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Content

EDITORIAL MESSAGE

It gives us immense pleasure to announce the special combine issue 1 & 2 of Nirma University Journal of Pharmaceutical Sciences (NUJPS) of 2022. NUJPS includes research and review papers and articles on the topics related to the area of Pharmaceutical Sciences.

This volume is dedicated to the theme of "sustainability". We understood the importance of nature, existence of each and every species on earth and the warning we are getting from nature in form of climate changes and natural calamities. Simply, realizing that there is a need to identify, analyze, and take corrective measures for the existence of life on Mother Earth, the United Nations (UN) has taken steps towards it and identified 17 sustainable development goals (SDGs). The dedication is required from each one of us to achieve the same for making an earth a better place to live with.

Sustainable development includes paying attention on identified common areas and keep checks on outcome towards achieving the targets. As a pharmacist, we can play a pivotal role to achieve the one or the other goals to a larger extend. We can collectively work towards shaping the future of humankind and continue to make a meaningful difference in the lives on the mother earth.

We extend our sincere gratitude to our contributors, reviewers and readers for their unwavering support and dedication to advancing the knowledge. Together, we can do better. Happy reading!!!

Editorial Team, NUJPS
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REVIEW ARTICLE

APPLICATIONS OF SUSTAINABLE DEVELOPMENT GOALS IN PHARMACEUTICAL INDUSTRY: CHALLENGES AND OPPORTUNITIES

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ABSTRACT

'Sustainability' has become a prime focus of every organization and Institute after the declaration of the UNSDG goals in 2016. However, the Pharmaceutical sector has yet to contribute a lot towards the sustenance of these goals at Industrial level and is far from ideal scenario to meet the UNSDG expectations. It becomes obligatory for the pharma Industry to practice sustainability as they are quite resource-intensive. With reports claiming the Pharmaceutical sector to be contributing 13% greater than the automotive sector to the pollution, and meagre measures taken by the companies and to control the greenhouse emissions, it becomes crucial to establish regulations for the same. As Health-care promoters, it becomes our prime responsibility to adapt sustainable practices while catering the business and not adversely affecting the health and well-being of the people. This document discusses the challenges, opportunities and perspectives where the pharmaceutical industry can contribute. With extreme rise and deterioration of the climate and environment, the need to adapt sustainability and embedding it into Pharma's genome has become inevitable so as to cater to the need of the present and the future too.

Keywords: Process mass intensity, Solvent Intensity, Zero emission, Green Chemistry.

1. INTRODUCTION:

A set of seventeen interconnected goals known as the Sustainable Development Goals (SDGs) or Global Goals were devised by The United Nations (UN) High-Level Political

Forum on Sustainable Development (HLPF) in 2015 with an aim to build a peaceful and prosperous planet for now and future **(Fig. 1)** [Adapted from 1]. UN-HLPF is convened yearly under the direction of the UN Economic and Social Council, and is in charge of overseeing the SDGs [1].

Figure 1: 17 Unique Sustainable Development Goals as Defined by the UN.

These master-crafted SDGs are intended to act as a shared blueprint that can guide futuristic partnerships for achieving the intended moto. These include overlaps and areas where the SDGs complement one another. For instance, the Intergovernmental Panel on Climate Change (IPCC) notes that SDG 13 on climate action has strong overlaps with SDGs 3 (health), 7 (clean energy), 11 (cities and communities), 12 (responsible consumption and production), and 14 (oceans)[2]. However, detractors and analysts have also pointed out trade-offs between the SDG objectives, such as those between eradicating hunger and advancing environmental sustainability. Concerns have also been raised about the excessive number of goals (in comparison to the eight Millennium Development Goals i.e. MDGs), which can result in complicated trade-offs, a lackluster emphasis on environmental sustainability, and challenges monitoring qualitative indicators.

The pharmaceutical industry is dedicated to creating medications to treat illnesses and is vital to global health and life preservation efforts. It has demonstrated outstanding success in treating debilitating conditions like infectious diseases and possesses a remarkable capacity to produce extremely inventive medications for extremely complex illnesses like cancer and neurodegenerative disorders. The pharmaceutical industry is most notable for

having established a global ecosystem that includes every stage of the difficult process of developing, manufacturing, and distributing new medications. This ecosystem's adaptability and resilience allowed the Covid-19 vaccinations to be produced in record time.

Given a chance and the right direction, there are lot many ways in which the pharmaceutical sector can contribute to the progress of the SDG goals which also may be divided as per their contributions to Environmental, social, governance (ESG) aspects of this business **(Fig. 2)** [1].

Figure 2: UNSDGs and ESGs they link with.

Some of the prime SDGs that intersect with the Pharmaceutical sector's expectations are:

SDG 3; Easy and affordable medicine: This is one of the major areas where the pharmaceutical industry plays a direct role. Immunization drives for fighting the infectious diseases, orphan and neglected health conditions, disorders and diseases are some of the most important expectations. Affordability of medicine is one of the most important pharmaco-economic factors that affect the patient prognosis and hence is one of the prime responsibilities on the shoulders of Pharma companies. Public health awareness programs, initiatives and infrastructure development for conducting healthcare promoting activities etc. may be contributing towards achieving the goal.

SDG 4; Training and Capacity Building: Local healthcare, especially in rural areas needs trained healthcare professionals.

SDG 9; Innovation and Research: Innovations in healthcare may devise novel strategies and interventions that may offer better health to the patients and improve

their condition. Approvals for novel medical devices, medications, vaccines and other therapeutic interventions may help tackle health issues more effectively. Funding research and innovations is directly going to foster the achievement of SDG goals to a significant extent.

SDG 10; Addressing Health Inequalities: Right to good health requires equal access to healthcare facilities while excluding the socio-economic, geographic, demographic disparities.

SDG 12; Responsible consumption and production are facilitated by the application of sustainable techniques for manufacturing, reduction in waste, reduction in environmental detoriorants and optimization of resource utilization.

SDG 17; Partnerships and Collaboration: In order to expand the scopes and facilitate achieving the goals, it becomes imperative to collaborate with governmental, NGOs, and other stakeholders. This may facilitate technology transfer, and knowledge-sharing and catalyze the individual efforts through synergistic mechanisms.

However, the sector at present has not much changed in terms of achieving these goals.

Arguably, this might be attributed to the fact that Implementation of the Sustainable Development Goals (SDGs) in the pharmaceutical industry comes with several challenges due to the industry's complexity, where businesses are expected to provide patients with secure, cutting-edge, and efficacious treatments at affordable rates.

Pharma companies are now adopting measurable and ambitious goals and laying out a plan of action, but there is frequently a critical gap between aspiration and action when it comes to target selection, achievement measurement, and pace of progress. In order to meet their goals, businesses must be proactive in fostering greater collaboration and transparency, build and analyze sizable data sets to produce useful insights, and think about drastically altering current procedures in order to bring about a dramatic, long-lasting change. Given the lengthy development cycles, the pharmaceutical industry will need to completely rethink its current supply chains, digital infrastructure, business models, and drug development and manufacturing processes in order to fulfill its obligations. Pharma is developing products, but they are not intended for the current market; rather, they are intended for the next ten years or more. Nevertheless, the environmental impact of the products that are currently on the market must also be carefully considered.

Overcoming the challenges faced in implementing the SDGs into Pharmaceutical sector requires a concerted effort from governments, regulatory bodies, pharmaceutical companies, consumers, and other stakeholders. Collaboration, innovation, financial incentives, and clearer guidelines are essential to successfully integrate SDGs

into the pharmaceutical industry while addressing these obstacles. It may be impossible to combine the following two factors into this equation without collated efforts of the sector's giants: 1. carbon-neutral research and development, production, and distribution chains; and 2. a business model that enables access to extremely innovative drugs at a reasonable cost on a global basis. This result requires practices that balances the needs of the market, science, finance, competition, and serendipity with those of regulatory bodies.

A complete reorganization of procedures is required throughout the whole pharmaceutical product life cycle and value chain for the pharmaceutical business to meet its net-zero targets, decrease waste, and restrict its use of natural resources. As new, disruptive strategies are implemented, momentum throughout multiyear business cycles must be preserved. Parallel to this, businesses must scrutinize the current production methods and goods.

Six interconnected topics are depicted in **Fig. 3** (Adapted from [3]) that will affect how quickly and how far the pharmaceutical industry may go toward its sustainability goals.

This article primarily focuses on the major aspects of ESG, such as industry approaches to lowering Scope 1, 2, and 3 greenhouse gas (GHG) emissions and more efficient use of the planet's limited resources. It looks at the significant obstacles the pharmaceutical industry faces in meeting its lofty environmental sustainability goals as well as the potential characteristics of an environmentally conscious pharmaceutical company and its supply chain. The paper assesses new investment, culture shifts, and simple wins throughout the value chain as means of advancing sustainability.

Figure 3: ESG-targets and Their Intersecting Pharmaceutical Product Value Chain.

2. INTERCALATION OF SDG INTO PHARMA DNA: WHY A MANDATE?

The pharmaceutical industry must adopt the Sustainable Development Goals (SDGs) for a number of reasons as discussed henceforth.

Resource intensive sector: Pharmaceutical sector is one of the most resource-intensive sector that raids upon several natural (plants, water etc.), electricity generating resources, supply-chain associated resources, and human resources to a significantly high extent.

Pollution-generative sector: Pharmaceutical pollutants include greenhouse gas emissions (GHEs), wastewater / effluent generation, paper waste, pharmaceutical (medical/biomedical) waste.

High GHE rates: According to a recently published report, the pharmaceutical industry was reported to be responsible for > 55% pollution than the automobile industry and the environmental impact of both the industries is almost identical, despite lower share in market of the former [4]. More than 210 pharmaceutical companies have their global existence, however only 25 of them have reported unswervingly their greenhouse gas emissions (GHE) for more than five years. It has been discussed elsewhere that in order to meet the reduction targets laid down in the Paris Agreement, there must be >59% reduction in the GHEs from the present [5].

Pharmaceutical waste:

Wastewater and effluent:

The complicated composition of pharmaceutical wastewater includes significant quantities of several types of organic contaminants that adversely affect the Chemical oxygen demand (COD) and biological oxygen demand (BOD), NH3-N and elevated suspended solids, richness of color, toxicity as well as additional characteristics. According to literature, about 500,000 cubic meters of wastewater are released each day, and approximately 100,000 tons of garbage and pollution are released annually only by the Chinese Pharmaceutical sector [6].

Pharmaceutical and biomedical waste have resulted in eco-toxic environmental repercussions due to contaminants emerging from the pharmaceuticals such as residual active pharmaceutical ingredients, reaction intermediates, toxic solvent wastes and endocrine disrupting chemicals (EDCs) that have sneaked through the food chains and contaminated the soil and water bodies [7].

Paper waste: Documentation being done conventionally by the Pharmaceutical companies to meet the regulatory specifications it takes a huge toll on the natural resources. About 90 billion sheets of paper are used annually to meet the regulatory requirements of the government just in the US as per the reports. This means the pharma paper gobbles up 1.8 million tons of Wood (more than 10 million trees), ~ 8.5 billion pounds of GHE, 12.3 million BTUs of energy, 10.6 billion gallons of water, and 585 million pounds of solid trash produced [8].

To summarize, the pharmaceutical industries implementing the SDGs can result in a more moral, sustainable, and inclusive sector that gives global health needs top priority while taking social and environmental effects also into account.

However, as mentioned earlier in the article, there are several road blockers for implementation of the SDGs in Pharmaceutical industry. These may be summarized as: high costing and investment, complex supply chains and regulatory environment, concerns for Intellectual Property, Public Health vs. Profit Motive, improper Consumer Behavior and Demand and difficult Measurement and Reporting.

3. ALIGNING ESG AND SDGs IN PHARMACEUTICALS: THE WAY FORWARD

Despite the disagreements and debates amongst the community regarding bilateral risks involved in advancing the businesses for today and the compromised future, the responsible corporates have already initiated measures to build sustainable business empires through SDG-driven market strategies. Environmental, Social, and Governance (ESG) frameworks, which aim to address the greater issue of being a good corporate citizen, are where sustainability programs are most frequently

implemented, and ESG requirements have been rising in every corporate industry including the Pharmaceuticals. Furthermore, after the ESG concerns were formalized in the UN Principles of Responsible Investment (UN PRI) in 2006, investors improved the alignment of their strategies and interests with the larger societal goals, so establishing a precedent for the mainstreaming of ESG investing. Over 1,600 signatories representing over USD 70 trillion in assets under management make up the global initiative today, which is not surprising given its amazing expansion on a worldwide scale. In 2021, a record $649 billion was invested globally in funds with an ESG focus. More corporations are giving ESG initiatives top priority as investors pour money into enterprises with sustainability plans in place. Ethical, sustainable, and corporate variables are a subset of nonfinancial performance measures [9].

In addition to helping businesses maintain their social license to operate, an integrated business approach that incorporates the SDGs and ESG in their marketing strategies will force them to focus on both financial and non-financial factors like corporate governance, direct and indirect environmental footprint, human rights issues, and more. This will also help them move toward a more proactive approach to the adoption of new business models through disruptive or realignment strategies. Market participants, asset owners, and managers are increasingly demanding that managers consider a more comprehensive long-term interest and strategy when assessing any and all business decisions. Furthermore, even if the SDGs are more thematic than corporate in character, they do assist in coordinating industry-and company-specific ESG concerns with more general societal and environmental objectives. Adaptation of GREENER Practices in Pharmaceutical sector has been discussed in detail elsewhere [7].

Herein, we discuss the most applicable strategies that are employed or can be employed for transforming pharmaceutical industry towards a more sustainable and eco-friendly one. ESG variables are a subset of nonfinancial performance measures that take into account difficulties with accountability and corporate governance. An effective resource management and balance can help the pharmaceutical giants to drive the future of the industry's and ultimately, people's well-being. When we examine the ESG issues in pharma more closely, several areas that are most relatable are:

Environmental (E):

- *Minimize Air pollution and GHE generated during business and business related activities*: The pharmaceutical supply chain involves the transportation of raw materials, intermediates, and final items through various sites and countries [10]. Several interventions that can be employed to reduce the GHE emissions are shown in **Fig. 4**[11].

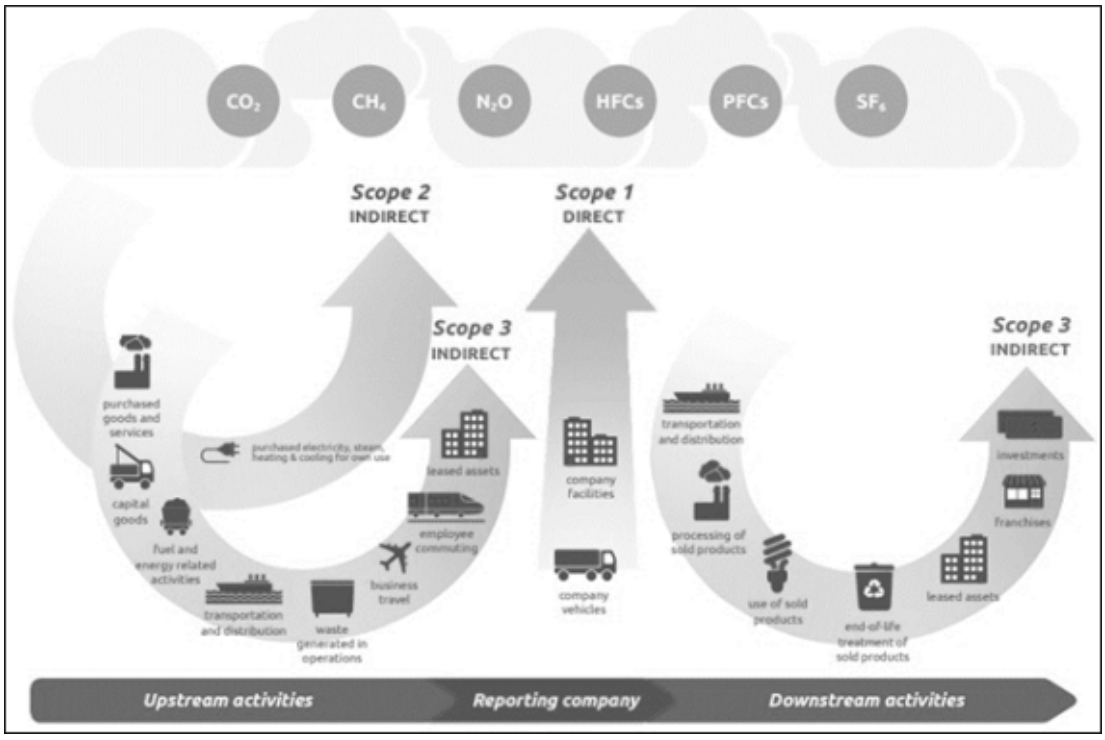

Figure 4: Emissions across various upstream and downstream activities involved in Pharmaceutical Product Chain.

- *Trash Management:* During the production process, pharmaceutical businesses produce a sizable amount of trash. In order to promote the adoption of sustainable practices and lessen their influence on the environment, ESG focuses on how businesses handle and dispose of this waste. Promote the use environment friendly methods like Plasma Incinerators.

  Packaging waste reduction: they use in their packaging. For instance, natural fiber-based pulps, such as those made of cellulose, cotton, sugarcane, corn or bamboo, which provide the rigid structure of a package, combined with a film made of polypropylene (PP), polyvinyl chloride (PVC), polybutylene adipate terephthalate (PBAT), poly caprolactone (PCL) and poly lactic acid or polyethylene terephthalate (PET), which can provide the composite with moisture-proofing, gas permeability, or other properties while still being up to 99% recyclable can be used. Smart labels and augmented reality (AR) instructions on how to administer pharmaceuticals or medications can take the place of paper inserts and manuals. Utilizing intelligent technologies to run a just-in-time

supply chain can improve the cold chain [12].

- *Energy Consumption:* Use renewable sources of energy for the business and business related activities: E.g. Use solar energy, biogas, PNG etc. to run the vehicles.

- *Water Usage*: To reduce their influence on regional water resources, pharmaceutical businesses must use water as effectively as possible, and ESG assesses whether they do so by adopting water-saving practices.

- *Employ Green chemistry principles* for synthesis and avoid the usage of solvents wherever possible.

- Promoting re-purposing of the drugs and laying down regulation for shelved drug- licensing.

- Using "Green" Phytochemicals as API and cultivating them in a sustainable fashion.

- *Reduce, re-use, recycle and refresh the resources wherever possible*. E.g. Solvent recovery for processes wherever applicable. Use effluent treatment plants for efficient saving of water and protecting the environment from probably hazardous waste generated during the processing of Pharmaceuticals [13], [14].

- *Employ metrics and methods that maximize process output and reduce waste and inefficient production:* Use principles of QbD and DoE, KAIZEN. Poke Yoke etc. to empower technology driven-robust process and products controls so as to minimize batch failures and wastages [11].

Some suggested metrics that have been recently employed by industries are: PMI i.e Process mass intensity, Solvent intensity and Environmental impact.

PMI: "process mass intensity" (PMI) describes the utilization of resources or raw materials used for manufacturing a single unit. It's a metric for evaluating efficacy for the pharmaceutical manufacturing processes and how they can impact the environment.

Reduction in PMI is advantageous for multiple reasons like reduced waste generation, less resource/energy utilization and reduced environmental footprint. Process optimization, recycling and Reuse and Life Cycle Assessments (LCAs) are some of the methods by which the pharmaceutical industries can reduce the PMI [14].

Solvent Intensity (SI): The quantity of solvent used in a manufacturing process per unit of product is referred to as solvent intensity (SI). Solvents are essential to the production of pharmaceuticals at many stages, such as synthesis, extraction, purification, and formulation.

It's critical to lower solvent intensity for a number of reasons such as environmental Impact due to the presence of volatile organic compounds (VOCs), that are

potential contaminants for water bodies, air, and destroy ecosystems. Reducing the usage of solvents and re-using them are critical in reducing the SI. Solvent-usage are associated with high health risk to the personnel involved in the occupation. Reducing the usage of solvents can reduce the risk for workers too.

Use of Green solvents such as water or bio-based solvents, involving recycling and recovery, eliminating/replacing the hazardous organic solvents and continual improvement through constant refinement of the processes and maintaining records over their usage may proportionate itself with environmental tewardship, and sustainable practices.

Social Interventions (S): Access to medications: Ensuring that individuals in both developed and developing countries have access to medications is one of the most important social challenges facing pharmaceutical corporations. ESG promotes businesses to create pricing and distribution plans that increase the availability and affordability of vital medications for people who need them.

Research and Development (R&D): ESG underlines the significance of R&D in the pharmaceutical sector. ESG experts and investors favorably assess businesses that make R&D investments to meet unmet medical needs and enhance healthcare outcomes.

Patient Safety and Product Quality: ESG focuses on how pharmaceutical businesses make sure that their medicines are both safe for patients and of high quality, including stringent testing and adherence to rules to prevent negative patient impacts.

However, stakeholders increasingly want more direct interventions on equity of access and affordability. Social sustainability through public health improvement. Pharma companies are simultaneously under increasing pressure to minimize their environmental impact throughout the product lifecycle due to their research and development (R&D) procedures and manufacturing processes, as well as by improving supply chains and logistics and collaborating more closely with patients and healthcare providers (HCPs) on product use and disposal. While the goods being developed by the pharmaceutical industry are not intended for the market today but rather for the upcoming decade and beyond, careful consideration must also be given to the environmental impact of medicines that are already on the market. To collectively meet the need of future, the pharmaceutical sector will need to fundamentally reinvent its current business models, supply chains, and digital infrastructure. Given the lengthy development cycles, this must be done immediately. This overview paper primarily focuses on the ESGs that encompass better resource management and industrial strategies that can meet the challenges in the way to sustainable pharmaceutical future and environmental sustainability. The research analyzes new investments, culture shifts, and quick wins

across the value chain as means of advancing environmental sustainability. These quick victories may give us the green light to implement the dramatic, more fundamental adjustments required to meet our objectives. The report takes into account the social ramifications of the environmental footprint-reduction measures.

Governance (G) and Regulations:

Pharmaceutical businesses are expected to uphold high standards of corporate governance, transparency, and ethical conduct. In particular, this entails revealing financial information, avoiding possible conflicts of interest, and following moral marketing principles.

Board Diversity: ESG assesses the diversity of a company's management and board of directors. Better decisions can be made when a leadership team is diverse, and it shows a commitment to inclusivity and fair opportunity.

Executive Compensation: ESG examines how executive compensation relates to the performance and long-term sustainability objectives of the organization. By doing this, it is made sure that incentives are in line with those of stakeholders and shareholders [15].

Some Case Studies [3]**:**

a. One of the few industrial giants, the UK-Swedish pharmaceutical corporation AstraZeneca, invests heavily in lowering emissions while putting a strong emphasis on open, ethical business practices, fair access to healthcare, and environmental protection. For four years running, the international organization CDP has given it a double-A rating for its environmental obligations. The Ambition Zero Carbon program aims to advance the time of zero carbon emissions by ten years with a $1 billion expenditure.

In March 2020, AstraZeneca introduced AMAZE, a cloud-based platform for managing chronic disease (for instance, in the fields of the respiratory, cardiac, and renal systems).

b. Roche is streamlining clinical trials to make them more convenient for both patients and professionals to participate in. One illustration is the Prospective Clinico-Genomic Study, which collects a variety of data streams via liquid biopsy and remote monitoring rather than requiring the patient to undergo many invasive testing in the hospital.

c. Novartis and Biofourmis have created a platform that monitors the health of people with heart failure. Patients are discharged from the hospital with the heart failure medication Entresto from Novartis as well as the Everion sensor from Bioufourmis, which continuously monitors the patient's state and enables clinicians to act quickly as needed.

d. In January 2021, Pear treatments and etectRx agreed to a partnership that will pair Pear's ground-breaking digital remedies for drug addiction and insomnia with smart tablets that feature an ingestible wireless sensor to track adherence. In order to incorporate this technology into clinical trial programs, the two companies wish to contact potential pharmaceutical partners. More effective ways to communicate with and support patients will be offered through the integrated platform.

e. Color Genomics, which first focused on cancer diagnosis, is now promoting COVID-19 testing across the US. Beyond the actual test, the business's unique value extends to its flexible and expandable "infrastructure" that now reaches patients wherever they are, including in workplaces and educational institutions in addition to hospitals and clinics. The company has outlined the strategy.

f. A high degree of industry-wide collaboration and data sharing should be a part of our vision for a net zero pharmaceutical sector (see Figure 5), which should be backed by connected data systems, powered by AI algorithms, and based on the principles of a circular economy.

g. Every year, millions of tons of unneeded medications are thrown. Two billion people lack access to essential medications. Avoidable losses are brought on by poor visibility throughout the pharmaceutical supply chain. Reliance on paper medicine information, which is rarely read and wastes resources. Using single-use plastics frequently in medicine packaging. The four-year SMP program aims to produce data-driven solutions, industry-wide frameworks, standards, and implementation toolkits in order to address the six pillars of sustainable pharmaceuticals.

To more accurately quantify and contrast the carbon footprint of medications, SMP Projects build tools like the Medicine Carbon Footprint (MCF) classifier. Digitizing drug information to deliver multimodal, inclusive, patient-centered, standardized drug information. Additionally, testing circular packaging ideas to cut less on single-use plastics without sacrificing functionality.

The Sustainable Medicines Partnership (SMP) program which aims to increase sustainability and access to medications. The SMP is a non-profit, public-private, multi-stakeholder global initiative with a goal of increasing awareness and putting evidence-based treatments into practice. YewMaker, an action lab that develops, tests, and scales sustainable healthcare solutions, is in charge of the program. It intends to support the creation of a cooperative ecosystem

for lowering drug waste, having a positive effect on the environment, and improving access to medications for all people.

h. AstraZeneca acknowledged the need to lessen the environmental impact of their extensive network of laboratories worldwide and teamed with the nonprofit organization My Green Lab in 2021 to implement a program to do so. As part of the UN Framework Convention on Climate Change (UNFCC) Race to Zero, the pharmaceutical industry has recognized My Green Lab certification as the industry gold standard for laboratory sustainability best practices. My Green Lab accreditation offers scientists and the teams that support labs practical solutions for enacting significant change. The program covers 14 themes, including engagement, energy, water, waste, chemistry, and materials, with a particular emphasis on behavior modification and assignments that scientists can do on their own.

All stakeholders, from the R&D scientist and factory scaling lead to the packaging designer and logistics manager, should place sustainability-by-design at the forefront of their minds. To make sure that green practices are deeply ingrained across the product value chain, these should cooperate.

4. PROSPECTS AND CONCLUSION:

It could be said that the pharmaceutical sector joined the ESG and sustainability movements late. However, the sector hasn't stood idly by. Successful sustainability projects that show how they have a positive impact on the environment, society, and the bottom line draw in a large number of investors and stakeholders who favor companies with a strong sustainability attitude. The industry's potential for making a good difference is proportionally greater because of its contribution to combating climate change, which may even be greater than the car industry's. The majority of the work is still ahead of us, despite some progress made by the industry in this direction. An example of an industry group that is focused on working together to measure and gather data that can be utilized to drive improvements throughout the It may be said that the pharmaceutical business was slow to embrace the ESG and sustainability movements. However, the sector has not stayed on the are a vital part of the sustainable ecosystem. Energy and water consumption can be decreased without making a significant financial investment by implementing digital models to predict and solve waste. One strategy for maximizing a plant's beneficial impact on its energy footprint is to concentrate on renewable energy sources as a source of power. Sustainability in the pharmaceutical industry touches nearly every link in the value chain of healthcare and goes far

beyond renewable packaging. If we are to successfully reverse the disastrous effects of climate change, the industry will need to concentrate in earnest.

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REVIEW ARTICLE

SUSTAINABLE STRATEGIES FOR DEVELOPMENT OF GREENER PHARMACEUTICAL PRODUCTS AND EXCIPIENTS

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ABSTRACT

The pharmaceutical business and its worldwide supply chain play a significant part in the healthcare system, but it also has notable repercussions for the environment. Drug manufacture and transportation are major factors to the pharmaceutical industry's carbon footprint. Like other manufacturing sectors, the pharmaceutical business contributes improve the sustainability of its operations. The current review focuses on sustainable strategies of pharmaceutical companies in order to achieve the greener goals. The field of chemistry known as "green chemistry," often called "sustainable chemistry," focuses on designing and improving goods and processes to reduce or eliminate the usage and production of hazardous materials. Sustainable hazardous waste management is critical for a safe, clean, and environmentally friendly environment and public health. The paper reviews newly developed management approaches, waste-to-energy conversion processes, and treatment technologies, as well as their applicability, advantages, and limitations. The extensive analysis presented in this article will assist in the formulation of cost-effective and environmentally friendly long-term development goals, as well as a number of projects to improve the pharmaceutical industry.

Keywords: Green chemistry, Sustainable strategies, Pharmaceutical waste management

INTRODUCTION

Sustainability and sustainable development goals

Defining the Meaning of Sustainability Despite the proliferation of health literature on sustainability, there is little consensus on how to define it. Sustainability was described with terms such as "continuation", "maintenance", "sustainability", "adoption", "contract", "relational", "adoption", "continuity", "integration", "long-term" and "contact". Fewer scholars generally define sustainability as "the maintenance of health benefits over time", USAID defines it as "the ability to maintain program services at a level that ensures ongoing prevention and treatment of health problems after significant financial, administrative and technical assistance from an external donor has ended. " Other researchers focus only on program components and define sustainability as "the continued use of program components."[1]

How pharmacy is connected with sustainable development goals as per WHO?

The Sustainable Development Goals (SDGs), officially known as Transforming our world: the 2030 Agenda for Sustainable Development is a set of 17 "Global Goals" [2], which in brief are as follows **(Fig. 1):**

Pharmaceutical Industry and Health / Cities / Environment

To meet the goals set out at the COP 26 conference in 2021, and recently confirmed at COP 27, nations throughout the world have set aims to achieve net zero carbon emissions and a brighter society by 2050. To help with this effort, energy-intensive industries, such as the pharmaceutical industry, are being pushed to change practices and set their own ambitious targets to futureproof operations. The three goals are directly linked with the pharmaceutical sectors which includes good health and well-being (SDG 3), sustainable cities and communities (SDG 11) and climate action (SDG 13). While some effects of climate change, such as continued sea level rise, cannot be reversed, "strong and sustained reductions in emissions of carbon dioxide (CO2) and other greenhouse gases (GHGs) would limit climate change" going forward, according to the latest Intergovernmental Panel on Climate Change report released in August 2021. Like other manufacturing sectors, the pharmaceutical business contributes improve the sustainability of its operations. To see how the sector

Figure 1: Sustainable Development- 17 "Global Goals"

is fairing, we reviewed pharma companies reporting environmental, social, and governance (ESG) scores. The Green Chemistry Working Group of the IQ Consortium initially met with the FDA in 2012 to identify prospects for boosting green chemistry. As a significant delivery device partner for pharmaceutical firms, one must also optimize their own processes. The following shows progress made to far towards being more sustainable - including examples from journey - and highlights areas where improvement has been missing thus far. [3]

GREEN CHEMISTRY AND SUSTAINABILITY

According to one scientist in US, Pharmaceuticals, the notions of green chemistry and sustainability have been widely embraced in the pharmaceutical business over the past 15 years, in the routine creation of greener API processes for all projects via innovative chemical research and new technologies. However, other scientists emphasises that more ways besides green chemistry principles should be considered to achieve true

sustainability, such as designing an effective waste management strategy at the end of the process. The field of chemistry known as "green chemistry," often called "sustainable chemistry," focuses on designing and improving goods and processes to reduce or eliminate the usage and production of hazardous materials. Environmental chemistry and green chemistry are not the same thing. The former focuses on how chemistry affects the environment and how environmentally friendly sustainable practices may be developed (such cutting back on the usage of non-renewable resources and developing pollution control measures). The latter focuses on how certain harmful or poisonous compounds affect the environment.[4]

The following is a list of the twelve guiding concepts for green chemistry that were proposed in 1998 by American chemists Paul Anastas and John Warner **(Fig. 2):**

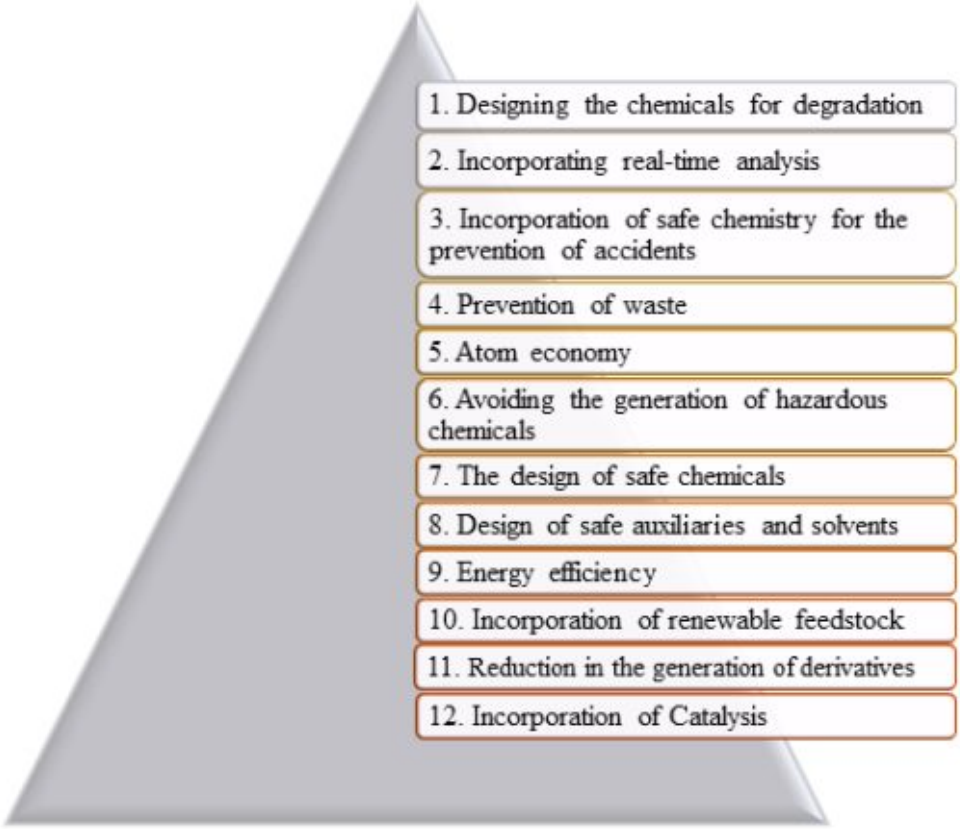

Figure 2. 12 key principles of green chemistry

1. **Designing the chemicals for degradation:** When constructing a chemical product to perform a certain purpose, care must be taken to ensure that the chemical is not an environmental contaminant. This may be accomplished by ensuring that the chemical degrades into non-toxic compounds.

2. **Incorporating real-time analysis:** It is necessary to build processes and analytical techniques to the point where they can provide real-time data for their monitoring. As a result, the process may be stopped or controlled by the people involved before harmful or dangerous compounds are created.

3. **Incorporation of safe chemistry for the prevention of accidents:** It is critical to ensure that the compounds used in chemical processes are safe to use while developing them. This may aid in the prevention of industrial hazards such as explosions and fires. This may also assist to create a safe environment around for procedure to take place in.

4. **Prevention of waste:** In any circumstance, it is preferable to avoid the creation of waste materials rather than to clean up garbage after it has already been generated.

5. **Atom economy:** Green chemistry-based synthetic processes must include all raw materials into the end product to maximise consumption. Strict adherence to this is necessary to reduce the amount of trash produced by any kind of procedure.

6. **Avoiding the generation of hazardous chemicals:** To prevent the certain of some poisonous compounds that harm human health, reaction and processes that include the synthesis of such molecules must be optimised.

7. **The design of safe chemicals:** Chemical goods must be non-toxic to persons and the environment when designed to perform a certain purpose. Developing chemical goods to achieve a goal requires procedures to assure health and safety for humans and the environment.

8. **Design of safe auxiliaries and solvents:** The use of auxiliaries in processes should be minimized and optimized to minimize hazards, even when necessary.

9. **Energy efficiency:** The amount of energy consumed by the process must be decreased as much as possible to the best of its capacity.

10. **Incorporation of renewable feedstock:** It is critical that the use of renewable raw materials and components be prioritised over the usage of non-renewable ones.

11. **Reduction in the generation of derivatives:** Minimizing the unnecessary use of derivatives is crucial as they often require additional reagents and chemicals, leading to excess waste generation.

12. **Incorporation of Catalysis:** It is critical to encourage the usage of such catalysts and catalytic reagents in order to reduce the energy demands of the chemical reactions that occur throughout the process.[5]

Impact of medicines on environment and connection with health

Medicines have a significant role in both human and animal illness treatment and prevention. However, due to the nature of medicines, they may have unforeseen consequences for animals and microbes in the environment. Although the side effects on human and animal health, are explored in toxicology and safety studies, the potential environmental repercussions of pharmaceutical manufacturing and usage are less well recognized and have only lately become a research focus of interest [6]. Some of the impacts of various chemicals are widely accepted, most notably veterinary anthelmintics and antibacterial treatments, however there are many other substances that can affect organisms in the environment. Furthermore, breakdown products and the mixing of multiple physiologically active chemicals may have unforeseen environmental impacts. As people can observe, it is critical that we work together to keep all drugs out of the environment, where they might hurt other animals and potentially endanger us.[7]

SUSTAINABLE STRATEGIES: GREEN CHEMISTRY AND PHARMACEUTICAL MANUFACTURING

Drug design tries to optimise the pharmacological benefits for a specific target while minimising the drug molecule's toxicological consequences. The purpose of pharmaceutical process development is to offer efficient

manufacturing conditions that eliminate or minimise toxicologically active contaminants.[8]

The ICH guideline for residual solvents in medicines divides solvents into three classes, from toxic or carcinogenic solvents to class 3 solvents with little toxicologic potential.

- Avoiding the use of hazardous solvents and process conditions that result in impurities coincides with the green chemistry idea of 'choose synthetic methods employing nontoxic substances' as well as regulatory requirements such as those outlined in the ICH.
- The use and definition of green solvents from a green chemistry ensure patient safety.
- The development of APIs and other drug components with less environmental impact is a component of the solution to the issue of API residues in the environment.
- However, a reduction of the impact of pharmaceuticals on the environment can be addressed

The proposed GREENER concept, including a "benign by design" approach, takes the natural environment as well as the patient into account.

Transition to eco-friendly packaging

In contrast to non-recyclable (or difficult-to-recycle) packaging such as plastic bags, composite chip bags, polystyrene clamshells, sustainable packaging generates little, wrappers or no waste. Eco-friendly items, rather than ending up in a landfill or the ocean, either decompose or can be recycled. They are shifting away from old, potentially hazardous packaging materials and towards more sustainable options. But how do they do it? Let's take a look at green packaging in pharmaceuticals.[9]

The following are the most common types of sustainable packaging:

a) **Compostable -** Compostable packaging is manufactured from materials that degrade in the environment without releasing hazardous chemicals. [10]

b) **Biodegradable -** Biodegradable packing materials degrade in the environment as well. Biodegradable materials which require a particular environment

c) **Recyclable -** Recycling materials can be gathered and remanufactured into new goods.

> Many regularly used packaging materials are potentially recyclable, but end up in trash because they are too complex and energy-intensive for standard recycling streams to handle.[11]

Here are a few ways that companies can reduce the environmental impact of their packaging:

- Reduce the use of packaging materials.
- Use recycled materials
- Implement biodegradable or compostable materials
- Optimise packaging design
- Use eco-friendly transportation
- Encourage recycling

Improve waste management

Pharmaceutical wastes may be produced by a range of activities in the health care system, including the use of syringes, and are not limited to intravenous (IV) preparation. In general, pharmaceutical waste may consist of personal medications, Waste material chemotherapy drug residues, excess drugs, Containers with hazardous waste drugs, Open containers of drugs that cannot be used, Drugs discarded; and Contaminated garments, absorbents, and spill cleanup material, Expired medications, Environmental groups, law enforcement agencies, government agencies, and waste management organisations are all collaborating to avoid pharmaceutical contamination.[12]

Strategies for Hazardous Waste Management for Waste minimization

Incineration

Incineration is a waste disposal process that burns solid organic waste to create residue and gaseous by-products. This method is ideal for solid waste and water management residue disposal. Solid waste is reduced by 20–30% using this strategy. Incinerators and other high-temperature waste treatment facilities are called “thermal treatment”. Waste incinerators create heat, gas, steam, and ash. Industrial trash incineration is far larger than residential garbage incineration. It disposes of solid, liquid, and gaseous waste. Some hazardous garbage may be disposed of this manner (For example, biological medical waste). Incineration is controversial due to gaseous pollution. Burning unsuitable materials like pressurised gas canisters, reactive chemical waste, halogenated chemicals, polymers, mercury, and radiography waste requires complex

incineration designs with air pollution control devices, secure landfills, skilled operators, and high investment costs.[13]

Autoclaving

In autoclaving, pathogens are killed by putting the Biomedical waste (BMW) in a pressure vessel with saturated steam that comes into direct contact with it. This happens for a long enough time and at a high enough temperature. The Biomedical Waste Rules say what the autoclaves must have in terms of temperature, pressure, and reside time in order to safely disinfect. Before being put in an autoclave, BMWs need to be shred to a good size, which is a process that would break down often. When you use an autoclave, you make waste that can be dumped in the ground with regular trash. It creates a stream of wastewater that needs to be disposed of properly. Autoclaves need qualified technicians to run, and they cost about the same to buy and run. No matter how helpful it is, autoclaving is not good for getting rid of human or animal body parts, chemicals, or pharmaceutical waste. [14]

Microwaving

An electromagnetic field applied to the BMW causes the liquid in the waste to vibrate and heat up, eliminating the pathogenic components by conduction. If the UV light reaches the waste material, this approach is effective. BMWs need shredding to an appropriate size and humidification before to microwaving. Microwaving is incompatible with human anatomical, animal, chemical, or pharmaceutical waste, as well as big metal components. Microwaving generates garbage that may be landfilled with municipal rubbish. The benefits of this treatment system include low electrical energy requirements and no need for steam. The downsides include the necessity for skilled personnel and the frequency with which shredders fail. This technique requires a moderate investment and running expenditures.[14]

Deep burial

A pit or tunnel should be excavated around two metres deep. Fill half of the hole with garbage and cover with lime up to 50 cm from the surface before filling with soil. When adding garbage to the pit, always cover it with 10 cm of soil. According to the Biomedical Waste Rules, Deep burial is only an option in remote locations without access to centralised treatment facilities, with prior clearance from the prescribed the law enforcement officials. Animals must not have access

to burial grounds. Covers made of galvanised iron or wire mesh can be utilised. The pits should be set far enough away from population to prevent surface or ground water pollution. The groundwater table should be at least six metres below the deep burial pit's lowest level. The region should be resistant to flooding and erosion. The location of the deep burial site must be approved by the appropriate authorities, such as the CPCB/SPCB or the District Pollution Control Board Office. The institution must keep a record of all trenches utilised for deep burial. The greatest advantage of deep burial is that harmful substances do not travel straight away to the ground surface.[15]

Chemical disinfection

In the context of a health care facility, chemical disinfection is most effective when used to the treatment of liquid wastes such as blood, urine, faeces, or sewage systems. Strong oxidants, such as chlorine compounds, ammonium salts, aldehydes, or phenol compounds, are added to the environment in order to make pathogens inert. Additionally, the length and duration of contact between the waste and the disinfectant, as well as the kind and amount of chemical that is used, are all factors that impact the success of the disinfection process.[14]

Secure land filling

Landfilling solid BMWs at a hazardous waste facility is secure. Pharmaceuticals, cytotoxic medications, solid chemical waste, and incinerator ash must be disposed of in safe landfills under the Biomedical Waste Rules. Burying garbage in landfills is still common in most nations. Underused quarries, mining voids, and borrow pits were utilised for landfills. A properly constructed and managed landfill can safely and affordably dispose of rubbish. Wind-blown rubbish, vermin recruitment, and liquid leachate may result from older, poorly designed, or poorly managed landfills. When organic waste decomposes anaerobically, landfills release gas (mainly methane and carbon dioxide). A greenhouse gas, this gas destroys surface plants and generates odours. Modern landfills use clay or plastic liner to contain leachate. Ordinary rubbish is compacted and coated to increase density and prevent bugs (such as mice or rats). Landfill gas extraction systems are implemented at numerous landfills. Gas from landfills is pumped via perforated pipes and flared or burnt in gas engines to generate electricity.[16]

Waste immobilization

a) Encapsulation

Encapsulation is extremely useful for disposing of objects that are sharp and other materials which may become sharp. It is also excellent for the disposal of pharmaceutical residues and some dangerous substances. One key advantage of the strategy is that it reduces the risk of scavengers accessing dangerous medical waste. Encapsulation is the process of solidifying medications in a plastic or steel barrel. Drums should be clean and have not contained explosives. Most hazardous wastes may be mixed into a waste-cement system, which contains 75% solid and semi-solid medicines and the remaining cement, cement/lime, plastic foam, or bituminous sand. Cut the drum lids apart and bend them back to facilitate filling. Avoid cutting your hands while putting drugs into drums. After 75 percent of the barrels have been filled, a 15:15:5 (by weight) mixture of cement, lime, and and water is added to fill them completely. To make transporting the drums easier, place them on pallets, which may then be loaded onto a pallet mover. [17]

b) Inertization

Inertization is a process where pharmaceuticals are removed from packaging materials, pills are extracted from blister packets, and a homogenous slurry of water, cement, and lime is formed. Due to the possibility of dust, workers must wear protective clothes and wear masks. The paste is then delivered in liquid form to a landfill by a concrete mixer truck and decanted into regular municipal garbage. The paste subsequently solidifies and disperses throughout the municipal solid garbage. The procedure is quite affordable and may be performed using simple equipment. The primary needs are a grinder or road roller to smash the medicines, a concrete mixer, and cement, lime, and water supply.[16]

Sewer

Some liquid medications, such as syrups and intravenous (IV) fluids, may be diluted with water and disposed into sewers in modest amounts over time without causing severe public health or environmental problems. Small amounts of well-diluted liquid medications or antiseptics may also be flushed down fast running watercourses. In cases when sewers are in disrepair or have been damaged by conflict, the aid of a hydro geologist or sanitary engineer may be necessary.[18]

Key contributing factors associated with active pharmaceutical ingredients

Dynamic drug fixings (APIs) can enter the indigenous habitat because of assembling, use, as well as removal, making public affected by about possible ecological hazards. One disadvantage of estimating ecological data sources in view of utilization inside a nation is that adherence to Programming interface treatment, especially for long haul treatment, is around half in big league salary nations and much lower in lower-pay economies. Albeit this action may consequently misrepresent Programming interface use, a significant number of these unused APIs can in any case be discarded in a way that will ultimately bring about ecological corruption. [19]

Factors influencing consumption patterns of active pharmaceutical ingredients

1. Disparities in disease loads
2. Healthcare policy
3. Cost-effectiveness of active pharmacological substances
4. Self-medication and excessive prescribing
5. Antibiotics and other active pharmacological substances used in veterinary medicine
6. Active therapeutic ingredient consumption rates
7. Non-traditional active pharmacological ingredients: complementary and alternative medicine's contribution
8. Receiving environments

Reducing toxicity in drugs / Green Toxicology for the early assessment of environmental safety

One of the most challenging parts of creating safer products and processes is minimizing toxicity while maintaining functionality and efficiency **(Fig. 3).** To achieve this goal, you need to understand not only chemistry, but also the principles of environmental science and toxicology. Highly reactive chemicals for the production of products because they are very effective in carrying out molecular changes that are more prone to react with unexpected biological targets, both ecological and human, causing unexpected negative effects. Even the most experienced molecular magician runs into trouble without a full toolbox if they don't understand the basic structure hazard relationship.

Drug toxicity is caused by a variety of physiological parameters, including age, dose-time correlation, exposure time, dietary position, gender, sex, and hormonal circumstances. Overdose deaths can be avoided.[20]

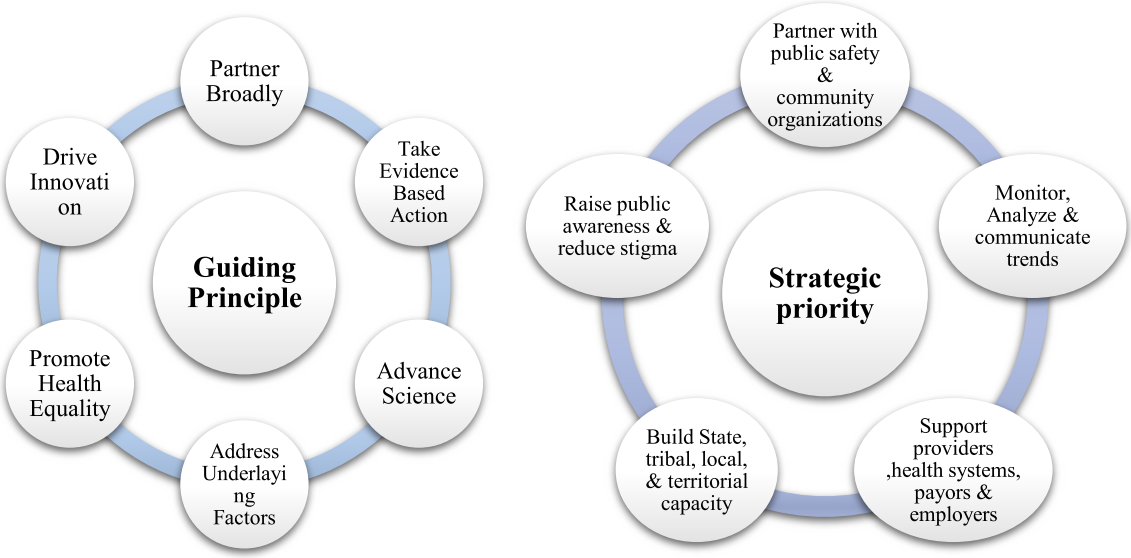

Figure 3. Measures to prevent overdoses and substance use-related harms.

Educate the public on how to use and dispose of medication

Household Waste Disposal Recommendations from the Food and Drug Administration.

- Remove pills from original containers,
- Mix with unwanted substance
- Place combination in disposable container with a cover and seal,
- Remove any identifying information from the empty original container,
- Throw away the sealed mixture and the empty original container

There is a lot of waste in the pharmaceutical industry, but it doesn't have to be that way. Every pharmaceutical firm, manufacturer, and facility can help to make pharma greener by adopting a proactive attitude and implementing sustainable solutions. [21]

CONCLUSION

Green chemistry is becoming more and more popular all over the world. Not only does green chemistry solve many environmental problems, but it also

creates high quality products with minimal harmful material residues. When we look at the overall situation of the pharmaceutical industry, and the challenges we face, including environmental concerns, high-cost products, and many more, we can say that green chemistry is a revolutionary way to improve living standards while reducing environmental issues. Green chemistry is good for the environment and good for the economy. Green chemistry will transform conventional pharmaceutical companies into sustainability companies.

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REVIEW ARTICLE

ROLE OF PHARMACIST IN DEVELOPING SUSTAINABLE HEALTHCARE SYSTEM

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ABSTRACT

This review is focusing on a proactive role of pharmacists to maintain and further promote sustainability in the healthcare system. It is very essential for pharmacist to play an active role in educating and spreading awareness to the public and helping other healthcare professionals for the sustainable practices in healthcare system. A pharmacist with updated knowledge and efficient skills for best practices in sustainability can provide high-quality care and build up a safe environment. The versatile role of pharmacist makes him a leader as well as a trusted health professional of a healthcare system. There are many different roles that pharmacist can perform include patient counsellor, clinical practitioner, formulation scientist, analyst, regulatory controlled, educator, health professional, in medicines management and safe environment, etc. are also depicted in this review. At last, it is the collective efforts by all stakeholders who are engage in health wellness of the society to work together for a very noble cause by understanding various health related problems, their causes and learn effective management of medicines and its disposal and also teach to common people, which can help in improvement of public health and also help in keeping the safe environment for the future generations also.

Keywords: Sustainable practices, Healthcare System, Pharmacist, Roles and Responsibilities, Safe Environment

INTRODUCTION – SUSTAINABLE HEALTHCARE SYSTEM

A sustainable healthcare system is 'a system of healthcare which aims and provides best quality care in an affordable way, with no or minimal impact to the environment'. It further describes in simple way that a system meets today's health needs and with focusing to the best health for next generations. Health of all the living creatures on earth and the environment surrounding them are connected intrinsically and mutually responsible to support each other by supporting each other's health. Sustainable healthcare is based on three main principles.

1. Sustainable prevention,

2. Sustainable pathways and

3. Sustainable practice

Sustainable prevention covers first prevention - health and lifestyle, second prevention identification of disease in early stage and third prevention – minimizing the impact of developed disease. It means to provide both short-term and long-term sustainability advantages with support of minimum healthcare consumption. Sustainable pathways mean people will get the right and effective health service at the right time, right place and right price, and developing healthcare systems effective and efficient by minimizing healthcare's environment footprint using decrease in patient travel and avoiding duplication of health tests which is not observed in current scenario. Sustainable practice can be achieved by reducing the carbon footprint and resources which impact the environment and used to provide high quality health results. It can be achieved by decreasing biomedical waste and high standards of waste management, using highly sustainable and reusable materials and medical devices. Hence, it is the duty of pharmaceutical industries, organizations, government, medicine experts, healthcare professionals – PHARMACISTS (specially have professional responsibility) to take the steps that show both the clinical effectiveness of medicines and minimizing the environmental impact because of its use. Increase in population, unhealthy and unhygienic lifestyles, enhancing in chronic disease, ageing populations and high access to healthcare leads to boosting in healthcare requirements and high usage of natural resources in coming years, which drives to have impact on environment and climate change, hence it is the high need of sustainable transformation today to save the environment.

Not only considering one of the environmental challenges, climate change is now becoming a significant health threat that we have ever seen before [1]. Climate change is affecting social and environment health of people such as clean air, safe drinking water, sufficient food and secure shelter, specially to the people who are most vulnerable and deprived and are suffering from health inequalities [2]. The data shows that it's a trigger point to do

something now if we want to maintain the last 5 decades of our tremendous efforts of public health gains otherwise all these would be wiped out very soon.

ROLE OF PHARMACIST - GENERAL

The goal of sustainable healthcare systems can be achieved when different health professionals work together to meet the healthcare needs of patients. Globally, general practice (GP) responsibilities have increased significantly due to the growing number of patients with multiple illnesses and the corresponding rise in drug consumption. [3,4,5] Pharmacists are required to perform a variety of tasks in general practice, including medication reviews and the management of both acute illnesses and chronic medical disorders. They are considered as qualified specialists in medications with a range of knowledge and clinical abilities [6,7]. The PHARMACIST must be recognized as the top most professional that responsible for therapy management. PHARMACISTs are experts in healthcare systems as they are knowing the safe and effective use [8] of medicines. As medicines are the most significant intervention in healthcare systems [9]. The impact of APIs, the large carbon footprint generated from manufacturing and distribution of pharmaceutical product and finally the pharmaceutical waste, all three are having the major impacts on environment. The various stages of a life cycle of pharmaceutical product development, post production processes, health study, prescription, usage and final waste disposal, PHARMACIST has an impact on all these stages. The **Fig.1** exhibits various roles of pharmacist in different disciplines of healthcare system.

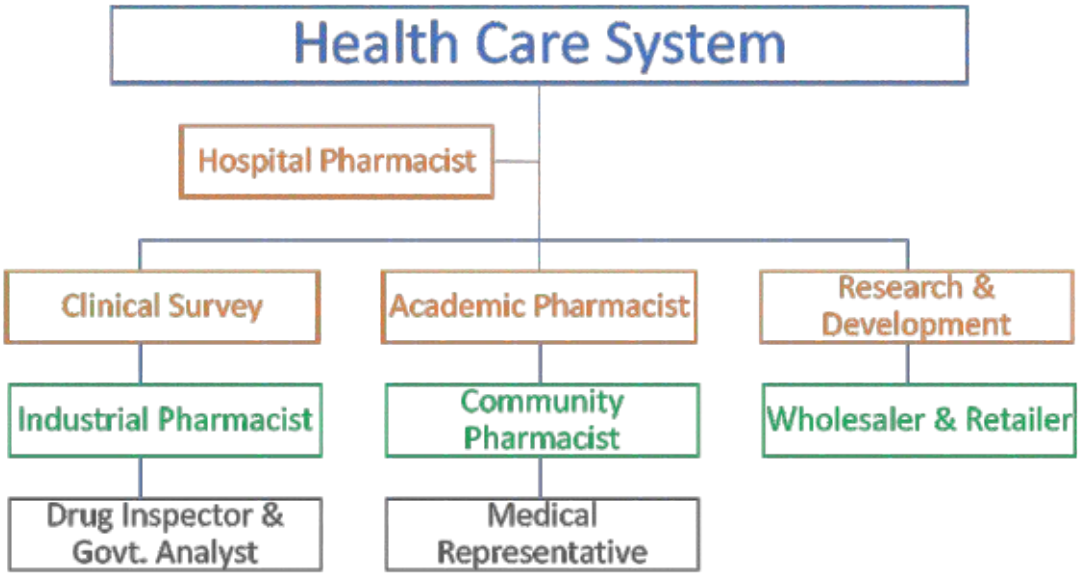

Figure 1: Various Roles of Pharmacist in Different Disciplines of Healthcare System [10]

The word PHARMACIST [5] stands for

P – Patience & Persistence	H – Honesty & Hardwork
A – Alertness and Active	R – Researcher
M – Motivator	A – Academician and Administrator
C – Courageous	I – Intelligent
S – Sincere and Spontaneous	T - Thinker

FUNCTIONAL SERVICES AND GOALS TO BE ACHIEVED BY PHARMACIST

The functional services by a PHARMACIST are -

- Clinical
- Medicines Information
- Quality Assurance
- Medicines Acquisition / Purchasing
- Technical Services
- Medicines Management
- Information Technology
- Research & Development
- Education & Training
- Medicines Supply & Dispensary

The Fig. 2 shows the goals to be achieved by a PHARMACIST to have sustainable healthcare systems such as availability of pharmaceutical care and services as and when required, providing right diagnosis and decision at the right time, counselling and updating information to patients, a sustainable, flexible and resilient delivery approach to the patients, etc.

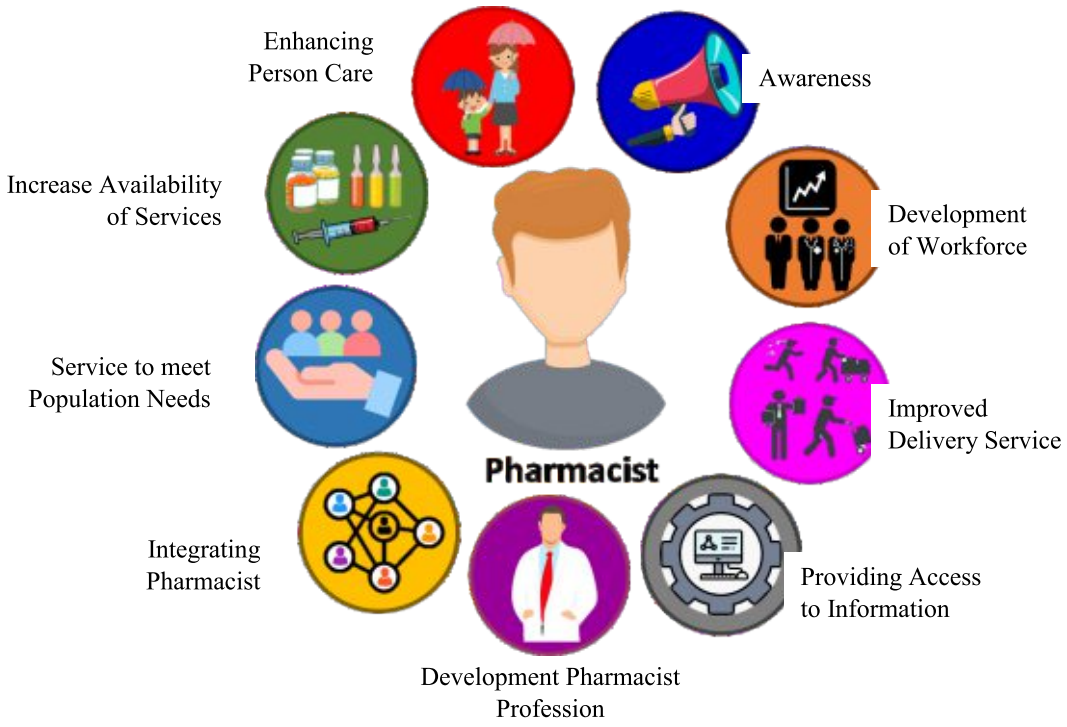

Figure 2: Goals to Achieve by A Pharmacist to Achieve a Sustainable Healthcare System [11]

DIFFERENT TYPES OF PHARMACISTS, THEIR ROLES AND APPLICATION FOR SUSTAINABLE HEALTHCARE

Table 1: Role of Various Types of Pharmacists for Development of Sustainable Healthcare System [10]

Type of Pharmacist	Role / Functions	Application for sustainable healthcare
Academic Pharmacist	• Teaching, Research, Practical Training • Organize conference, seminar, workshop, training, project, etc • Overall skills & personality development	Students who gain knowledge of scientific principles and techniques of pharmaceutical sciences help in new drug discovery and development and growth of his career in pharmacy profession;

		Disseminate information about drug disposal; understanding of medicine metabolism and toxicology help in understanding its impact in nature and to the environment
Industrial Pharmacist	• R&D • Manufacture and QA • Drug Information • Drug registration & application • Clinical Trials and post marketing surveillance • Sales and Marketing • Management	Contribute to development of pharmaceutical product with high quality, safety and effectiveness; Understanding of GMP, validation, overall production, testing etc. using six sigma and QbD approach; Provide detailed information on medicines to other health professionals and to the patients; Can do online efficient product submission as per the regulatory requirements of the country; Can have details information of effect of drug on humans before commercializing the products; Use biodegradable materials; usage of innovative approach for waste-management like plasma technology; perform on-line Qc testing using PAT; do architectural innovation with minimum resources and maximum utilization; shifting from in-vivo to in-vitro and ex-

		vivo studies; Reduce off-target events; reduce exposure via less emission;
Primary care pharmacists / prescribing advisors	• Health services including doctor's surgeries, advice to doctors for selection of medicine, strength and it's dose	Best use of medicines and its resources; Medication review clinic or pharmacy clinic; risk and hazard mitigation
Community pharmacist	• Frontline healthcare professional • Helping people, assessing their health status, and taking decision • Dispensing medicine and offering patient advice	Help to maintain people's health, diet control, quitting bad habits of patients; risk and hazard mitigation
Hospital Pharmacists	• Part of team where main focus is on patients and their health • Assist doctors • Manufacturing sterile medicines • General management of hospital • Enhance patient awareness	Manage drug shortages; Medication experts, COVID-19 medication management; develop treatment protocols, etc. Reduce medication errors and adverse drug events; Securing access to medicines and medical devices Closed loop medication system; Medicines without harm initiative
Regulatory Pharmacist	• Having the duty to see that all relevant laws and regulations are followed	Professionals in pharmaceutical regulation carry out important work with wide-ranging consequences. They ensure that

	• Regulate and communicate drug approval requirements • Member of a regulatory team	medications adhere to certain national and local regulations. Regulatory experts aid in guaranteeing that the general public has access to secure and efficient medications. [12]
Research & Development Pharmacist	• Developed new molecules for the different diseases • Formulate the new formulation to increase effect of already available formulation	Pharmacists contribute to research and their expertise in formulation development will particular relevance to the biological availability of active ingredients and enhance the patient's life. [13]
Pharmacist with special interest	• Specialized in specific area such as cancer and diabetes etc.	Clinical and educational services to community residents

FUTURE RESPONSIBILITIES OF PHARMACIST

By having knowledge of pharmacist role, it is important that pharmacist should accept the responsibility of entire medication-use process to reduce impact of pharmaceuticals on environment. The whole process of drug manufacturing to consumption and medical waste generation contributing to climate change [14]. Following are some approaches that pharmacist has to take up to maintain sustainable healthcare systems.

- More rational in prescribing reduce volume of unused medicines
- Become trusted, accessible and respected medical information resource
- Aware patients how to tackle the problems of drug disposal procedures
- Update themselves with every type of drug disposal method used in their area/region and recommend to patients
- Significant fundamental changes in pharmaceutical education curriculum covering drug disposal methods, drug metabolism and toxicology and its impact on nature [15]
- Effective eco-friendly approach for medical waste management programme
- Proper patient counselling about consumption of any medicine [16]
- Continue to learn, educate themselves and go for training for awareness of medicines use and its side effects [17].

CONCLUSION

Medicine use and its disposal is very critical issue today and need deeper understanding from healthcare professionals to the patients. Pharmacists as the trusted health professionals has the right to remain forefront in this movement and they are the real professionals who can educate and advice the people about the linkage between climate issue and public health. Proper and complete patient counselling about use of safe medication and its disposal can have a significant impact on public health and environment. This will only possible if these types of studies included in the education curriculum. Proper education, training, good hands in research with analytical capabilities make pharmacist to develop safe, effective and economic product with help of industrial resources and government support. Significant research and all multidisciplinary stake holders, government, physician, pharmacists, and people should engage to understand various health issues and learn proper use of right medicine with right diagnosis can improve public health and also reduce the burden on environmental impact. Some key priorities are rational prescribing and medicine use, controlling pharmaceutical waste, preventing adverse health, safe infrastructure and ways of working.

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REVIEW ARTICLE

AN OVERVIEW OF NATIONAL STRATEGIES FOR INTEGRATION OF SDGS IN PHARMACEUTICAL SECTOR

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ABSTRACT

Integration and implementation of the Sustainable development Goals by UN is important of achieve the goal by 2030. The defined 17 SDGs delivers the goals, targets and plan to execute and achieve the substantial plan that are the key measures of growth of any country. Importantly, for implementing the goals the budget and national policies are the prosecutors. The drafting of the national strategies and successful implementation to achieve the agenda "no one should leave behind" is most crucial one under national government. Looking at the various perspective, the current review highlights the various national strategies under Indian government for integration of UNSDG under pharma sectors. The review will talk in details about the key points and consideration while implementing the policies in national framework, various government policies designed by NITI AAYOG and current schemes implemented by Indian government. The review will also provide the consolidated data of various registration under various schemes. In conclusion, the review will provide the detailed overview of various national strategies for implementing the SDGs under Indian pharma and health sectors.

Keywords: Sustainable Development Goals (SDGs), National Strategies, Government schemes, Pharma regulation

INTRODUCTION

In the year 2015, the United Nations proposed "The Sustainable Development Goals" (SDGs) to eradicate the global issues like poverty, hunger, environment pollution, malnutrition, poor health, quality education etc (**Fig.1**). There are total 17 SDGs, which are aimed to be completed by the year 2030. Out of 17 SDGs, the 3rd goal is good health and well-being. The aim of this goal is to provide basic health care to those 400 million people across the globe who can not either access it or afford it. One of the sub-goals of the 3rd goal is to support research & development in vaccines and medicines for communicable and non-communicable diseases & disorders [1]. **(Fig.2)**

Figure 1: United Nations Sustainable Development Goals [1]

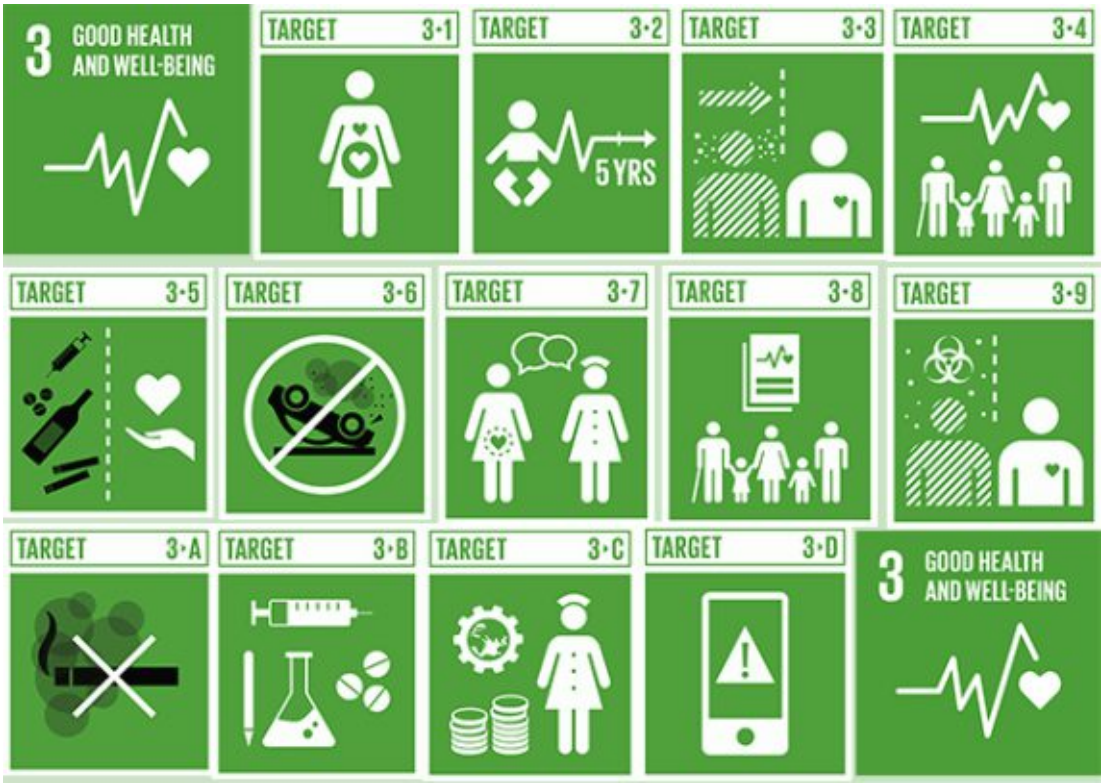


Figure 2: United Nations 3rd SDG Targets [1]

General National Strategies

Although each and individual country need to have its own national plan, strategies, program to achieved the 17 SDGs goals. However, in General a few can be considered common strategies to consider [2]. Some are as below:

1. National Action Plans: Many countries develop comprehensive National Action Plans for the SDGs. These plans outline specific targets, indicators, and strategies for achieving each goal and involve various government ministries and stakeholders.
2. Policy Alignment: Governments align their existing policies, plans, and programs with the SDGs to ensure coherence and avoid contradictory actions. This often involves conducting a gap analysis to identify areas where additional measures are required.
3. Data Collection and Monitoring: Establishing reliable data collection systems and monitoring mechanisms is crucial for tracking progress toward the SDGs. Governments invest in data infrastructure and capacity-building to monitor and report on indicators related to each goal.

4. Engaging Stakeholders: Engaging with civil society, private sector, academia, and other stakeholders is fundamental for successful SDG integration. Partnerships and collaboration help share responsibilities, resources, and expertise.

5. Financing and Budgeting: Allocating adequate financial resources and integrating the SDGs into national budgeting processes are critical steps. Governments often explore innovative financing mechanisms and private sector involvement.

6. Capacity Building: Building the capacity of government officials, civil servants, and institutions in areas related to sustainable development and the SDGs is essential for effective implementation.

7. Inclusive and Participatory Processes: Ensuring inclusivity and participation of marginalized groups in decision-making processes is crucial to avoid leaving anyone behind and promote equitable development.

8. Legislation and Policy Reforms: Countries may need to introduce new laws, regulations, and policies to address specific SDG-related challenges and enable sustainable development practices.

These all points can be considered as referencing while nation or international strategies to be formed while integrating SDGs in system.

NATIONAL STRATEGIES AND SDG INTEGRATION

As of the other countries, India had also actively participated and involved with other UN country member to achieve the 17SDGs by 2030. In India, this been earlier started by our honourable prime minister Shri Narender Modi Ji with "SBKA SATH, SABKA VIKAS" resembling much with UN SDGs goals that "no one should leave behind". The government of India made several strategies plans to achieve the goals. This is been comes up as "New India" with the goals that India should be poverty free, zero hunger, less terrarium and many other which can be build up by developing the infrastructure and resources [3].

India and the SDGs

Government of India is strongly committed to UN SDGs agenda 2030, this been endorsed by the prime minister of India in sustainable development summit in New York. The parliament of India has taken several initiatives to get/ propel UN SDGs agenda 2030. The National development agenda outlining the measurement of government initiatives taken place by the government of India [3].

Mainly NITIAYOG, Mo SPI, UTI are responsible for planning and strategic programming for for SDGs agenda for 2030.

SDG India Index 2018

Considering the importance of agenda 2030, NITI Aayog has decided to estimate the progress through a single measurable index that would serve as an advocacy tool. SDG India Index is proposed to deliver a holistic opinion on the social, economic and environmental status of the India and its states along with union territories.

Embedding the National Policies and Strategy: Pharma Sector

With the ancient India capture Vasudhaiva Kutumbakam, much resembled goal of UN principles one to all. Line to this, the national strategy document, 'Strategy for New India@75, deep down a long strategic plan for making india, comprising 41 sectors- each mapped to the relevant SDGs. Further, the major 11sectors (majorly the pharma) been divided into several major cluster such as infrastructure, inclusion and governance [4].

The Various Schemes and Programs

NITI Aayog has taken the several initiatives and introduces the various schemes under the in line agenda 2030 **(Fig 3).** Many schemes and programs are *PMJAY-Ayushman Bharat, The Pradhan Mantri Kisan Samman Nidhi (PM-Kisan), National Rural Drinking Water Mission,*

Swachh Bharat Mission, National Health Mission (NHM), Pradhan Mantri Awas Yojna (PMAY)

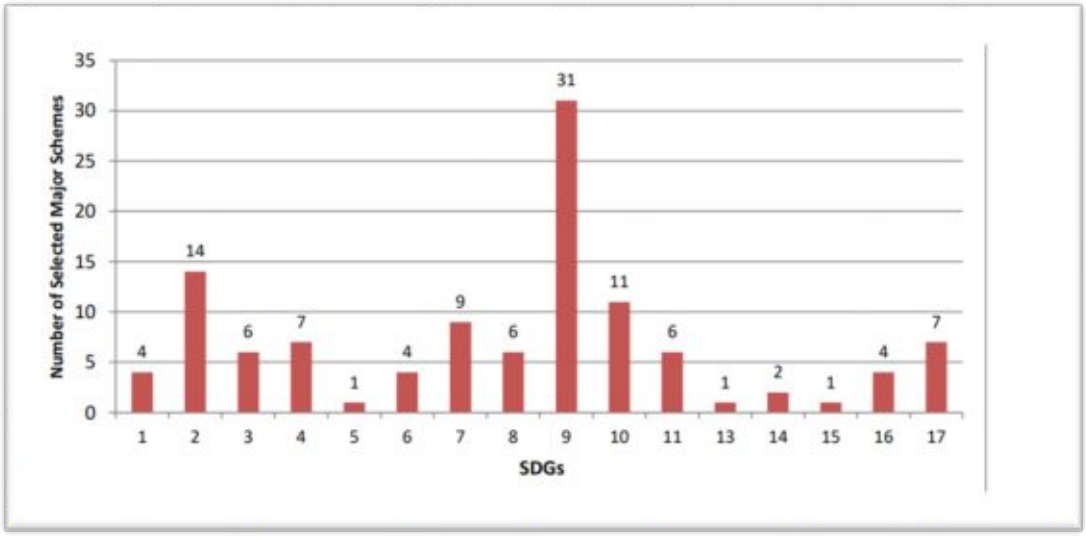


Figure 3: Major Schemes of India – For Various SDG [4]

The data released by the NITI ayaog itself speaks a lot. Many programs like s Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) for life insurance and Pradhan Mantri Suraksha Bima Yojana (PMSBY) for accidental death insurance have also been launched for the health sector as per the agenda 2030.

Similarly, talking about more in detail to the pharma and health sector a many of the scheme are being run by the government of india. POSHAN Abhiyaan, Mid-Day Meal scheme is the largest program run by the government as world largest program for providing the food and nutritious food to around 120 million children for improving the health and nutrition [5].

A remarkable achievement was under national heath mission till date and many more strategic plan are being implementing by the government of India to achieve the height towards leading to agenda 2030. Talking about the Ayushman Bharat, world's largest health protection scheme provides an annual cover of INR 500,000 (USD 6,666.7) to 100 million families from economically weaker groups [6]. Lots of budget been allocated to achieve the individual goals by the government of india **(Table 1).**

Table 2: SDG Goal-wise Expenditure of Selected Major Schemes (Directly Linked with SDGs) (in INR Billion)

SDG Goal	2017-2018	2018-2019	2019-2020 (RE)	2020-2021 (BE)
9	1841.18	2071.80	2332.84	2702.39
2	746.36	834.31	1467.19	1848.76
1	697.31	760.08	872.31	789.29
3	377.83	401.94	466.18	513.64
4	320.02	374.78	450.97	485.96
11	247.64	282.03	302.62	358.79
8	96.66	161.28	215.53	265.27
6	278.88	231.67	211.92	254.34
10	188.35	194.75	205.51	215.92
7	131.40	162.49	176.69	167.24
16	77.82	90.52	96.74	89.14
17	70.96	65.94	74.65	70.38
13	18.90	19.04	17.89	21.50
5	9.45	11.38	9.61	11.63
14	3.21	4.85	9.00	11.37
15	9.55	9.78	7.87	9.26
Total	5115.53	5676.64	6917.52	7814.88

Table 1: SDG Goal -wise Expenditure for Various Schemes [6]

As per the data available, SDG 3 goal, that is good health and wellbeing been successfully. Very well example, During the COVID 19, the India was the heighten in terms of vaccine production and distribution to other market. Pharma sector played a remarkable contribution toward the SDG 3 on good health and wellbeing[7].

Promotional Schemes by Government of India to Promote Immunization (Vaccination) as Sub Part of 3rd SDG by UN

Universal immunization programme

In the year 1978, India launched the its' first immunization programme. The programme was aimed to immunize urban population. The programme was renamed as "Universal Immunization Programme" in 1985 and it was expanded to rural areas also. In 1992, the programme was included in "Child Survival and Safe Motherhood Programme" and subsequently in 1997 it was included in the realm of "National Reproductive and Child Health Programme". The Government of India launched "National Rural Health Mission" in 2005, since then "Universal Immunization Programme" has always been an integral part of it. The features of the "Universal Immunization Programme" is as follows [8]:

- It is one of the largest public health programmes immunizing nearly 2.67 crore new-borns and 2.9 crore pregnant women annually.
- It is one of the most cost-effective public health interventions and largely responsible for reduction of vaccine preventable under-5 mortality rate.
- It provides free of cost vaccination against 12 diseases (Diphtheria, Pertussis, Tetanus, Polio, Measles, Rubella, severe form of Childhood Tuberculosis, Hepatitis B and Meningitis & Pneumonia caused by Hemophilus Influenza type B, Rotavirus diarrhoea, Pneumococcal Pneumonia and Japanese Encephalitis)
- A child receives all 12 vaccine within 1st year age of child.
- With the implementation "Universal Immunization Programme" India was able to eradicate polio completely in 2014 **(Fig.4)**.

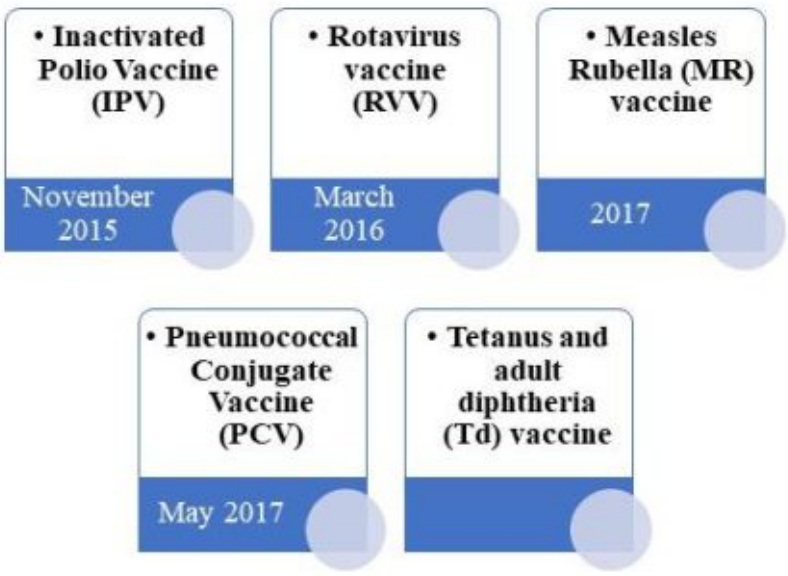


Figure 4: New vaccines developed under "Universal Immunization Programme"

Vaccine Maitri

Vaccine Maitri was a philanthropical initiative by the Government of India to provide corona virus vaccines to the under developed, developing and needy developed countries around the world [9]. In the end of February 2022, India had distributed around 16.29 crore (162.9 million) doses of vaccines to 96 countries. India donated 2 lakh doses of COVID-19 vaccines to UN for distribution to the needy people under the mission "Vaccine Maitri" ("Vaccine Maitri").

Production-Linked Incentive (PLI) for 'Atmanirbhar' Vaccine Industry

On 21st December 2022, a newspaper article in e-newspaper "Mint" published the news about the announcement of new Indian government incentive scheme to boost vaccine industry by providing [1] 2,500 crore financial assistance. The programme was aimed for enhancing the production of vaccine raw materials to improve self-sustainability if there is again increase in number of covid cases worldwide.

The programme aims to reduce import dependency for filters, cassettes and cartridges used in vaccine manufacturing and increase production of immunization shots in the country.

In July 2022, survey was carried out from the vaccine & biopharmaceuticals manufacturers about the problems they are or industry is facing due to the import of the raw material, excipients and packaging materials. With this process, department

was able to collect the list of critical raw materials, micro-reactor bags, cell culture media, filters, cassettes, cartridges, and chromatography resins. The manufacturers requested the government for possible support to manufacture these materials [10].

Promotional Schemes for Vaccine Research and Development

Department of Biotechnology (DBT), Ministry of Science & Technology, Government of India is actively supporting various schemes for basic and translational research for strengthening vaccine science in the country[11] **(Fig.5).** Various schemes currently under implementation are

- Indo – US Vaccine Action Programme (VAP)
- National Biopharma Mission (NBM)
- Ind-CEPI Mission
- Mission COVID Suraksha

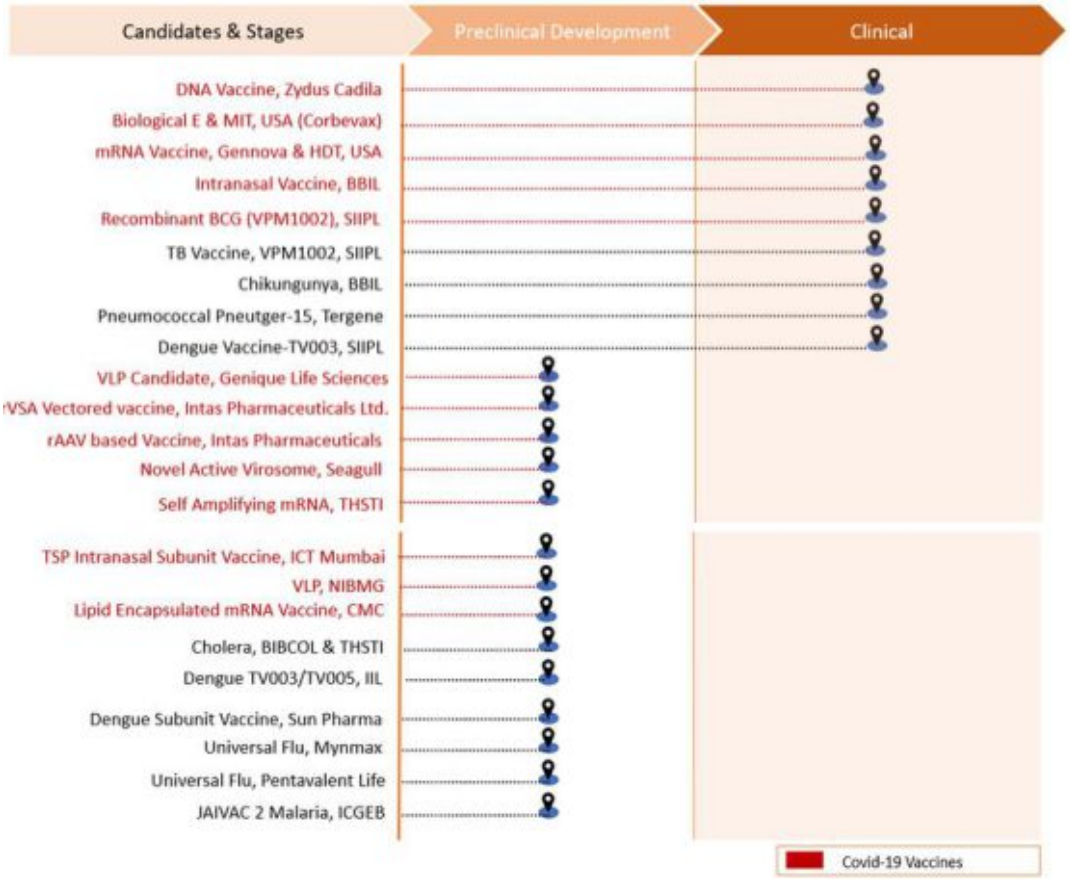
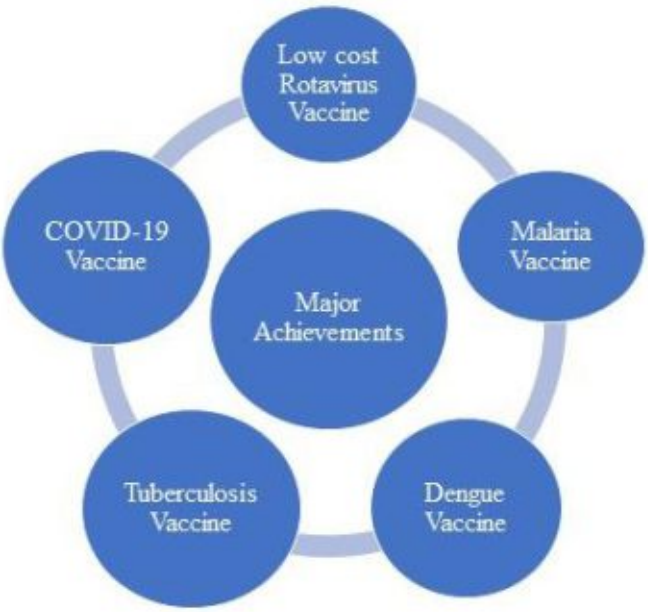
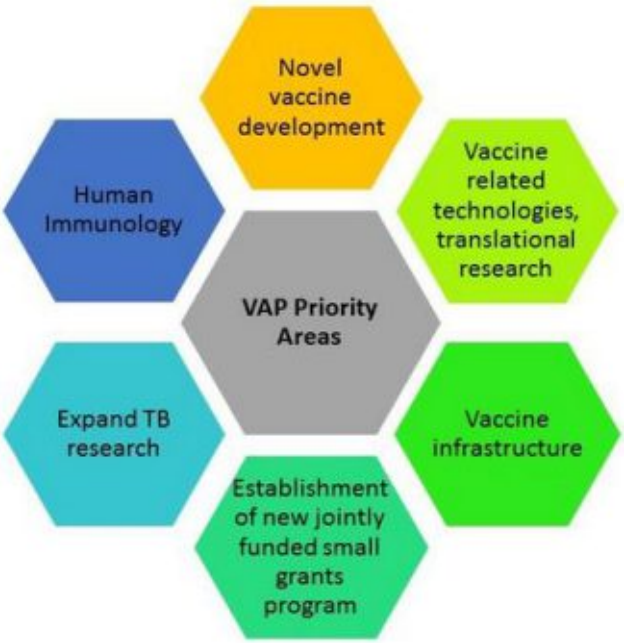


Figure 5: DBT Support for Development of Vaccine & Stage [11]

Indo-US Vaccine Action Programme (VAP*)*

The Indo-US Vaccine Action Programme (VAP), is a flagship programme of the DBT jointly with the National Institute of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH), USA, since 1987.





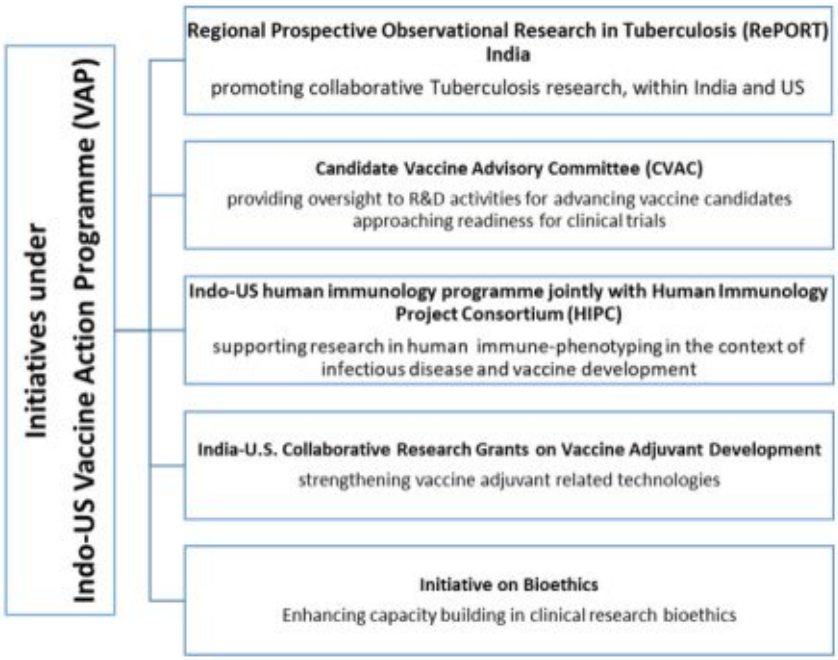


Figure 6: VAP Major Achievements, Priority Areas & Initiatives [11]

Indo-US human immunology programme jointly with Human Immunology Project Consortium (HIPC) provide Indo-U.S. Bilateral Collaborative Research Grants on Human Phenotyping and Infectious Diseases **(Fig.6).** The programme is designed to support research efforts as depicted below:

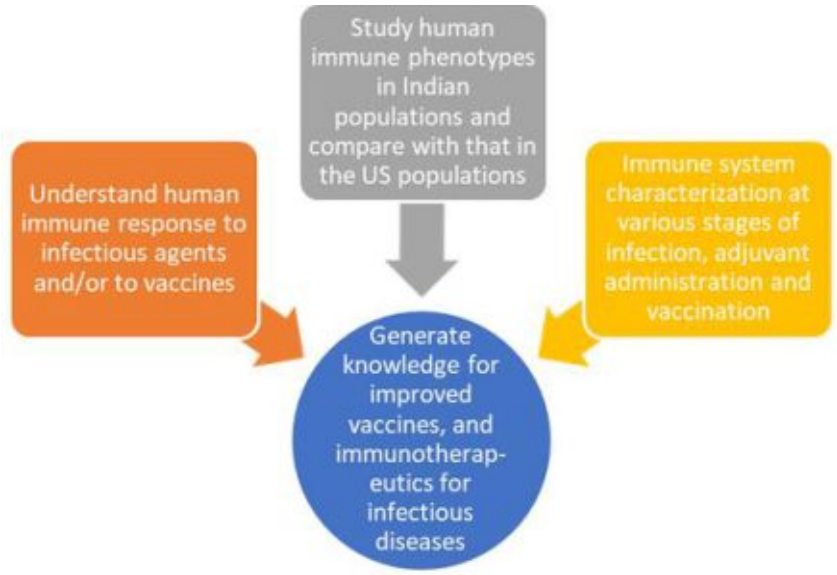


Figure 7: HIPC Work Flow [11]

National Biopharma Mission (NBM)

The National Biopharma Mission (NBM) is an Industry-Academia collaborative Mission, for accelerating early development of biopharmaceuticals. In May-2017, i3 "Innovate in India" mission was launched by Government of India. Total funding of [1] 1500 Crores for five years on a 50% cost sharing basis via World Bank loan and is being implemented at the Biotechnology Industry Research Assistance Council (BIRAC) was available. The NBM mission is also aligned with "Make in India" and "Start-up India" missions for development of biotechnology field. The availability of affordable and accessible vaccines in India is one of the priority areas of the Mission and support is being extended for vaccine candidates at different stages of development [12] **(Fig.8)** .

Figure 8: National Biopharma Mission Wordcloud [12]

Coalition for Epidemic Preparedness Innovations (CEPI) Mission

The DBT is supporting the implementation of the Ind-CEPI Mission. CEPI is an innovative global partnership between public, private, philanthropic, and civil society organizations. CEPI's endeavour is to accelerate the development of vaccines against emerging infectious diseases caused by viruses such as Ebola, Zika, Chikungunya, Nipah and SARS viruses, in alignment with the priority list established by the WHO in its "R&D Blueprint for action to prevent epidemics"

The Ind-CEPI Mission was approved on March 27, 2019, for a period of five years and is part of a broader Initiative called the 'Atal Jai Anusandhan Biotech Mission - Undertaking Nationally Relevant Technology Innovation (UNaTI)', which is expected to transform Health, Agriculture and Energy sectors during the next 5 years. The Ind-CEPI Mission aims to support vaccine development for potential outbreak threats and enhance inter-ministerial co-ordination for rapid vaccine development (Fig.9). The total funding available was [1] 312.92 Crores[13].

Figure 9: CEPI Mission Wordcloud [13]

Scheme for "Strengthening of Pharmaceuticals Industry

Department of Pharmaceuticals, Government of India proposed Production Linked Incentive (PLI) scheme on 11th March 2022 for the enhancement of manufacturing capabilities by increased investment in green field projects. Before introduction of this scheme, 3 schemes were there for pharmaceutical MSMEs given as follows [14] **(Fig. 10)**

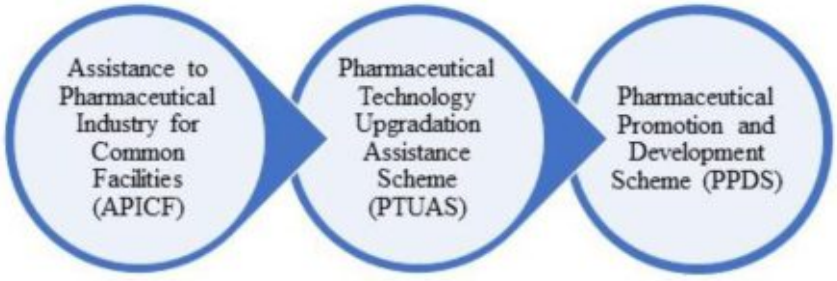


Figure 10: Existing Schemes by Department of Pharmaceuticals [14]

5.1 Financial Outlay

Assistance to Pharmaceutical Industry for Common Facilities (API-CF)						
Financial Year	**2021-2022**	**2022-2023**	**2023-2024**	**2024-2025**	**2025-2026**	**Total**
Financial Outlay (Rs. in crore)	10.30	36.60	61.90	54.10	15.50	178.40
Pharmaceutical Technology Upgradation Assistance Scheme (PTUAS)						
Financial Outlay (Rs. in crore)	00	53.60	104.30	120.70	21.50	300.10
Pharmaceutical & Medical Devices Promotion and Development Scheme (PMPDS)						
Financial Outlay (Rs. in crore)	1.50	5.00	5.00	5.00	5.00	21.50
Total Financial Outlay	11.80	95.20	171.20	179.80	42.00	500.00

Figure 11: Financial Outlay of Various Schemes by Department of Pharmaceuticals [15]

Roadmap for Indian Pharmaceuticals Sustainability [15]

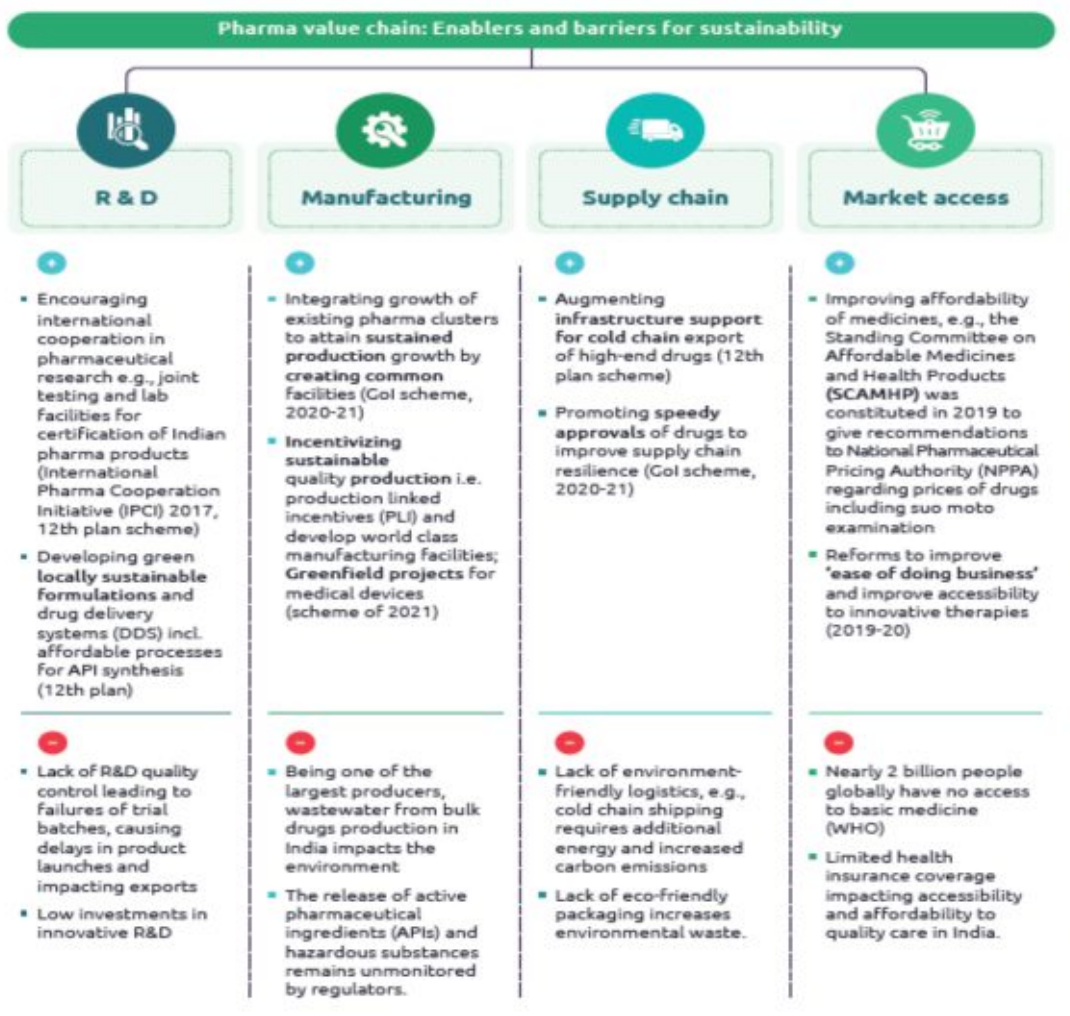


Figure 12: Enablers and Barriers for Indian Pharmaceuticals Sustainability [15]

In conclusion, the Indian government has implemented several strategic plans, policies to reach towards the UN SDGs goals and agenda 2030. Wherein several policies were made by the government of the pharma sector pirating the quality standard maintain to others. Several schemes are being run by the government like Ayushman and other for achieving the Sustainable Development Goals. Since, the pharma sector in India is huge and embracing the sustainability is major challenge, not only governance also the pharma industry need to work together and need to take some bold moves with well define strategies to successfully navigate the journey towards the sustainability and towards the achievement of UN SDGs goal by 2030.

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REVIEW ARTICLE

A ROAD MAP TO ACHIEVE SUSTAINABLE GOALS IN THE HEALTHCARE SYSTEM: A PERSPECTIVE OF A PHARMACIST

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ABSTRACT

Total 17 Sustainable Development Goals (SDGs) for 2030 are developed and adopted by UNs through several decades of work by member nations and department of economic and social affair of UN. The progress reports of the same have been reviewed time to time by UN system (i.e., SDG progress reports of 2016, 2017, 2018, 2019, 2020, 2021, 2022 and 2023). Pharmacists can be a part of the major initiative to improve overall public health and can contribute at a large to reach to SGD-3 targets of good health and wen-being. Through this SDG pharmacist can play an active part to improve and ensure health and well-being of all age people though patient care, patient education and active participation in health policy development of the country. This article reviews how pharmacist can play a crucial role in meeting SDG of health and well-being.

Keywords: SDGs, Pharmacist, Health care, Education, Training

INTRODUCTION

Sustainable development goals were adopted by the members of United Nations in 2015. These goals provided the blueprint for the prosperity of all including human and non-human livings on the plant for the present and future time. There is total 17 goals were decided and all the developed and developing countries were requested for the global partnership to full fil the need to reach these goals by 2030. Thus, the goals were decided to eradicate property and many other challenges faced globally by adopting strategies and working hand-in-hand

by all the countries globally to improvise the health and education level, reduced the inequalities and to make economic growth equally though out the world considering the preservation of oceans and forests and thereby facing the climate change. The complete SDGs cover all the broad aspects of health and well-being, economics, education, climate, communities, life, strong institutions, etc. where a pharmacist can play a key role. [1,2]

POSSIBLE KEY THEMES WHERE PHARMACIST CAN PLAY A ROLE

Sustainability and Pharmacist

Pharmacist has a proactive role in the society to take a step towards sustainability. And pharmacist can play a major role in SDG of the millennium. Many professional, educational and research organizations defined and discussed role of pharmacist in sustainability. FIP is one of them that frequently deliberated how pharmacist can play a role in sustainable practices in pharmacy. Pharmacist has the unique role in promoting the sustainable health care practices. For the collaboration with health care professionals, pharmacist can take a lead role and explain the importance of sustainable practices in health care. Pharmacist can be a trusted role for this purpose.[2,3]

Continuous Training and Education as an Urgent Need

The landscape of the continuous upgrading the knowledge and practices can be possible only through the training and education. If the knowledge and training can keep the pharmacist up to date in line with the climate changes, changes in the health need of the public, utility of various technologies, and other aspects can keep the pharmacist well equipped to perform well and can raise awareness in the stake holders for the same. For example, life cycle of medicines, storage of medicines, disposal of medicines, minimizing waste, ecofriendly use of medicines, important aspects where pharmacist can play a role. [3, 4]

Significant of Partnership and Interdisciplinary Collaboration

The third and very important theme for the sustainable health care practices and role of pharmacist is the partnership and the interdisciplinary collaborations. Like all other field, collaboration and interdisciplinary work always give higher success than the individual efforts in sustainable healthcare system for communities of patients, their relatives. [2,3,4,5]

Significance of Continuous Evaluation and Monitoring

Continuous monitoring and evaluation of the learning and practices of the pharmacist. It is one of the crucial practices to evaluate the effect of

sustainable practices which are initiated to ensure its success and based upon the evaluation improvements can be continued. technology and there is a need to evaluate by various discussion forums, stake holder feedbacks, and need to identify the areas where good improvement is achieved and where lack of the success. The areas identified as poorly achieved areas can be taken ahead for further training and practices to get the greatest impact. Based upon such evaluations time to time policy changes and decision making can also be improvised for betterment of environment and the community. [6]

Adaptation of Upcoming Technology and AI

Current technology is required to be adopted for the easy, fast and smooth practice in pharmacy by the pharmacist. For example, disposal of medicine, climatic effect on medicine, etc. can be easily monitored by use of AI and various software. [2,6]

One such example where we can understand the significance of use of technology is the maintaining of patient records (i.e., e- health records or EHRS) as a part of sustainable healthcare practices. There is a need to start from the beginning of the prescription which we can say as a story beginning for pharmacist's role in everything. Through EHRs, the pharmacist gets have easy access to all the information for required for the sustainable patient care like medication management. [2,6]

To Overcome the Challenges for Sustainable Health Care Practices

Whenever there are inadequate or limited resources the scope of improvement, education and training would be affected. Such kind of challenges can be overcome by the access to the quality literature and updates, utilities in the field, so quality care of the patients can be delivered by the pharmacist. And while giving access to such resources the population of patients should always be considered. Covid-19 is an unforgettable example where each and every country faced the problems of lack of utilities and resources for the patients' welfare and sustainable cares. [7]

The Potential Role of Pharmacists

The potential role of pharmacists in addressing environmental health issues is an area that requires further exploration. Role of the pharmacist is always emphasized by the FIP and other organizations in SDG including air pollution, climate changes, sustainable communities, education to the patients and communities and promote policies for the environment health care. [1,2,8]

When all the themes are reviewed and priorities are made to support the SDGs globally by the pharmacist few important roles were identified. These are:

1. Advocating the expansion of pharmacists' scope of practice by focus on increasing the scope of pharmacist's practices and research. [6,9,10]

2. Embracing digital health and technology in health care practices. [6]

3. Addressing environmental health issues by pharmacists and prioritize the issues of health hazards due to environment. [6]

4. Measuring the impact of pharmacy practice through the use of certain observatories designed by global organizations like FIF (i.e. GPO) [6]

5. Collaborating with other stakeholders and healthcare professionals i.e. physicians, patients, nurses, payers, policy makers, etc. [6]

6. Focusing on patient-centered care should be prioritized and take role of patients in decision making and in investing in education and various training programs so the role of pharmacist can be improved in collaborative mode. [6]

CONCLUSION

Pharmacist can play a key role in sustainable health care practices if they are training and educated well in collaboration with other health care professionals and stake holders. Further, rapid implementation of newer technologies is also required from the side of pharmacist in clinical pharmacy.

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