treatment. The proposed cost was €660 per person.

In the end, the Indonesian government agreed to drop the suit against Newmont Mining in return for the company funding a scientific, monitoring program at Buyat Bay. Newmont Mining paid 12 million US dollars to cover the initial cost and another 18 million US$ to fund an environmental program. [19]

The proposal for the detoxification program was acknowledged and at length discussed. No more.

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[18] Malm O. Gold Mining as a Source of Mercury Exposure in the Brazilian Amazon. Environ 1998: Section A, 73-78

[19] Newmont reaches $30 pollution agreement. Metal Bulletin Daily. 16Feb2006

## 6. The toxicity of Mercury

Mercury's neurotoxicity is medically known and acknowledged. Central nervous disorders linked to mercury exposure include Autism; among those less known to be caused by a mercury burden are sleeping disorders, headaches and migraines. In the Amazon Basin where gold mining is part of the people's daily life, hair mercury concentrations of children living in various areas showed mercury concentrations above 10mcg/g, a limit which is known to affect development. A level of 10mcg/g exceeds the maximum allowed German hair reference range 20 times! The researchers conducting the evaluation concluded that 'the current mercury pollution seems sufficiently severe to cause adverse effects on brain development."[20]

Autoimmune disorders such as Hashimoto/Thyroiditis are also linked to mercury intoxication. In South Africa, about 240,000 people may be affected. [21] Mercury as a cause of skin problems and the increasing prevalence of atopic eczema has been confirmed.

Photo 1: Adult Dermatitis. Courtesy Dr. Lam, Hong Kong


[20] Grandjean P. White RF, Nelsen A, Cleary D, deOliveira Santos EC. Methylmercury neurotoxicity in Amazonian children downstream from gold mining. Environm Health Perspect, 1999 Jul; 107(7):581-91

[21] US Census Bureau, International Data Base, 2004

In the Journal of Allergy and Clinical Immunology, researchers linked the body burden of mercury of children living in southern Germany to acute atopic eczema, a rising pediatric problem. They also noted a high IgE response, meaning the mercury-burdened children do not just experience skin reactions, they also react immunologically.[22] The long term affect of this problem is unknown as of yet.

The Hong Kong population is experiencing a sharp increase in allergies and skin problems. The Hong Kong Medical Journal published in 2009 a not so unusual case study of an infant. The examination showed a thin and irritable infant with a nonspecific rash that covered its entire body, swollen extremities and disfigured fingernails. Blood and urine testing indicated mercury intoxication. The cause was soon found: a mercury-containing Chinese home remedy that was given to the child for 4-months, resulting in mercury intoxication. This case documents that herbs grown in toxic soil pose a growing danger.[23]

Dr. Lillian Ko, a Hong Kong pediatrician and Clinical Metal Toxicologist, treats children affected by atopic eczema and neurological disorders. One such case was a three months old infant suffering from severe skin and behavioral problems. Laboratory diagnostic of both, mother and child, demonstrated high mercury and nickel exposure. Hair values were 4.2mcg/g for the mother and 3.1mcg/g for the child compared to a maximum allowed value of 0.4mcg/g. Blood values were 80nmol for the mother and 65nmol for the 3-month old child, compared to a maximum allowed range of 45nmol/L. The mother's fish consume during pregnancy and during the nursing period was the cause. The child was fully nursed! Nickel levels were elevated as well.

Detoxification treatment was simple, yet effective. It involved a dietary change i.e. no fish consumption for the mother plus the provision of simple nutrients for mother and child such as antioxidants plus the supplementation of balancing trace elements in age-appropriate amounts.

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[22] Weidinger S, Krämer U, Dunemann I, Möhrenschläger M, Ring J, Behrend H. Body Burden of Mercury is associated with acute atopic eczema and total IgE in children from southern Germany. J Allergy Clin Immunol 2004 Aug, 114(2);457-9

[23] Koh C. Kwong KL. Wong SN: A Case Report of Mercury Poisoning: a rare but treatable cause of failure to thrive and developmental regression in an infant. Hong Kong Med J. Feb 2009

Photo 2+3: Juvenile atopic eczma,  before treatment. Courtesy of Dr. Lillian Ko, MD, CMT


Photo 4+5 : Juvenile atopic eczma, after  treatment:. Courtesy of Dr. Lillian Ko, MD, CMT

## 7. Single Metal Exposure extremely rare in the chronically exposed

Single metal exposure is extremely rare in the environmentally and chronically exposed. Dr. Ko's case is only one to demonstrate that fact. In most countries, clinical medical laboratories follow doctors' request for the analysis of the *one suspected toxin*, usually lead or mercury. Due to the author's research involvement, Micro Trace Minerals Laboratory (MTM) of Germany nearly always tests the full metal spectrum, even though the submitting physician may receive only the requested value (and only pays for that one test ordered). MTM does not shy away from the great expense involved in multi elemental analysis. It is the author's experience that patients are rarely exposed to one element only, but if the submitting doctor chooses the 'wrong' element, the patient's treatment (or lack thereof) will not be a success.

Multiple toxicities are the rule rather than the exception in the chronically exposed. By identifying the type(s) of metal exposure, the physician can select the appropriate treatment. This alone improves treatment success.[24]

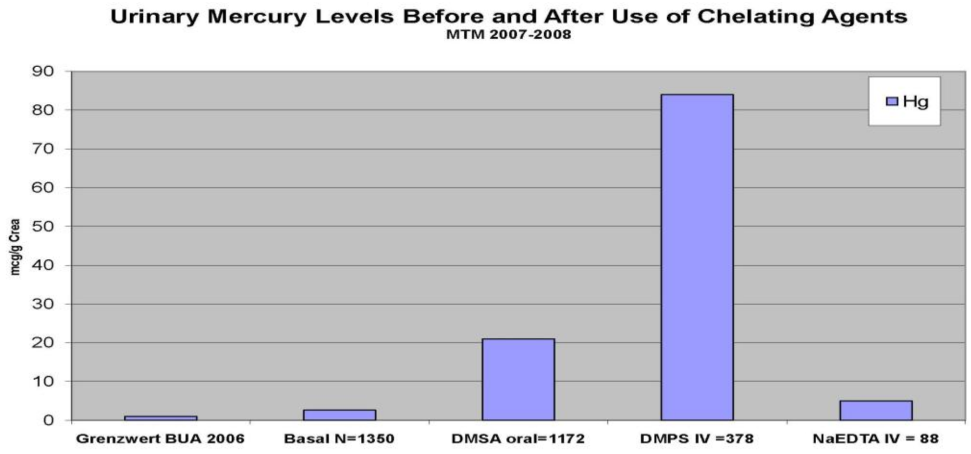
## 8. The Biochemical and Medical Answer

Globally, our environment and all life on this planet will continue to be threatened by the rising pollution humans create. Through proper diagnosis, we can identify toxins, which in turn allows the correct selection of detoxification treatments.

Chelation is nothing more than the forced binding of metals. We can force the body to eliminate toxins by using synthetic antidotes or nutrients such as the SH-containing amino acids Cysteine or Methionine, which have the ability to bind metals such as mercury. Synthetic antidotes act on the sample principle as DMSA (Dimercaptosuccinic acid) or DMPS (2-3-dimercapto-1-propanesulfonic-acid) which also forces metal binding through SH- or thiol groups. All thiol groups have a good binding affinity with metals such as mercury.

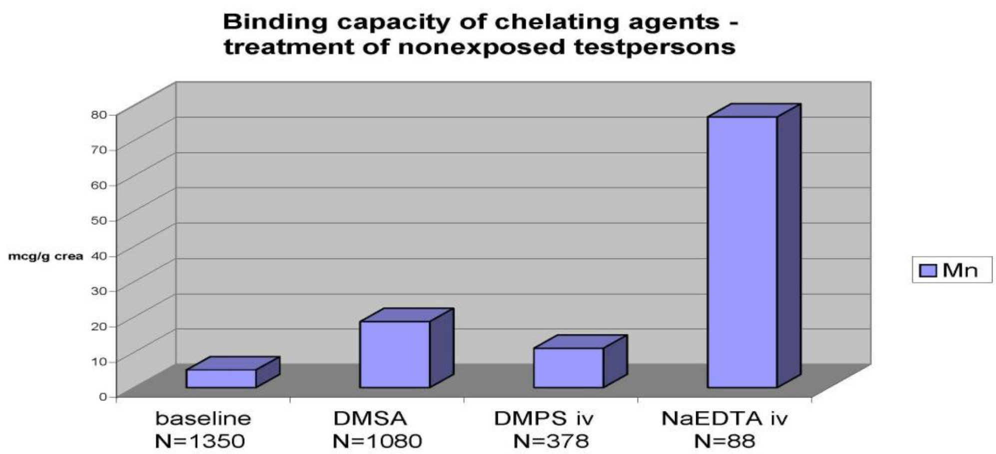
[24] Blaurock-Busch E. Metal Toxicity and Antidotes: The Chelation Handbook. MTM 2010

See Table 4. Source: MTM Database 2007-2008




We can also utilize antidotes with carboxyl groups such as EDTA, known to bind lead, cadmium, iron and manganese, among others.

Table 5: Source: MTM Database 2007-2008



It should be noted that Table 5 and 6 are based on the statistical evaluation (95percentile) of so-called non exposed people. The statistics clearly indicate that EDTA is suitable to detoxify manganese, whereas DMPS is best used for mercury. These MTM statistics support information as provided by the German Poison Centers, GIZ Nord.

Poison centers around the world are concerned about the use of antidotes in acute cases of intoxication. The following table shows a list of antidotes as approved and provided by German poison centers.

Table 6: Courtesy of the GIZ Nord (Giftinformationszentrum Nord)

| **German Official Antidota List (Synonym, Products)** | **Indication (appreviated information)** |
|---|---|
| **Aktive charcoal** (Carbo medicinalis) | important for decontamination of intestinal tract with non specific binding of organic and inorganic toxins. Recommended oral use: 1g/kg body weight in approx 200ml fluid. |
| **Ca-EDTA**<br>Calcium-disodium-EDTA, Calcium-edetat-Sodium | Lead, Chromium, Cobalt, Vanadium, Zinc, Cadmium, radioactive Metals |
| **Ca-DTPA**<br>Calcium-Trisodium-DTPA; Ditripentate, | Decorporation of Cadmium, Lead, Zinc, Iron (also for Haemochromatosis), Manganese, Chromium, Plutonium u.a. radioactive Metals |
| **Deferoxaminmethansulfonate**<br>(Desferal®); Desferrioxamin-B-mesylate | Iron and Haemochromatosis<br>Aluminium (Dialysis patients) |
| *Dimercaptoprol (BAL, British Anti-Lewisite, Sulfactin)* | ***Obsolete Chelating Agent.*** |
| **DMPS**<br>Dimercaptopropansulfonic acid, Dimaval®<br>Na-(2,3)-dimercaptopropan(1)-sulfonate, Sulfactin | many heavy metal compounds. For example lead, organic und inorganic mercury and arsenic |
| **DMSA**<br>Dimercaptosuccinic acid; Succimer | Lead, Mercury, Arsenic and other metals |
| **Na-EDTA**<br>(Ethylendiamintetraacetic acid), Na-EDTA (GPU Pharma) | Lead, Calcium, Iron and other metals |
| **Iron(III)-hexacyanoferrat(II)**<br>(Berliner Blau, Antidotum Thallii Heyl®); Radiogardase-Cs Heyl® | Thallium, Cesium |
| ***D*-Penicillamin** | Copper, Lead, Mercury, Zinc, Gold, Cobalt. Due to side effects, used only when other chelating agents are not an option |
| **Zn-DTPA**<br>Trisodium-Zinc-diethylen triamin pentaacetate, DTPA-Zinc-Sodiumsalt | Like Ca-DTPA |

Poison centers are not set up to provide diagnostic or treatment information for chronic metal exposure, however the chelating agent approved for an acute mercury intoxication is equally suitable for a case of chronic intoxication. What differs is the application and protocol. Obviously, an emergency case requires a more aggressive approach than a chronic case.

Again, the selection of the appropriate chelating agent depends on the diagnosis. As Table 7 indicates not every antidote is suitable for the detoxification of every metal, although some antidotes have a wider range of application than others.

To select the proper antidote, we depend on laboratory diagnostics, and the interpretation thereof.

For instance, we can monitor chronic metal exposure through hair mineral analysis. Saner researched and published information on hair manganese values in infant born with congenital malformations as early as 1985.[25] More recent research supports the validity of this often misunderstood test.[26],[27], [28] While hair metal analysis monitors a patient's past metal exposure, it does not provide information as to the present situation. If we want to evaluate a patient's immediate exposure, blood metal analysis is the test of choice.[29] Vice versa, a blood test will not tell us anything about a metal exposure that happened 6 months ago. Hair does.

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[25] Saner G, Dagoglu T, Özden T. Hair manganese concentrations in newborn and their mothers. The American J Clin Nutr. Vol 41, 1985: 1042-1044

[26] Razagui I.B-A.; Haswell S.J.Mercury and Selenium Concentrations in Maternal and Neonatal Scalp Hair: Relationship to Amalgam-Based Dental Treatment Received During Pregnancy Biological Trace Element Research, Volume 81, Nr1, July 2001 , pp. 1-19(19)

[27] Degner D, S. Bleich, A. Riegel, R. Sprung, W. Poser, E. Rüther. **Verlaufsbeobachtung nach enteraler Manganintoxikation.** Klinische, laborchemische und neuroradiologische Befunde. Der Nervenarzt. Vol.71, Nr 5, 2000: 416-419

[28] Shamberger RJ. Validity of hair mineral testing. Biol Trace Elem Res. 2002;87(1-3):1-28.

[29] Blaurock-Busch E. Blood Metal Analysis to Biomonitor and Diagnose Acute vs Chronic Metal Intoxication. Townsend Newsletter f. Doctors, 2009.

If we want to monitor the body's ability to detoxify and how efficient a detoxification treatment is, urine testing is considered best.[30]

**Summary:**

The US consensus bureau estimates that at present, the world population nears 7 billion people. South Africa's population is estimated to be near 50 million people. In 2015, South Africa will house about 53 million, and in 2020, the population will approach the 57million mark. Pollution will rise accordingly. Environmental problems including mining disasters are likely to affect more people. Cases of chronic metal intoxication will result in a sharp rise of chronic disease, and the cost to governments and health insurances will be staggering.

We can panic or we can act.

In South Africa and on a global level, metal detoxification treatment which is safe and inexpensive, can become part of the health care system as it already is in Germany. However, globally, physicians have to rethink on how to practice medicine. They can treat the rising number of environmentally-caused symptoms as they have in the past, and can continue to lose the battle against chronic diseases such as cancer, atherosclerosis, Parkinson, Autism and more.

Instead, doctors could engage in identifying and removing the cause, and it is a well-documented fact that chronic metal intoxication is a significant cause of chronic disease.

Metal detoxification as taught by the German Medical Association of Clinical Metal Toxicologists (www.metallausleitung.de) and the International Board of Clinical Metal Toxicology (www.ibcmt.com) is a simple and highly effective cause-removing treatment approach. It may very well be South Africa's most cost-effective answer to rising health care costs.

[30] Van der Schaar P. IBCMT Textbook of Clinical Metal Toxicology. IBCMT 2009