

➤ **INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (ICP-MS)**

- Since 1980, ICP-MS has emerged as a new and powerful technique for elemental and isotopic analysis.
- It is used for qualitative, quantitative and semiquantitative analysis and for the measurement of isotopic ratios through mass-to-charge ratios.
- It allows the measurement of elements with atomic mass range from 7 to 250 U, and sometimes higher.
- ICP-MS offers numerous features which make it particularly attractive for the clinical laboratory.
- These include: high sensitivity, wide linear dynamic range, wide elemental coverage, multi-element capability, high sample throughput and simple sample preparation.

➤ **FEW ENLISTED BIOMEDICAL APPLICATIONS OF ICP-MS**

1. Measurement of multi-elements in drugs

- Impurities such as cadmium, copper, chromium, mercury, iridium, molybdenum, nickel, lead and vanadium and their derivatives can be analyzed in drugs.
- Long exposures of such drugs can cause physiological and behavioural issues. For instance, daily exposure to 0.06 mg of lead for a period of 1 month is sufficient to cause long-term problems such as kidney impairment, demineralization and obstructive lung disease.

2. Measurement of multi-elements in food products

- Multi-elemental analysis of food products is of special importance and interest to food producers and consumers.
- It enables evaluation of the nutritional value of food products and assessment of the health risks related to excess or lack of relevant elements.
- Lagad and colleagues identified six heavy metals such as molybdenum, cadmium, lead, antimony and titanium along with eight lanthanides at nanogram per gram in 77 Indian tea samples.

3. Analysis of trace elements in human health

- Everybody knows that in human health, some of the elements are essential and others are toxic.
- However, the benefits and risks of each element depend on the quantity of the

LIST OF SELECTED HEAVY METALS

intake, the accumulation, the mobility of the element and the storage.

- For example, the antioxidants such as selenium, copper, zinc and manganese in blood can be controlled in diseased state. ICP-MS offers a quick, accurate and sensitive method for the determination of these elements. With dietary management of these elements patient's recovery period can be successfully shorten.

S NO.	Toxic Heavy Metals	Heavy Metals Maintenance by Dietary Intervention	Heavy Metals <i>(found elevated in patient but cannot be managed by dietary intervention)</i>
1	Arsenic	Chromium	Rubidium
2	Lead	Copper	Strontium
3	Cadmium	Iron	Titanium
4	Mercury	Manganese	
5	Aluminium	Zinc	
6	Barium	Molybdenum	
7	Beryllium	Phosphorus	
8	Cobalt	Sulphur	
9	Lithium	Sodium	
10	Nickle	Potassium	
11	Vanadium	Calcium	
12	Boron	Magnesium	
13		Selenium	



➤ **SUMMARIZED LIST OF HEAVY METALS FOUND TO BE PREVALENT IN PATIENTS ADMITTED AT ERA'S LUCKNOW MEDICAL COLLEGE & HOSPITAL**


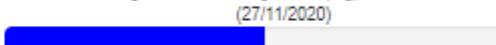
- *Note: -*
 - Orange colour denote those heavy metals that are stored in body.*
 - Blue colour denotes those heavy metals that are excreted out.*

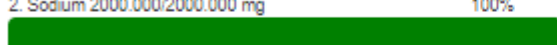
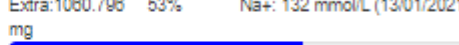
➤ **APPLICATION OF ICP-MS IN DIETARY MANAGEMENT OF PATIENTS AT ELMC&H**

- The elements found to be either elevated or deficient were managed by incorporating food products or supplements to combat the diseased condition in patients being admitted at ELMC&H.
- The protocol followed for some of the patients at Era is shown here: -


• DATE:10-02-2021	
PID NO:	Comorbidities
1566298	Somatization disorder with anxiety



ICPMS DATA			
Calcium(Ca)	0.77 mmol/L ↓	• 2.00 - 2.40 mmol/L	
NUTRITIONAL ACHIEVEMENT RDA			
1. Calcium 800.000/800.000 mg	100%	Extra:806.752 mg 75%	Calcium(Ca): 0.77 mmol/L (27/11/202
			



ICPMS DATA			
Magnesium(Mg)	0.74 mmol/L ↓	• 0.85 - 1.10 mmol/L	
NUTRITIONAL ACHIEVEMENT RDA			
3. Magnesium 420.000/420.000 mg	100%	Extra:199.660 mg 47%	Magnesium(Mg): 0.74 mmol/L (27/11/2020)
			

ICPMS DATA			
Sodium(Na)	102.19 mmol/L ↓	• 135 - 143 mmol/L	
NUTRITIONAL ACHIEVEMENT RDA			
2. Sodium 2000.000/2000.000 mg	100%	Extra:1060.796 mg 53%	Na+: 132 mmol/L (13/01/2021)
			

ICPMS DATA			
Zinc(Zn)	350.00 ppb ↓	• 700 - 1500 ppb	
NUTRITIONAL ACHIEVEMENT RDA			

4. Zinc 10.500/10.500 mg	100%	Extra:13.405 mg 127%	Zinc(Zn): 350.00 ppb (27/11/2020)
			

ICPMS DATA			
Molybdenum(Mo)	0.00 ppb ↓	• 0.10 - 0.18 ppb	
NUTRITIONAL ACHIEVEMENT RDA			
2. Molybdenum 0.045/0.045 mg	100%	Extra:0.079 mg 175%	Molybdenum(Mo): 0.00 ppb (27/11/2020)
			

ICPMS DATA			
Selenium(Se)	42.50 ppb ↓	• 60 - 340 ppb	
NUTRITIONAL ACHIEVEMENT RDA			
5. Selenium 0.050/0.050 mg	100%	Extra:0.057 mg 114%	Selenium(Se): 42.50 ppb (27/11/2020)
			

ICPMS DATA			
Phosphorous(P)	8.58 mg/dl ↑	• 2.5 - 4.5 mg/dl	
NUTRITIONAL ACHIEVEMENT RDA			
6. Phosphorus 1000.000/1000.000 mg	100%	Extra:38.318 mg 3%	Phosphorous(P): 8.58 mg/dl
