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SIGNIFICANCE OF RARE EARTH ELEMENTS IN THE HEALTH DIPLOMACY DURING COVID-19 PANDEMIC

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With the world going through the Pandemic trauma, the health system wants a renewed emphasize that requires less cheaper process to develop medical sector. In this scenario, the significance and utilization of Rare Earth Elements in the development of new medicines and medical technologies come into context, which is used in the form of ceramics, alloys, phosphors, permanent magnets.[1] China, as the dynamic healthcare industry with investing more than 6.5-7% of its GDP in the market,[2] became the major source of ray for the world with exporting Covid related protective equipment and face masks. The China owes its advancement in medical technologies to its highest rare earth reserve and production capacity that also puts further importance on the rare earth industry. This furthers the need to focus on rare earth elements as part of developing health diplomacy as new foreign policy factor for the world.

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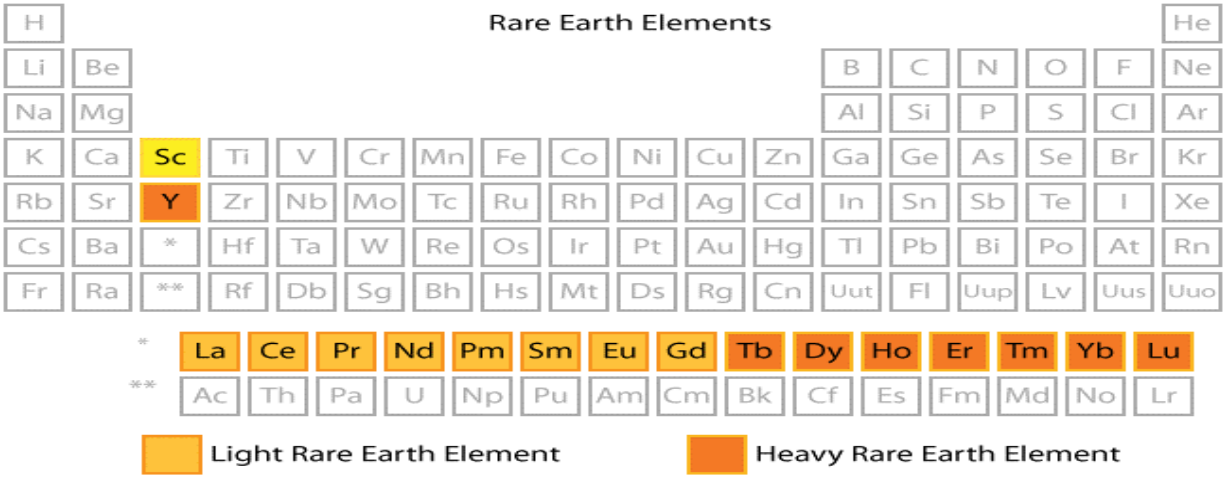
What are Rare Earth Elements?

The Rare Earths are 17 metallic elements majorly considered as part of the Transition Metals group, whose discovery started when a miner found a strange black rock in Ytterby, Sweden in 1788 and got identified as 'Rare Earth' for two reasons- a) nothing else was discovered like this; b) the geopolitical terms for rocks was 'earth' in the 18th century.[3] In 1794, Johan Gadolin named this rare-earth Yttrium after the town where it was discovered. This was followed by the discovery of 16 more elements from the late 18th century to the mid-20th century, which were named by multiple renowned chemists (Table 1). These elements should not be confused with

Alkali and Alkaline earth elements but called Lanthanides metals is available in the F or 6th-block of the periodic table.[4]

The major use of rare earth has been as catalysts in auto and petroleum refining catalysts; as phosphors in color television and flat panel displays, permanent magnets, rechargeable, and numerous medical devices; in the defence equipment like Jetfighter engines, missile guidance system, antimissile defence, space-based satellites, communication systems; and as permanent magnets like neodymium, gadolinium, dysprosium, terbium that are used in numerous electrical/ electronic generators for green technologies.[5]

Figure 1: Rare Earth Elements in the Periodic Table



Source: Anne Helmenstine, "Rare Earth Elements", Science Notes, September 4, 2015, https://sciencenotes.org/rare-earth-elements/. Accessed on 24 July 2021.

Table1: The Seventeen Rare Earth Elements

Rare Earth Name	Discovery Year	Atomic Name & Number	The chemist who named it	Light/ Heavy REE	Critical/ Uncritical	Usage
Yttrium	1788	Y-39	Sweden Johan Gadolin	Heavy	Critical	Metal Alloys and Night vision goggles
Cerium	1803	Ce-58	Europe-John Jacob Berzelius	Light	Excessive	Automobiles
Lanthanum	1839	La-57	Sweden-C arl Gustaf Mosander	Light	Uncritical	Optical Glasses, Night Vision goggles
Erbium	1842	Er-68	"	Heavy	Critical	Fibre and Optic Cables Machine
Terbium	1843	Tb-65	"	Heavy	Critical	Visual Display and fuel cells

Ytterbium	1878	Yb-70	Sweden- Jean-Charles Galissard	Heavy	Excessive	Stainless Steels
Holmium	1878	Ho-67	Sweden- Per Teodor Cleve	Heavy	Excessive	High strength Magnets and Glass coloring
Scandium	1879	Sc-21	Scandinavia- Lars Fredrik Nilson	Heavy	Critical	Defence Equipment
Samarium	1879	Sm-62	France- Paul-Émile Lecoq de	Light	Uncritical	Nuclear Reactors
Thulium	1879	Tm-69	Sweden- Per Teodor Cleve	Heavy	Excessive	Lasers, Portable, X-ray machines
Praseodymium	1885	Pr-59	Germany-Carl Auer von Welsbach	Light	Uncritical	Lasers
Neodymium	1885	Nd-60	"	Light	Critical	Laser Ranger Finders ommunication
Dysprosium	1886	Dy-66	France- Paul-Émile Lecoq de	Heavy	Critical	Permanent Magnets
Europium	1886	Eu-63	Europe-Eugène-Anatole Demarçay	Heavy	Critical	Optical Fibres
Gadolinium	1886	Gd-64	Sweden- Johan Gadolin	Heavy	Uncritical	X-ray and scanning
Lutetium	1907	Lu-71	Austria- Carl Auer von Welsbach and Georges Urbain	Heavy	Excessive	Petroleum Refining
Promethium	1947	Pm-61	America- Jacob A. Marinsky, Lawrence E. Glendenin, and Charles D. Coryell	-	-	Doesn't exist like earth, but its isotopes are available in the radioactive elements

Source- Rose Ragsdale, "Rare earth metals see new medical uses", Metal Tech News, June 27, 2020, https://www.metaltechnews.com/story/2020/04/29/tech-metals/rare-earth-metals-see-new-medical-uses/217.html#:~:text=Holmium%20lasers%20emit%20at%202.1,problems%20with%20a%20thulium%20laser. Accessed on 16 July 2021.

Use of Rare Earths in the Medical sector

Rare Earth Elements (REE) are important not only to industrial machinery and electronics but also in medical equipment whose importance is being realized more during the global pandemic. Despite the use of almost 45% REE in ceramics and alloys to make medicines and high-tech medical devices, the importance of REE in the development of new medicines, medical technologies get little public attention.

The importance attached to the defense and surveillance technology continued to be the reason for the ignorance of the medical significance of rare earth elements.[6] The knowledge and realization about the importance of rare earth elements in sectors other than defense would be growing with the health diplomacy of countries, considering their usage in the cheaper manufacturing of medicines and medical equipment. In addition, Medical innovation is the need of the time during the pandemic situation, which requires the world to focus not only on military and space technology but also soft sector of health and aiding.- but does it need to be either or- why can't both happen at the same time-

Table-2 Medical use of Rare Earth Elements

Rare Earths	Medical Use
Lanthanum	Enhance metabolism, lower cholesterol level, Blood pressure, blood coagulation risk.
Yttrium	treat cancer in at least two days by targeting cancer cells, and used as Yttrium-90 as radiation therapy to give antibodies to arteries.
Samarium	used in the palliative treatment of bone pain associated with osteo-blastic metastatic bone lesions; and as cancer drug quadramet.
Terbium	used in alloys for electronic equipment and as a greener phosphor in electronic displays.
Erbium	used in lasers, infrared light filters and optical fibres, and dental implant surgery.
Holmium	a soft-malleable white metal found in monazite and gadolinite, used in medical, dental and fibre-optical applications.
Thulium	the rarest REE used in portable X-Ray machines.
Promethium	used as isotope 147 in nuclear batteries.
Ytterbium	used as Yb-169 for fighting cancerous cells.
Cerium	dental ceramics and medicines La-based drug- for hyperphospha-temia Ho: YAG Laser- for medical surgical procedures.Tm-169 and Yb- for portable X-ray machines.
Gadolinium	MRI agents

Source: Rose Ragsdale, "Rare earth metals see new medical uses", Metal Tech News, June 27, 2020, https://www.metaltechnews.com/story/2020/04/29/tech-metals/rare-earth-metals-see-new-medical-uses/217.html#:~:text=Holmium%20lasers%20emit%20at%202.1,problems%20with%20a%20thulium%20laser. Accessed on 16 July 2021.

China's Medical Expertise and High Rare Earth Reserve

China is the only country with advancement in extraction and geotechnology engineering of rare earth elements, which enhanced its dominance in the value supply chain. It has been a leading reserve, producer and exporter of rare earth elements since the 2000s, which has continued with the current reserve of 44MT and production capacity of 132 MT enhancing its monopoly in the technology of every sector.[7] The medical sector has developed a new area

of Chinese monopoly shaping its health diplomacy during the Covid-19 Pandemic, which is majorly the result of Chinese continued R&D investment in the rare earth sector. As the largest and dynamic market for the healthcare industry investing more than 6.5-7% of GDP,[8] China became the major source of ray for the world with exporting Covid related protective equipment and face masks.

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China came up with the 'Health Silk Road Initiative' as part of which it sent medical support to more than 27 countries including India's neighbors- Pakistan and Myanmar. President Xi Jinping introduced the idea of the "Community of Common Health" shaping the global health leadership of China. However, the 'Mask diplomacy' of China has been receiving mixed responses with the Western countries most particularly EU high representatives calling it 'politics of generosity' and accusing China of spreading misinformation. While some parts of Europe like Serbia Belgrade thanked China for the assistance.[9] The most appreciation came from the countries of Africa and the Gulf region for Chinese vaccine diplomacy, for instance- Anthony Augustine Sandi, the acting health minister of Sierra Leone, said a friend need in need is a friend indeed to appreciate the friendship of China.[10]

The monopoly on rare earth production is the major base of the Chinese medical sector enabling it to supply not only vaccines but also medical equipment like ventilators, oxygen concentrators, breathing kits and so on. However, the quality issues of these equipment raised with cases like the faulty design of the 250 ventilators supplied by China to the UK as part of their consignment deal.[11] This made the countries look for alternative supplies and gave opportunities to countries like India and Russia to improve their medical sector and enhance their soft power through health diplomacy.

Way Ahead for India

India emerged as the first responder to the need for humanitarian assistance during the Pandemic. The assistance in the form of medicine, ventilator, rapid action teams supply has been seen as part of its ancient philosophy 'Vasudeva Kutumbakam'. Foreign Secretary Harsh Vardhan said- "Health diplomacy is the subset of the larger multilateral diplomacy of India, and the Pandemic brought India's role as a pharmacy of the world into focus". [12]

S. Jaishankar, External Affair Minister, also said that "India's reputation as the 'Pharmacy of the World' stands reinforced the with it reaching out to the nations during global crises and supplied vaccines to 72 nations."[13]

However, the status of India as a pharmacy of the world is a debated statement as argued by Prof. Gautam R. Desiraju, who said "India is a Formulation Capital of the World, not the pharmacy capital." He said only 25% of the Indian medical industry involved in the manufacturing of new generic drugs, while the rest is involved in the formulation of existing APIs into tablets, syrups or medicines. This owes to the limited R&D investment and medical research by India, unlike China, which causes India to import 90-95% of high API medicines from China.[14]

India has 6% of the world's rare earth reserves but produces only 2% of the total rare earth oxides globally and despite having a large reserve of eight rare earth elements such as Lanthanum, Cerium, Praseodymium, Neodymium, Samarium, Gadolinium, Yttrium, Dysprosium, it has not exploited the industry to improve in other sectors, and the focus has been on defense.

In the case of the rare earth industry, there has been a restricted focus in India unlike China as it has engaged only in developing permanent rare earth magnets for space and missile programmes. India has 6% of the world's rare earth reserves but produces only 2% of the total rare earth oxides globally and despite having a large reserve of eight rare earth elements such as Lanthanum, Cerium, Praseodymium, Neodymium, Samarium, Gadolinium, Yttrium, Dysprosium, it has not exploited the industry to improve in other sectors, and the focus has been on defense. Although the Indian rare earth sector came a long way since the 1950s from engaging in purely mining efforts to the setup of separation plants PRYNCE and HERO by the Indian Rare Earth Limited (IREL), but the progress is not enough. [15]

The Department of Atomic Energy (DAE) estimated the total reserves of rare earth in India at 10.21 million tons. Monazite is the main rare earth source in India found in the heavy minerals, inland placer deposits, and beach sands. Monazite contains both elements of thorium and uranium, but its mining is allowed only to the government body – DAE- due to the presence of radioactive elements. [16] The large deposits of Monazite in India mostly found in the coastal tracts of Orissa on the east coast and in Kerala on the west coast. Bastnaesite – a source of cerium- found in the state of West Bengal. Monazite in Carbonatites found in the Meghalaya, Tamil Nadu, Assam. Xenomite containing REE dysprosium- found in states of Chhattisgarh and Jharkhand. [17] India has 35% of the world's total beach sand minerals deposits and besides Monazite, the rare earth sources include- Ilmenite, Sillimanite, Garnet, Zircon, Rutile- collectively called Beach Sand Minerals. [18] The Indian Rare Earth Industry currently contributes nearly $200 billion to the Indian economy but its net potential is around 90,000 that has been underused. The production of carbonate and oxalates that further get converted to oxides are the preliminary separation products from the Indian rare earth industry, and the capacity to manufacture final products would require a detailed R&D investment and strategies. [19]

However, the growing health diplomacy and soft power of India as part of its pandemic

assistance to other countries is likely to enhance its focus on the rare earth elements and their usage in sectors other than defense. Many small Indian firms such as Skanray Technologies, AgVa Healthcare, Life Line Biz, and others, have already begun to manufacture ventilators and high-end machines at a lower price than imported high priced ventilators. The investment initiative in rare earth elements would enhance the availability of Permanent magnets. The focus and investment in the rare earth sector would enhance both the technological advancement and soft power diplomacy of India, which has immense potential to contribute in building its great power status. Thus, India needs to come up with detailed R&D strategies as a plan to develop the field, as part of which it can collaborate with the potential rare earth producing countries.

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