Global Expansion Strategy of Plasma-Derived Medicine Products Supply through Changes in India's Plasma Management System.

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Global Expansion Strategy of Plasma-Derived Medicine Products Supply through Changes in India's Plasma Management System.

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신촌에서 민경석 드림

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Abbreviation and Acronyms

Abbreviation/Acronyms	Definition
WHO	World Health Organization
HIV	Human Immunodeficiency Virus
NACO	National AIDS Control Organization
BBC	British Broadcasting Corporation
PIL	Public Interest Litigation
NBTC	National Blood Transfusion Council
SBTC	State Blood Transfusion Council
NAT	Nucleic acid test
MFDS	Ministry of Food and Drug Safety
Ab	Antibody
Ag	Antigen
HBV	Hepatitis B Virus
HBsAg	Hepatitis B virus surface antigen
NATO	North Atlantic Treaty Organization
EU	European Union
KOTRA	Korea Trade-Investment Promotion Agency
SHCs	Sub Health Centers
PHCs	Primary Health Centers
CHCs	Community Health Centers
SECC	Socio-Economic Caste Census
HWC	Health and Wellness Centre
GDP	Gross Domestic Product

PDMP	Plasma-derived Medicine Product
SWOT	Strengths, Weaknesses, Opportunities, Threats

ABSTRACT

Global Expansion Strategy of Plasma-Derived Medicine Products Supply through Changes in India's Plasma Management System.

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This research explores strategies to improve India's plasma management system and, consequently, expands the supply of plasma-derived medicine products on an international scale. With a population of 1.43 billion as of 2022, India holds the highest potential globally to significantly alleviate the shortage of plasma-derived medicines by enhancing its plasma management system. Therefore, India's policies and current status in plasma management play a crucial role in the global plasma-derived medicine industry. Efficient operation of the plasma collection and management system, the primary raw material for this industry, is imperative for its sustained growth.

This research provides a comprehensive analysis of India's plasma management system, exploring regulatory frameworks, economic capacities, and healthcare dynamics. Through a SWOT analysis, the research identified the system's strengths, weaknesses, opportunities, and threats. Regulatory constraints, such as export limitations and the absence of mandatory Nucleic Acid Testing (NAT), pose hurdles to international collaboration, demanding a delicate balance between safety measures and economic

considerations.

Economic challenges, including budget constraints and healthcare expenditure disparities, highlight the need for strategic planning and collaboration with foreign entities. India's plasma fractionation capacity falls significantly short of the EU's, necessitating strategic alliances and addressing deficiencies in the plasma management system, notably the absence of mandatory NAT.

The health insurance system in India faces challenges in supporting plasma-derived medicine products due to the limited budget. For example, balancing the allocation of resources between rare diseases and prevalent health concerns emerges as a critical consideration. In response, this research proposes collaborative strategies to enhance plasma collection centers and strengthen India's health insurance system through partnerships with foreign companies.

In recommendations from this research, focusing on the establishment of collaborative plasma collection centers and collaboration to strengthen India's health insurance, aim to navigate regulatory complexities, overcome economic barriers, and enhance healthcare infrastructure. If implemented, these strategies are anticipated to foster successful collaboration between foreign companies and the Indian government, meeting global demand for plasma-derived medicine products sustainably and ethically.

Keywords: Plasma, Plasma Management, Plasma-Derived Medicine Products, India, SWOT Analysis, Regulatory Constraints, Economic Capacity, Health Insurance, Collaborative Strategies, Global Healthcare

I. Introduction

1. Background

According to the World Bank, as of 2022, India has the highest population in the world, approximately 1.43 billion people. Improving India's plasma management system, given its vast population, can significantly contribute to addressing shortages in the global pharmaceutical supply that utilizes plasma in international healthcare. On the domestic front, India's population has been steadily increasing for several decades, leading to a rising demand for healthcare services. Consequently, both the Indian government and private healthcare institutions are making considerable efforts to expand and enhance healthcare facilities. However, to address these challenges effectively, there is a need for underlying support through the improvement of plasma and blood management systems.

Plasma-derived medicine products are bio-pharmaceuticals obtained from plasma and find applications in various medical scenarios. These products are crucial for treating conditions such as immune deficiencies, autoimmune diseases, blood clotting disorders, and hemophilia. For example, immunoglobulin supply is essential for the survival of immunodeficient patients, while patients with hemophilia, caused by a deficiency of Factor VIII, can be treated with Factor VIII supply. The manufacturing technology of plasma-derived medicine products involves fractionating only the necessary components from plasma to aid in patient treatment.

There is a significant global demand for Plasma-derived medicine products that has yet to be fully explored, especially with advancements in medical diagnostic systems leading to an increasing trend in demand. However, the corresponding increase in supply has not been realized, posing overall difficulties in the global healthcare sector's access to Plasma-derived medicine products. Several factors restrict the increase in the supply of these products in the international healthcare community. The primary challenge lies in

the scarcity of healthy plasma supply for the production of Plasma-derived medicine products and the limited number of countries possessing plasma management systems. Insufficient healthy plasma supply can impede the treatment of international patients, leading to severe issues in emergency situations.

As previously mentioned, India, with the world's largest population, has the potential to make a substantial contribution to the global supply of Plasma-derived medicine products by improving its plasma management system. However, India currently faces limitations in contributing to the supply due to issues such as inadequate safe plasma collection and management, a lack of plasma donation culture, and insufficient manufacturing facilities or collaborative networks. Overcoming these challenges requires a comprehensive approach to address serious healthcare issues.

Therefore, this paper takes an approach that suggests significant contributions to the international supply of Plasma-derived medicine products by bringing about changes in India's plasma collection and management system. By investigating and proposing solutions for achieving this goal, the aim is to contribute to the support of international patients and the development of healthcare in India. Through these efforts, the paper aims to increase the international supply of Plasma-derived medicine products, strengthen India's healthcare system, and enhance healthcare services both in India and globally.

2. Objectives and Significance

2.1. Objectives

Analyze the current status of India's plasma collection and management system and identify key challenges for improving the international supply of Plasma-derived medicine products.

Derive various legal and managerial strategies for the transformation of India's plasma collection and management, and investigate the feasibility of implementing these

strategies.

Advocate to the Indian government, from the perspective of the Global Business Development Manager of a current Plasma-derived medicine products manufacturer, the potential contribution of changes in India's plasma management system to the expansion of international Plasma-derived medicine products supply and overall improvement of India's healthcare system.

2.2. Significance

1) Global Health Issues Associated with the World's Largest Population: As mentioned earlier, India has the world's largest population as of 2022. This underscores the importance of India's healthcare system in the global health perspective. Improving India's plasma collection and management system could positively impact the worldwide supply of Plasma-derived medicine products.

2) International Demand for Plasma-derived Medicine Products and Supply Shortages: The international demand for Plasma-derived medicine products continues to grow, but there are supply shortages. The current challenge lies in achieving stable and safe plasma collection to meet the demand, causing difficulties in the global healthcare community due to the shortage of Plasma-derived medicine products.

3) Need for Expansion and Enhancement of India's Healthcare System: India's population is steadily increasing, leading to a significant rise in the demand for healthcare services. Improving the plasma management system is a crucial factor in effectively responding to this increased demand for healthcare services.

4) Necessity for International Collaboration: The improvement of India's plasma collection and management system requires collaboration on an international scale. The Indian government can contribute to solving global health issues through collaboration with international health institutions and private companies.

5) Recommendations to the Government through Research: This study provides practical proposals to the Indian government from the perspective of a Plasma-derived medicine products manufacturer. It offers realistic suggestions based on on-the-ground experience.

Therefore, this research signifies that the improvement of India's plasma collection and management system holds significant international implications, presenting a crucial potential for development towards a healthier and sustainable future.

3. Methodology

Plasma-derived medicine products are essential pharmaceuticals with abundant international research data. Therefore, this research initially referenced and compiled existing studies and research data from institutions such as the WHO. To address gaps in the data and enhance insights, this research conducted in-depth interviews with personnel from Plasma-derived medicine products manufacturers.

3.1. Rationale for In-depth Interviews

The ultimate goal of this research is to broaden the international supply of Plasma-derived medicine products through changes in India's plasma management system. Accordingly, this research selected interviewees involved in planning overall business

aspects, such as procurement and export, within Plasma-derived medicine products manufacturers, assuming they possess the most comprehensive insights. Interviewees were classified into two categories: those actively working in Indian Plasma-derived medicine products manufacturing companies and those working in Korean Plasma-derived medicine products manufacturing companies but had experience planning business ventures in India. As a result, documents explaining the subjects, consent forms, questionnaires, etc., were distributed separately in English for Indians and in Korean for Koreans.

According to FORTUNE BUSINESS INSIGHTS, there are eight major Plasma-derived medicine products manufacturers in India (PlasmaGen BioSciences Pvt. Ltd./Bangalore. Hemarus/Hyderabad. Reliance Life Sciences/Mumbai, Intas Pharmaceuticals Ltd./Ahmedabad, Biocon Limited/Bangalore, Bharat Serums and Vaccines Limited/Mumbai, VIRCHOW BIOTECH/Hyderabad, Fusion Healthcare/Hyderabad). Interviews were conducted with employees from the companies judged to be actively engaged in business as of the current moment.

In the Republic of Korea, SK Plasma and GC Biopharma are two companies manufacturing Plasma-derived medicine products and exporting them to India. Interviews were conducted with employees responsible for planning Indian business ventures.

3.2. Selection and Exclusion Criteria for In-depth Interview Participants

1) Selection Criteria

   a. Individuals with at least three months of experience in planning business within Indian Plasma-derived medicine products manufacturing companies or those who have at least three months of experience planning Indian business ventures in companies attempting to enter the Plasma-derived medicine products market.

   b. Individuals providing voluntary written consent.

c. Adults aged 19 or older.

2) Exclusion Criteria

a. Individuals lacking voluntary consent capacity.

b. Individuals with less than three months of experience in planning business within Indian Plasma-derived medicine products manufacturing companies.

c. Individuals with less than three months of experience planning Indian business ventures in companies attempting to enter the Plasma-derived medicine products market.

d. Exclusion of participants if, during the investigation, they no longer wished to continue with interviews or surveys.

3.3. Research Design

In this study, a qualitative research method, particularly in-depth interviews, was employed to understand the current status and cases of international plasma-derived medicine product supply through the improvement of plasma management systems in India. Firstly, necessary information was gathered through a literature review. For information that was challenging to collect or access, in-depth interviews were utilized to supplement the data. The characteristics of the Indian plasma-derived medicine products market, as perceived by the interviewees, formed the basis of the investigation conducted through in-depth interviews.

Given the constraints of physical locations, not all interviews could be conducted face-to-face with employees from Indian companies. However, the guidelines and recommendations of the research were applied to the content and preparation process.

This research prepared in-depth interview questions that align with the current status and cases of plasma management system improvement and international Plasma-derived medicine products supply. Interviews were conducted based on the interview

questionnaire. This research investigated general characteristics of interviewees and basic information about the companies they work for, categorized into common questions and individual questions. Common questions covered a broad range of topics such as the plasma collection and management system, India's health insurance system, etc. Individual questions were divided into those for individuals working for Korean companies and those for individuals working for Indian companies. Common questions were about aspects of plasma collection and management, production and supply aspects of Plasma-derived medicine products, and the overall Plasma-derived medicine products industry. Individual questions were about the production environment of the company the interviewee works for and individual challenges faced during business operations.

For in-depth interviews, this research utilized Colaizzi's phenomenological analysis method (1978). The entire process, from obtaining participant consent to the end, was recorded by audio while conducting one-on-one in-depth interviews. The data were classified by topic and described descriptively. This research visualized this information in tables, interpreting and visualizing themes derived from the data. The detailed process is as follows:

First. The research team repeatedly read the entire content to understand the overall meaning and content of participants' experiences.

Second. Significant sentences were extracted from the content, and common elements of responses were identified from these meaningful sentences.

Third. The researchers rephrased the extracted meaningful sentences in their own language.

Fourth. Themes encompassing the overall experience were selected based on the rephrased meanings.

Fifth. The themes were further confirmed through a verbatim transcription, and the final data were described in the structure of themes and theme clusters.

Sixth. The extracted meanings were classified, and the final data were described structurally as themes and theme clusters.

II. Current Status of the Global Plasma-Derived Medicine Products Supply and the Plasma Industry Environment in India

1. Global Plasma-Derived Medicine Products

1.1. Concept of Plasma-Derived Medicine Products

Blood collected from humans is classified based on components for direct transfusion to patients or processed through fractionation, purification, virus inactivation, and filling processes to produce plasma-derived medicine products. Separating components of essential proteins in plasma, such as albumin, immunoglobulin, blood coagulation factors, and antithrombin, allows for more efficient use in patient treatment compared to whole blood transfusion. Notably, albumin and immunoglobulin account for approximately 80% of the protein components in plasma and are the two most in-demand items in the global plasma-derived medicine products market (Kim M. J., & Burnouf T., 2017). Furthermore, these two components, especially albumin and immunoglobulin, have gained prominence in the plasma-derived medicine products industry due to their complex indications, allowing for various treatment methods. For instance, Grifols conducted clinical trials for Alzheimer's treatment using a combination of albumin and immunoglobulin. Given the versatility in application, these two pharmaceuticals have been the focus of attention and have diverse indications, as outlined by the World Health Organization (WHO) criteria (WHO, 2007). While there are over 300 substances in plasma, this discussion will focus on the three major pharmaceuticals with high consumption.

1.2. Types of Plasma-Derived Medicine Products

1) Immunoglobulin G: Immunoglobulin recognizes and destroys pathogens such as bacteria or viruses, playing a crucial role in immune response. Intravenous immunoglobulin, initially used for primary immunodeficiency patients, has proven effective in neurological disorders, hematological conditions, and infectious diseases, with applications expanded to over 200 diseases. The U.S. Food and Drug Administration (FDA) has approved immunoglobulin use for primary immunodeficiency, chronic inflammatory demyelinating polyneuropathy, idiopathic thrombocytopenic purpura, Guillain-Barré syndrome, Kawasaki disease, chronic lymphocytic leukemia, and post-bone marrow transplantation, among others (U.S. FDA, 2017). Immunoglobulin consumption is overwhelmingly high in Europe and North America.

2) Albumin: Albumin, first used to treat wounded soldiers in World War II, finds application in cases of significant bleeding from surgery or accidents to prevent shock and facilitate efficient blood replacement. Due to its utility in preventing shock, albumin is considered an essential medicine in many countries, even serving as humanitarian aid through international organizations. For instance, SK Plasma, a Korean manufacturer, won a bid organized by the North Atlantic Treaty Organization (NATO) and provided support to soldiers and police in Afghanistan. Beyond its wartime application, albumin is used in conditions such as sepsis, shock, therapeutic plasma exchange, burns, and renal dialysis. In the Asian region, albumin is widely used, with higher consumption compared to Europe and North America, even for purposes like protein supplementation and energy recovery.

3) Coagulation Factor VIII: Hemophilia is an inherited disorder where insufficient

production of Coagulation Factor VIII results in difficulties with blood clotting, making it a condition where bleeding is challenging to control. Hemophilia is categorized into mild, moderate, and severe based on the degree of Coagulation Factor VIII deficiency. In cases where a patient's hemophilia reaches a severity level of moderate or above, regular external supply of Coagulation Factor VIII is necessary (Kim M. J., & Burnouf T., 2017). In developed countries, recombinant Coagulation Factor VIII has been widely used since the contamination incident with plasma-derived Coagulation Factor VIII in the 1980s. However, in developing countries, plasma-derived Coagulation Factor VIII is more commonly used due to the economic reasons associated with the higher cost of recombinant Coagulation Factor VIII. The per capita usage of Coagulation Factor VIII continues to rise, particularly pronounced in developing countries. For instance, between 2002 and 2007, the diagnosis of hemophilia patients increased by 35%, and Coagulation Factor VIII usage rose from 0.80 IU to 1.32 IU per capita, a 63% increase (Cheraghali A.M., Abolghasemi H., 2010). Nevertheless, 70% of hemophilia patients remain undiagnosed, and only 25% of diagnosed patients receive appropriate treatment (Skinner M.W., 2009). Given these circumstances, it can be inferred that the demand for Coagulation Factor VIII will continue to increase in the future. While the actual manufacturing cost of recombinant Coagulation Factor VIII is lower than that of plasma-derived Coagulation Factor VIII, the advantages in terms of safety and efficacy have led to higher distribution prices in developed countries compared to plasma-derived Coagulation Factor VIII (Giangrande P., 2016).

1.3. Manufacturing Process of Plasma-Derived Medicine Products

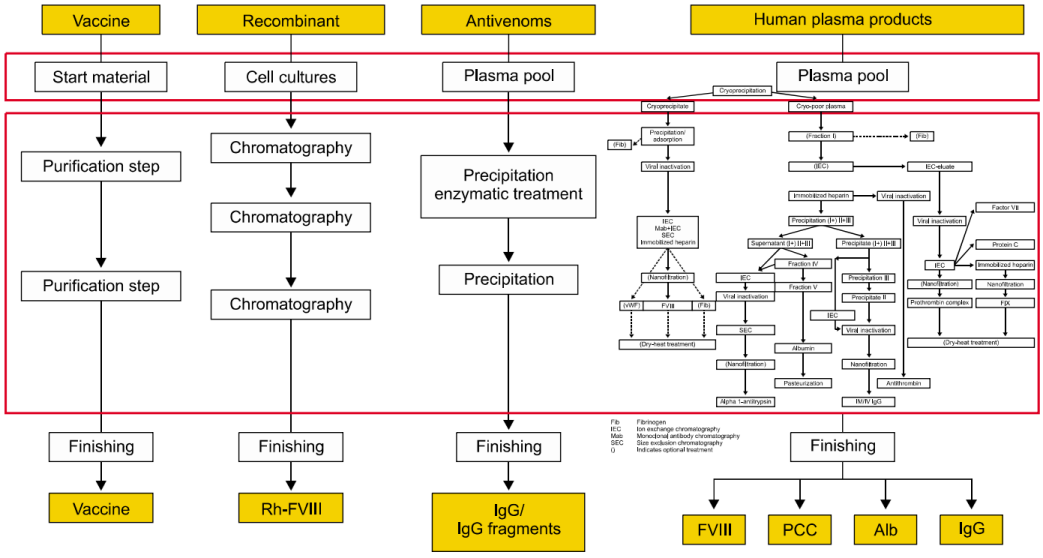
The manufacturing process of plasma-derived medicines is often referred to as the fractionation process. For this reason, when entering into outsourcing agreements, the

pharmaceutical industry frequently employs Contract Manufacturing Organizations, which are commonly used in the field. In some cases, it is referred to as Contract Fractionation Organization. Alternatively, it may also be termed Toll-manufacturing or Toll-Fractionation due to slightly differing business concepts. When manufacturing plasma-derived medicines, the typical production volume for one batch is around 2,000 to 3,000 liters, based on the volume of plasma input. The traditional fractionation process involves precipitating plasma at 1 to 4°C, from which Coagulation Factor VIII, von Willebrand factor, Fibrinogen, among others, are produced (Cohn E.J. et al., 1946). Generally, vaccines, recombinant pharmaceuticals, or antidotes go through three to four process steps. However, plasma-derived pharmaceuticals encompass an operational product manufacturing process, so they require a minimum of ten or more steps. The supernatant, after removing the precipitate, undergoes an adsorption process to produce Coagulation factor VII, Coagulation factor IX, and others. The residual portion after adsorption is precipitated at -3°C with 8% ethanol and pH 7.2 to produce Fibrinogen, Coagulation factor IX, and Coagulation factor XIII. The supernatant is adjusted to -5°C with 25% ethanol and pH 6.9 to precipitate, from which immunoglobulin is produced. Furthermore, the supernatant is adjusted to -5°C with 18% ethanol and pH 5.2 to produce Antithrombin III and haptoglobin. Finally, it is adjusted to -5°C with 40% ethanol and pH 4.8 to precipitate and produce albumin. The production processes for each product are interconnected, so a problem in one process can impact other products (Kim M. J., & Burnouf T., 2017).

Because of these characteristics, the manufacturing process of plasma-derived medicines, with its operational product feature, requires complex and vital business modeling and the establishment of a Look-back system to realize net profit. In particular, in terms of business modeling, if the sale of products with a low impact on manufacturing costs is made difficult, it involves selling other products with higher profitability at higher prices, similar to the business model of fractionating and refining crude oil. The table below compares the production processes of plasma-derived medicines and vaccines,

recombinant products, and antivenoms.

Figure 1. Plasma fractionation process: unique technology.



Source: Burnouf, T. (2007). Modern plasma fractionation & Burnouf, T. (2017). Current status and production trends of plasma fractionation in the world

1.4. Demand for Plasma-Derived Medicine Products

Globally, the scale of Plasma-Derived Medicine Products exceeds 20 trillion won, equivalent to approximately 45 million liters based on plasma fractionation volume (Robert, P., 2016). Of this, Immunoglobulin accounts for 46%, Albumin for 17%, and Coagulation Factor for 10% (The Marketing Research Bureau, 2014). The demand for each Plasma-Derived Medicine Product is consistently increasing annually, with Immunoglobulin at 7.9%, Albumin at 4.8%, and Coagulation Factor VIII at 4.5% (Robert P., 2014). Examining the production volume of Plasma-Derived Medicine Products over the last 30 years, there has been a steady increase in plasma volume for Albumin manufacture. Particularly noteworthy is the significant consumption of Albumin in China,

where the demand has surged with the country's economic growth. Immunoglobulin represents the product category with the most rapidly increasing demand among Plasma-Derived Medicine Products. In the case of Coagulation Factor VIII, the emergence of gene recombinant drugs has led to a slowing growth trend (Robert P., 2014).

The United States is the leading consumer of Plasma-Derived Medicine Products, spending over 600 million dollars. Following the U.S., countries with high GDP, such as China, Japan, France, Germany, Italy, and the UK, exhibit substantial consumption (Robert P., 2015). Consumption of Plasma-Derived Medicine Products correlates with the GDP of a country, as observed in other cases. For instance, in countries with a GDP of 30,000 dollars, per capita consumption of Plasma-Derived Medicine Products is approximately 10 dollars (Stonebraker J.S. et al., 2003).

This is attributed to the nature of Plasma-Derived Medicine Products, where the cost of human plasma, the primary ingredient, is high, leading to expensive drug prices. Consequently, it is challenging for developing countries to afford these products. If Plasma-Derived Medicine Products were to be used for infectious diseases like influenza, international organizations might consider purchasing them through funding. However, due to the rare and orphan nature of the indications for Plasma-Derived Medicine Products, international organizations and developing countries might not prioritize purchasing them at a high cost. From the perspective of developing countries' governments, allocating limited resources to more efficient products such as vaccines and disease diagnostic products that can protect a larger population from diseases is considered more practical.

2. Healthcare Industry Environment in India

2.1. India's Health Insurance System

Healthcare in India is characterized by a multi-payer healthcare model where the

majority of public hospitals are supported entirely by taxes, alongside a combination of public and private health insurance for cost-sharing. Public hospital services are, in most cases, provided free of charge to all residents of India, with the exception of some self-payment aspects (KOTRA. 2019).

Low-income populations in India have a lower utilization rate of public healthcare services compared to the middle and upper-income groups. Particularly for the treatment of severe illnesses, due to the lower quality of medical care in the public sector, individuals tend to rely more on private sector healthcare services. As a result, a significant portion of public healthcare services is concentrated in rural areas. Similar to South Korea, where people also prefer working in urban areas rather than rural areas, India faces difficulties in securing experienced medical personnel in rural areas. Consequently, most public healthcare facilities in rural areas are operated by intern doctors (KOTRA. 2019).

Public health centers operated by the Indian government in rural areas are established and managed according to the population size. However, the percentage of facilities that meet medical facility standards is only around 15%, and they face operational challenges due to a lack of personnel (KOTRA. 2019).

Table 1. Status of Public Health Centers in Rural Areas of India as of 2017

Level	Quantity	Region
Sub Health Centers(SHCs)	156,231	Population 3,000 - 5,000
Primary Health Centers(PHCs)	25,650	Population 20,000 - 30,000
Community Health Centers(CHCs)	5,624	Population 80,000 - 120,000

Source: Ministry of Health and Family Welfare, India. (2017). Health and Wellness Centre Report

Even in the relatively better-equipped Community Health Centers (CHCs) within the public sector, the shortages of surgeons, obstetricians, and pediatricians are significant. For example, despite the existence of approximately 6,000 CHCs, many are found to lack even auxiliary nurses (KOTRA. 2019).

In the private sector, healthcare services are primarily concentrated in top-tier 3rd level facilities (large general hospitals). Consequently, in cases of severe illness, Indians mainly rely on private hospitals. However, approximately 68% of related expenses are not covered by insurance. In India, only around 20% of the population is estimated to benefit from health insurance. In rural areas, around 86% lack insurance coverage, while in urban areas, approximately 82% are uninsured, which can pose a financial burden on families when health problems arise. Even for those with insurance, coverage is often limited to inpatient expenses, and many severe conditions like cancer are not included in the insurance benefits (KOTRA. 2019).

Hence, the Indian government introduced a support plan known as the Ayushman Bharat Yojana, often referred to as PM-JAY, which could be considered as the Indian National Health Insurance system. PM-JAY aims to provide comprehensive health insurance support to all by 2030. Ayushman means "Long Live," Bharat means "Nation," and Yojana means "Scheme," collectively implying a plan for creating a healthy nation. Officially, it is called "Ayushman Bharat, Pradhan mantri jan Arogya Yojana" and is commonly referred to as PM-JAY. The term PM-JAY signifies the healthcare support plan proposed by the Prime Minister of India, emphasizing his role in proposing a plan to support vulnerable populations (KOTRA. 2019).

PM-JAY is estimated to benefit a total of around 500 million people. The specific beneficiaries include around 174 million low-income residents living in rural areas and urban residents who qualify based on their occupation, according to the Socio-Economic Caste Census (SECC) data. PM-JAY covers medical expenses, surgery, medicines, and diagnostic and treatment procedures required for secondary and tertiary medical services.

A total of 1,350 medical packages are included within the scope of support (KOTRA. 2019).

PM-JAY primarily aims to address the problem of India's existing health insurance policy, known as Mediclaim Policy, which has been implemented since 1986 and only supports hospitalization expenses while not covering medical expenses for medicines, post-surgery care, etc. Many people find it challenging to receive substantial treatment when there is no support for any medical expenses. Furthermore, PM-JAY has the advantage of removing age-related restrictions to support vulnerable populations, including women, children, and the elderly (KOTRA. 2019).

The budget for implementing PM-JAY is estimated to be approximately USD 1.71 billion, with a funding ratio of 6:4 between the central government and state governments. This policy is expected to have a positive impact on the growth of the Indian healthcare industry, driven by infrastructure improvement. As a result, the Indian government is promoting comprehensive improvements, such as infrastructure enhancement for approximately 150,000 public health centers (SHCs and PHCs) and expanding services, including mobile telemedicine and home visits. These centers have been renamed Health and Wellness Centers (HWC) to facilitate comprehensive improvements (KOTRA. 2019).

2.2. India's Economic Capacity and Health Expenditure

Referring to the table 2, Japan and Republic of Korea have the highest life expectancy, with India having the lowest. In terms of per capita nominal healthcare expenditure, the United States ranks the highest, while India ranks the lowest. Japan, Canada, Germany, the United Kingdom, and France have similar levels of healthcare expenditure. Looking at the percentage of healthcare expenditure in GDP, the United States has the highest share. Germany, the United Kingdom, France, and Canada are at similar levels, with Japan slightly lower. India is the lowest in this regard. When

considering government expenditure on healthcare per capita, the United States again tops the list. Germany, the United Kingdom, and Canada have similar levels. Japan and France are slightly lower, and India is the lowest. In terms of the percentage of per capita nominal healthcare expenditure that the government contributes, Japan and the United Kingdom have the highest share, at a similar level. Germany, France, Italy, and Canada have slightly lower percentages. Republic of Korea follows with a slightly lower percentage, and China and the United States are similar but slightly lower than Republic of Korea. Here, for a more focused comparison of Japan, Republic of Korea, and India, the following can be observed.

Table 2. Health Expenditure Data for the Top 10 Countries by Nominal GDP in 2020

A: Life expectancy at birth, total (years)
B: Current health expenditure per capita (US$)
C: Current health expenditure (% of GDP)
D: Domestic general government health expenditure per capita (US$)
E: Domestic general government health expenditure (% of current health expenditure)

Country	A	B	C	D	E
India	70	$57	3.0%	$21	36.6%
Republic of Korea	83	$2,642	8.4%	$1,612	61.0%
Japan	85	$4,388	10.9%	$3,697	84.2%
China	78	$583	5.6%	$319	54.7%
Germany	81	$5,930	12.8%	$4,652	78.4%
United Kingdom	80	$4,927	12.0%	$4,123	83.7%
France	82	$4,769	12.2%	$3,659	76.7%
Italy	82	$3,057	9.6%	$2,326	76.1%
Canada	82	$5,619	12.9%	$4,213	75.0%
United States	77	$11,702	18.8%	$6,643	56.8%

Source: World Bank 2020

Among the top 10 countries in nominal GDP, Republic of Korea does not have particularly high healthcare expenditure as a share of GDP or government spending per capita on healthcare. When comparing Republic of Korea, which has a relatively low expenditure share among the top 10 countries, with India, it becomes apparent that for India to match Republic of Korea's share of healthcare expenditure in GDP, it would need to increase it by 64%. Even when looking at government spending per capita on healthcare as a percentage, India still has a 40% budget surplus compared to Republic of Korea. However, even if India were to allocate resources to match Republic of Korea's expected expenditure share, India's per capita nominal healthcare expenditure and government spending per capita on healthcare would still be around 1-2% of Republic of Korea's levels. This reflects the limitations of the budget due to the significant disparity in per capita GDP between India and Republic of Korea.

Table 3. Comparison of Healthcare Expenditure in Republic of Korea and India in 2020

	The percentage of India compared to Korea (%)
Current health expenditure per capita	2%
Current health expenditure (% of GDP)	36%
Domestic general government health expenditure per capita (US$)	1%
Domestic general government health expenditure (% of current health expenditure)	60%

Source: World Bank 2020

Expanding India's healthcare insurance model based on Republic of Korea or other countries is anticipated to face budget constraints. When comparing the situations in Republic of Korea and India, according to the 2020 World Bank data mentioned earlier, India accounts for 3% of per capita GDP in terms of the share of per capita current health

expenditure, while Republic of Korea stands at 8.4%. Even if India were to expand its per capita current health expenditure to the Republic of Korean level of 8.4% of GDP, the per capita current health expenditure in India would still be around $160 USD, which is only 6% of Republic of Korea's $2,642 USD. Furthermore, India's government spending per capita for current health expenditure is approximately 60% in comparison to Republic of Korea. Even if we assume that India increases this to 100% of Republic of Korea's level, the per capita health expenditure in India, under the assumed expansion in 2020, would still be around $97 USD, which is significantly insufficient when compared to Republic of Korea's government spending of $1,612 USD, accounting for approximately 10%. This indicates that fundamental budgetary limitations exist due to the shortage in per capita GDP.

Table 4. Simulating the adjustment of India's government healthcare subsidy rate to match that of Republic of Korea.

A: Current health expenditure per capita (US$)
B: Current health expenditure (% of GDP)
C: Domestic general government health expenditure per capita (US$)
D: Domestic general government health expenditure (% of current health expenditure)

Assumption	Country	A	B	C	D
Before	India	$57	3.00%	$21	36.60%
	Republic of Korea	$2,642	8.40%	$1,612	61.00%
After	India	$160	8.40%	$97	61.00%
	Republic of Korea	$2,642	8.40%	$1,612	61.00%

Source: World Bank 2020

According to the comprehensive audit report from the Central, Central-Eastern, and Southern Blood Testing Centers of Republic of Korea in 2014, the cost of Nucleic Acid

Testing (NAT) amounts to 9,220 won per donor, calculated based on the exchange rate of 1,349 as of October 16, 2023. This is equivalent to $6.83 USD per donor. Assuming that each plasma collection amounts to 250 ml and that 3,000 liters of plasma are required for one batch production, NAT cost for one batch is $82,016 USD. While plasma-derived medicine products manufacturing facilities may have variations in yield, referring to the yields provided by Vincenzo De Angelis and Antonio Breda, a batch (3,000 liters) of Albumin and IVIG, which make up a significant portion of plasma-derived medicine products, would yield approximately 76,000 grams of Albumin and 12,500 grams of IVIG. This translates to an increase in price of $0.93 USD per gram if the cost is evenly distributed across the two products. As mentioned earlier, based on the calculated global demand patterns, the theoretical average demand for Albumin is 270 kg per million population, and for IVIG, it's 60 kg per million population. Therefore, supplying just 1% of India's population, which amounts to 14 million people, would require 3,780 kg of Albumin and 840 kg of IVIG. Consequently, even if we consider supplying only 1% of India's population, the cost increase due to mandatory NAT implementation amounts to approximately $4.28 million USD.

Table 5. The amount of Albumin and IVIG from 3,000 liters of plasma.

1 Plasma bag (ml)	Batch Size (ml)	Donor Quantity (EA)	
250	3,000,000		12,000
NAT cost (USD)		Product Quantity (gram)	
per donor	6.83	Albumin	76,000
per batch	82,016.31	IVIG	12,500
per gram	0.93	Total	88,500

* KEB Hana (October 16, 2023), first official exchange, buying standard rate: 1,349

Source: Vincenzo, D. A. & Antonio, B. (2013). Plasma-derived medicinal products self-sufficiency from national plasma: to what extent?

Table 6. Additional costs incurred by implementing mandatory NAT

Assumption	Demand (Million Population)	Product	Demand (Product kg)	NAT Cost (Million USD)
Before	1	Albumin	270	0.31
		IVIG	60	
		Total	330	
After	14	Albumin	3,780	4.28
		IVIG	840	
		Total	4,620	

Source: Vincenzo, D. A. & Antonio, B. (2013). Plasma-derived medicinal products self-sufficiency from national plasma: to what extent?

3. Plasma Management System in India

3.1. Overview of India's Plasma Management System

India formulated rules for preparation, manufacturing, storage, and usage under the Drugs and Cosmetics Act of 1940. In the early to mid-1990s, regulation of blood donations was notably insufficient, and the voluntary donor system was meeting the demand for plasma through blood donations. During this period, India operated with very limited plasma fractionation facilities (Ranjeet S. Ajmani, 2018).

In 1986, the first reported case of HIV transmission through blood transfusion occurred in Mumbai, India. This incident raised concerns in the public health sector. Consequently, in 1992, the Indian central government established the National AIDS Control Organization (NACO) to oversee the overall operation of blood banking services in India and ensure the supply of safe blood and blood products (Ranjeet S. Ajmani, 2018). However, according to a BBC report from May 31, 2016, over the past 17 months, at least 2,234 Indians were infected with HIV while receiving blood transfusions in

hospitals, and approximately 2.09 million HIV/AIDS patients still exist in India (BBC, 2016). Therefore, deficiencies in the screening and monitoring system for blood and plasma continue to be a significant challenge in the Indian blood transfusion market.

In 1996, based on Article 32 of the Indian Constitution, Hari Dev Shourie filed a Public Interest Litigation (PIL) in the Supreme Court of India, seeking the government's response to the situation. After deliberation, Judges SC Agarwal and GB Pattanaik ruled on January 1, 1998, that blood donations were illegal from this date onwards. The court also provided a series of recommendations to improve the overall quality of India's blood banking services and strengthen the nation's responsibility. The recommendations included the following (Ranjeet S. Ajmani, 2018): The Indian government should establish the National Blood Transfusion Council (NBTC) and State Blood Transfusion Councils (SBTCs), Mandatory regulation and licensing by central authorities, Expansion of voluntary blood donation, Improvement through changes/amendments/revision in the Drugs and Cosmetics Act, Enhancement of screening tests for blood and plasma, Establishment of modern quality standards, Introduction of transfusion medicine postgraduate courses.

3.2. Plasma Screening System in India

In India, when screening for plasma safety, immunological tests for five bloodborne pathogens HIV 1 and 2, HCV, HBV, syphilis, and malaria are mandatory. However, India does not mandate Nucleic Acid Testing (NAT). In contrast, in Republic of Korea, the Ministry of Food and Drug Safety (MFDS) obliges plasma NAT for individual donors. The reason for this obligation in Republic of Korea is the need for high sensitivity and specificity NAT during bloodborne virus testing, especially for the window period. Making NAT mandatory for individual donors is considered a crucial part of plasma safety management.

To understand the status of countries other than India and Republic of Korea, data

from the World Health Organization (WHO) was referenced. According to WHO, out of 171 respondent countries (excluding 5 countries that did not respond to the questions), 166 countries have policies for mandatory Human Immunodeficiency Virus (HIV) testing for all blood donations. A total of 21 countries reported testing for HIV-1/2 antibodies, and 90 countries reported testing for both HIV-1/2 antibodies and antigens (Ab+Ag). Furthermore, 55 countries reported using HIV RNA testing, NAT, in addition to immunological tests for blood donations.

Table 7. Distribution of blood laboratory screening policies for HIV-1/2 by WHO region

Region	Ab	Ab+Ag	Ab+NAT	Ab+Ag+NAT	Unanswered
Africa (n=43)	6	33	0	2	2
Americas (n=33)	1	24	3	4	1
South-East Asia (n=10)	4	2	0	4	0
Europe (n=42)	1	14	11	16	0
Eastern Mediterranean (n=18)	0	11	1	6	0
Western Pacific (n=25)	9	6	4	4	2
Global (n=171)	21	90	19	36	5

Source: WHO. (2022). Global Status Report on Blood Safety and Availability 2021

For Hepatitis B Virus (HBV), out of the 171 respondent countries, 166 countries have policies for mandatory testing of all blood donations. All 166 countries have a policy to test for Hepatitis B Surface Antigen (HBsAg), and 55 countries reported using NAT for HBV in addition to immunological testing.

Table 8. Distribution of blood laboratory screening policies for HBV by WHO region

Region	HBsAg	HBsAg +anti-HB	HBsAg +NAT	HBsAg +anti-HB + NAT	Unanswered
Africa (n=43)	33	5	0	2	2
Americas (n=33)	13	12	1	6	1
South-East Asia (n=10)	4	2	3	1	0
Europe (n=42)	10	6	16	10	0
Eastern Mediterranean (n=18)	6	4	1	7	0
Western Pacific (n=25)	14	1	6	2	2
Global (n=171)	80	30	27	28	5

Source: WHO. (2022). Global Status Report on Blood Safety and Availability 2021

Out of 171 respondent countries, 164 countries have policies for mandatory immunological testing of all blood donations for Hepatitis C Virus (HCV). A total of 126 countries have policies for HCV antibody testing, and 38 countries reported policies for both HCV antibody and antigen (Ab+Ag) testing. In addition, 54 countries reported implementing NAT for HCV in addition to immunological testing.

Table 9. Distribution of blood laboratory screening policies for HCV by WHO region

Region	Ab	Ab+Ag	Ab+NAT	Ab+Ag+NAT	Unasnwered
Africa (n=43)	31	8	1	1	2
Americas (n=33)	17	7	5	2	2
South-East Asia (n=10)	5	1	3	1	0
Europe (n=42)	10	5	23	3	1
Eastern Mediterranean (n=18)	7	4	3	4	0
Western Pacific (n=25)	13	2	8	0	2
Global (n=171)	83	27	43	11	7

Source: WHO. (2022). Global Status Report on Blood Safety and Availability 2021

Therefore, countries such as Australia, China, Japan, France, Germany, Italy, South Africa, Thailand, the United States, and others with major plasma-derived medicine

products manufacturing facilities mandate NAT for HIV, HBV, and HCV during plasma screening. To facilitate collaborations using plasma collected in India with fractionation facilities located in other countries, it is essential to mandate NAT.

The two challenges in order to proceed with NAT are ‘Reliability and Expertise in NAT’, ‘Increased Pharmaceutical Costs due to NAT Mandate’.

The first method to increase the reliability and expertise of testing is to use trusted testing equipment and reagents, as using equipment and reagents recognized at international standards ensures the safety of plasma-derived medicine products. These widely used products are often referred to as "Global Standards." Products from Grifols and ROCHE are commonly used as Global Standards. ROCHE, a Swiss-based company, is one of the leading companies in the field of medical diagnostics with high revenue and advanced technology. Grifols, a Spanish-based company, is highly regarded in the field of plasma-derived pharmaceuticals as it is involved in almost every aspect, from plasma collection, manufacturing of testing equipment and reagents, to the production and distribution of plasma-derived pharmaceuticals, resulting in a high level of understanding in this field. While South Korea has several excellent diagnostic testing manufacturers, BIONEER and Seegene, who are considered leaders in the field of NAT testing in South Korea, do not produce reagents for HIV, HBV, and HCV testing recognized internationally.

The second method to increase reliability and expertise is through regular inspections and certification by third-party organizations. Delegating everything to organizations that directly collect and manage plasma can lead to a lack of objectivity. Hence, Europe, the United States, South Korea, and other countries commonly have a system of regular inspections by third-party organizations. However, the shortcoming of this system is that these inspections are often conducted by national agencies rather than in the private sector. This means that if the administrative system of a specific country is corrupt or still underdeveloped, trust in the inspection process itself may be difficult. Nonetheless, there is a clear difference between countries that have and have not

implemented regular inspections and certification systems when viewed from the perspective of foreign countries. Furthermore, if foreign plasma-derived pharmaceutical manufacturers can have a wealth of experience, they can also accumulate experience, as they may conduct these inspections when they outsource production to these manufacturers.

Nevertheless, as mentioned earlier, mandating NAT leads to an increase in testing costs. Therefore, if such a policy is implemented in India, where coverage for the purchase of plasma-derived pharmaceuticals through the health insurance system is limited, it is necessary to examine India's health insurance system in view of the increased pharmaceutical costs.

3.3. Storage and Transportation of Plasma in India

From a quality management perspective, several key factors must be considered in the process of collecting and preserving plasma from donors. These factors include the timing of plasma collection and freezing, storage and transportation temperatures, the choice of plasma bags, anticoagulants, apheresis machines, and the implementation of a Look-back system. Among these factors, the timing of freezing, storage temperatures, and transportation temperatures are particularly critical not only for the safety of plasma but also for the financial management of the business.

The timing of plasma collection and freezing is typically categorized into whether it occurs within 24 hours or within 72 hours. While rapidly freezing plasma helps maintain its freshness, allowing flexibility in the freezing process until a later point can be advantageous from a cost-management perspective. The standard for establishing freezing timing criteria can depend on which plasma product holds dominance in sales at a given time. For instance, during the era when Coagulation Factor VIII held a significant share of sales among plasma-derived pharmaceuticals, there was a considerable price difference based on whether the plasma was frozen within 24 hours or later. However,

with the emergence of recombinant gene-based pharmaceuticals, the share of Factor VIII supply from plasma-derived pharmaceuticals decreased, and other complex factors led to changes in plasma prices. India does not enforce mandatory timing for plasma collection and freezing. Therefore, India needs to consider whether to mandate freezing within 24 hours to maintain the high freshness of plasma overall or strategically allow freezing within 72 hours, based on the product's dominance at the time.

Storage and transportation temperatures also influence protein content. Guidelines in the EU, the USA, and South Korea specify maintaining storage and transportation temperatures below -20 degrees Celsius. It is crucial not to store plasma at temperatures exceeding -20 degrees Celsius from the time of freezing until it arrives at the plasma-derived pharmaceutical manufacturing facility. According to interviews, India has not enforced a specific mandate to maintain temperatures below -20 degrees Celsius for storage and transportation. However, as a common practice, businesses typically maintain storage temperatures below -20 degrees Celsius to ensure the best protein condition, considering the profitability of the operations.

The choice of plasma bags, anticoagulants, and apheresis machines involves using internationally recognized products for collaborating with foreign companies. According to the interviews, India utilizes international standards like Haemonetics and Fresenius Kabi for plasma bags, anticoagulants, and apheresis machines. However, Indian brands are also widely used.

Lastly, in the event of an incident related to plasma-derived pharmaceuticals, it is essential to determine at which stage and point the problem occurred. This process of tracking is facilitated by a Look-back system, which, when documented as an SOP (Standard Operating Procedure), is advantageous for collaboration with international organizations. According to the interviews, India has a concept of the Look-back system in place, and leading Indian companies such as Intas and Reliance have implemented the Look-back system.

3.4. Laws Regarding the Export of Plasma from India

According to Interviews, the export of Indian plasma faces legal limitations, presenting obstacles for collaboration with foreign governments and businesses. Two models exist for the global export of plasma, namely:

1) Contract Manufacturing Organization (CMO): Also known as Toll-manufacturing, this model involves outsourcing the production of plasma-derived pharmaceuticals to foreign manufacturing facilities. In this process, Indian plasma is sent to foreign facilities for the production of plasma-derived pharmaceuticals, which are then returned to India. As the Indian government retains ownership of the primary raw material, plasma, it only pays for the manufacturing costs.

2) Plasma Sales: This involves selling the rights to plasma, including its authorization, to foreign manufacturing facilities or governments.

Currently, the legal framework restricts the export of Indian plasma, allowing only the Contract Manufacturing Organization (CMO) model for the production of plasma-derived pharmaceuticals for international markets. The types of regulations governing this process include:

1) Plasma Ownership: The Indian government maintains ownership of the plasma used as the primary raw material. Consequently, when exporting plasma, the Indian government remains the owner of the plasma, and manufacturing companies only pay for the manufacturing costs. This regulation complicates the international movement of plasma, restricting activities related to plasma distribution between countries.

2) Restrictions on Plasma Sales: Selling plasma collected in India to foreign institutions is legally regulated. This regulation stems from humanitarian reasons related to India's free plasma collection and ethical concerns associated with selling plasma. As a result, plasma collected in India is not internationally sold, limiting the diversity of applications in the global plasma market.

3) Ethical and Social Considerations: The sale of plasma and the associated profits are considered sensitive issues from social and ethical perspectives. Since plasma collection is generally conducted free of charge, efforts need to be made by the Indian government to maintain public trust in voluntary plasma donations. Therefore, appropriate regulations and ethical considerations regarding the sale and profits from plasma are necessary.

In the case of Contract Manufacturing Organization (CMO), regulatory agencies in the plasma-collecting country and the country with manufacturing facilities usually enforce minimal regulations. From the perspective of the country collecting plasma, there is no transfer of ownership of plasma, and all products made from this plasma are returned to that country. In the country with manufacturing facilities, unless there is a domestic distribution purpose, strict controls are generally not enforced, assuming proper equipment management.

However, for plasma sales, both countries tend to manage regulatory barriers more rigorously. This is mainly because justifying the creation of profits from plasma collected from citizens is challenging. India, too, similarly permits the export of plasma for the purpose of contract manufacturing organizations but does not allow plasma sales.

These legal constraints impede the improvement of the Indian plasma management system in the international plasma-derived pharmaceutical market. Therefore, a solution that involves international collaboration and overcoming legal

obstacles is essential.

3.5. Plasma Fractionation Capability in India

In India, there are approximately five active manufacturers of Plasma-Derived Medicine Products. This research has evaluated whether, through their active operations, they can meet the global demand for Plasma-Derived Medicine Products. The assessment of production capacity has been compared with EU.

European countries classified as relatively advanced also frequently resort to contract manufacturing for plasma-derived medicine products, primarily due to limited production capacity or insufficient technical expertise for specific products. The table 10 provided depicts the status of fractionation facilities located in the EU.

According to EuroStat, the total population of the 27 EU member states was approximately 450 million in 2020. The annual total plasma fractionation capacity of fractionation facilities within the EU, as shown in the table, is 12.84 million liters. Calculating the EU's fractionation capacity per ten million population by dividing 450 million (the EU's total population) into 12.84 million liters, it amounts to approximately 29,000 liters. By applying the same calculation method to India, with a population of 1,396,387,127 in 2020 (World Bank data) and an annual total plasma fractionation of 1,300,000 liters in India, the fractionation capacity per ten million population in India is approximately 9,300 liters. In other words, India's plasma fractionation capacity is approximately 3% of the EU's fractionation capacity.

Table 10. Fractionation plants in the EU (2011)

Country	Number of fraction plants	Owner	Fractionation capacity(L)/year
Austria	2	Baxter	NA
		Octapharma	NA
Belgium	2	CAF-DCF	500,000
		Baxter	NA
Bulgaria	1	Ministry of Health	NA
France	4	LFB (2)	1,400,000
		Octapharma	Over 1,000,000
		Sanofi Pasteur	50,000
Germany	3	CSL Behring	2,000,000
		Biotest	700,000
		Octapharma	650,000
Hungary	1	Kedrion	200,00
Italy	3	Kedrion	Over 1,000,000
		Baxter	500,000
Poland	1	Biomed	50,000
Spain	1	Grifols	2,100,000
Sweden	1	Octapharma Nordic AB	1,340,000
Netherlands	1	Sanquin	800,000
U.K.	1	BPL	750,000

Source: EU. (2015). An EU-wide overview of the market of blood, blood components, and plasma derivatives focusing on their availability for patients.

When product fractionation facilities are insufficient, or there is a lack of technological development in fractionation facilities, outsourcing to foreign fractionation facilities and sending domestic plasma to increase the supply of pharmaceuticals to the

country's own citizens is a common practice in Europe, as mentioned earlier. Examples of cases where plasma is exported abroad for fractionation in Europe include:

Table 11. Countries reporting exported plasma for fractionation in 2012

Country	Amount Plasma	Destination
Germany	3,399,419 Liter	Not Specified
Denmark	61 tons	Switzerland
Estonia	26,997 doses	Octapharma
	7,199 doses	Biotest AG
Slovakia	3,063 Liter	Ukraine

Source: EU. (2015). An EU-wide overview of the market of blood, blood components, and plasma derivatives focusing on their availability for patients

As previously compared, India's production capacity of Plasma-Derived Medicine Products is significantly insufficient compared to the EU. Even the EU, with its limited manufacturing facilities, seeks to supplement the shortage through Contract Manufacturing Organizations. Therefore, for India to enhance its production capacity with its own plasma, various methods such as the export sale of plasma and Contract Manufacturing Organizations need to be considered.

India's annual plasma collection amounts to 3 million liters, while the total fractionation capacity of India's facilities is approximately 1,300,000 liters. To meet the demand, substantial outsourcing of production to foreign manufacturing facilities can help alleviate this issue. Therefore, India should consider strategies that involve outsourcing production to international plasma fractionation centers while ensuring that they meet international standards in plasma management. As expanding fractionation facilities requires significant capital and time investments, focusing on improving the plasma management system is a suitable medium-term solution. It is essential to consider a direction that secures a strategy to expand the supply of plasma-derived medicine

products to the nation by contracting production to foreign fractionation facilities.

However, when it comes to India's plasma, as mentioned earlier, India does not mandate Nucleic Acid Testing (NAT) during plasma screening. This deficiency in the plasma management system poses a challenge when it comes to outsourcing production to foreign fractionation facilities.

IV. Analysis and Results

1. SWOT Analysis of India's Plasma Management System

Based on the information gathered, a SWOT analysis of India's Plasma Management System has been conducted. Leveraging this SWOT analysis, will explore avenues for further development in India's plasma management system.

Table 12. SWOT Analysis of India's Plasma Management System

Strengths	Weaknesses
▪ Abundant Human Plasma Resources ▪ Cost Efficiency ▪ International Collaboration Experiences	▪ Regulatory Constraints ▪ Infectious Disease Concerns ▪ Quality Management Challenges ▪ Public Benefits through Voluntary Donation
Opportunities	**Threats**
▪ International Regulatory Alignment ▪ Global Health Partnerships ▪ Increased Demand for Plasma-Derived Products	▪ Public Health Incidents ▪ Stringent Regulatory Requirements ▪ Global Economic Uncertainty

1) Strengths

- Abundant Human Plasma Resources: India, with the world's largest population, has the potential for the highest plasma supply globally.
- Cost Efficiency: Due to economic reasons, India may have lower management and supply costs for plasma, serving as a significant advantage in international competition.
- International Collaboration Experiences: Pharmaceutical companies in India are actively engaging in international partnerships. This experience and global

network facilitate the global growth of the plasma business.

2) Weaknesses

- Regulatory Constraints: Legal restrictions on the export of Indian plasma limit international collaboration and export activities.
- Infectious Disease Concerns: India has faced issues with infectious diseases in the past, raising concerns about the use of plasma collected in India. Enhancing international trust in India's plasma management system may require substantial investments.
- Quality Management Challenges: Some of India's plasma collection and storage centers do not adhere to international standards in terms of quality management. Consideration should be given to implementing NAT testing and using plasma bags and apheresis machines commonly accepted in the international community. This transition may involve significant costs.
- Public Benefits through Voluntary Donation: Free plasma donation is common in India, leading to skepticism among the majority of the population about the benefits derived from blood donation. This poses a challenge in securing an adequate amount of plasma for plasma centers.

3) Opportunities

- International Regulatory Alignment: Harmonizing regulations for plasma export could unlock numerous opportunities.
- Global Health Partnerships: Collaborating with international plasma business companies can enhance competitiveness in plasma collection and processing technology.
- Increased Demand for Plasma-Derived Products: As observed earlier, there is still a global shortage in meeting the demand for Plasma-Derived Medicine Products. This provides an opportunity for India to offer advanced products in

the international market.

4) Threats

- Public Health Incidents: Health incidents arising from Plasma-Derived Medicine Products made from Indian plasma could damage international trust in India's plasma management system.
- Stringent Regulatory Requirements: The increase in international regulatory demands might outpace the independent development of Indian plasma centers, resulting in ongoing challenges for India's plasma export and international market entry.
- Global Economic Uncertainty: Negative impacts on India's plasma export and international market participation may result from global economic uncertainties.

2. Results: Legislation and Amendment for India’s Plasma Management System

The analysis of India's plasma management system reveals the need for several improvements to leverage the plasma supply potential of the country with the world's largest population.

1) Legal Constraints on Plasma Export

India currently relies solely on the Contract Manufacturing Organization (CMO) model to collaborate with foreign companies using Indian plasma. Unlike the United States and Europe, where collecting plasma domestically to meet domestic supply needs and selling surplus plasma abroad is permissible, India has legally prohibited the sale of plasma to foreign entities. This acts as a barrier to international collaboration and export

activities for India's plasma industry, necessitating legal amendments for cooperation with foreign governments and companies.

2) Quality Management Challenges, Infectious Disease Concerns, Public Health Incidents, Stringent Regulatory Requirements

India's plasma management system may not meet international standards in certain cases. Plasma not subjected to mandatory Nucleic Acid Testing (NAT) poses challenges in ensuring international safety standards. Plasma safety plays a crucial role in maintaining international trust and ensuring the production of safe products. Given India's heightened concerns about infectious diseases, more stringent plasma management techniques are needed. Failure to implement proper plasma management could result in a loss of trust in Indian plasma if incidents occur. Moreover, international regulatory requirements are becoming increasingly stringent over time. The pace at which international regulatory standards are tightening may outstrip the domestic development rate of India's plasma management technology.

3) Global Collaboration

For Plasma-Derived Medicine Products, the most important factor in the business is the stable supply of safe and abundant plasma. The demand for Plasma-Derived Medicine Products is consistently rising in the global market. According to SWOT analysis, India anticipates low plasma center management costs, making it an attractive option for cost-effective plasma center operations. With its substantial population, India has the potential to secure abundant plasma. Therefore, if the Indian government permits it, establishing plasma centers in India could be an appealing prospect for foreign Plasma-Derived Medicine Products manufacturers. Foreign companies with excellent plasma management technology and substantial capital could overcome the aforementioned weaknesses by

establishing plasma centers in India.

4) Public Benefits

From the perspective of foreign companies with the approval of the Indian government, they can collect and sell Indian plasma for profit using their excellent capital and technology. However, considerations must be made for the welfare of Indian citizens based on the approval of the Indian government. Firstly, a portion of the plasma collected by foreign companies must be supplied to India to meet domestic demand. As the initial owner of the plasma collected by foreign companies is not the Indian government but the foreign companies themselves, the Indian government must negotiate and purchase it at an appropriate price. Secondly, a portion of the profits generated by foreign companies collecting and selling Indian plasma must be subject to taxation by the Indian government. These taxes can be utilized as a budget to enhance India's health insurance. This approach could contribute to the overall advancement of India's healthcare industry.

5) Reference to the U.S. Plasma Collection Standards

If the collection of plasma by foreign companies proves to be highly beneficial to Indian citizens, excessive plasma collection could potentially threaten the health of the population. Therefore, the Indian government must rigorously and transparently manage plasma collection, limiting individual collection within bounds that do not compromise public health. Detailed guidelines on allowable plasma collection in countries that allow paid plasma donation, such as the United States, can be used as a reference. For instance, the United States, being a representative country allowing paid plasma donation, has strict regulations in place to prevent an excessive frenzy of blood donation. Notably, the U.S. standards for plasma collection restrictions are as follows:

a. Age requirement of 18 years and older.
b. Weight of 110 pounds or more.
c. Available to donate plasma twice a week.
d. Adherence to regulatory agency-defined ranges for factors such as pulse rate, body temperature, and blood pressure
e. Restrictions for individuals with recent surgeries, tattoos, pregnancy, or certain illnesses

Detailed information can be verified through ABO Plasma (2022) and Verywell Health(2023). And when analyzing this in terms of the process and various perspectives on benefits and risks, the following can be observed.

VI. Discussion

1. Unfamiliarity with Plasma Donation in Indian Culture

According to the research, India does not have a familiar culture of blood donation. Therefore, even if foreign companies establish excellent plasma centers, it may be challenging to collect the targeted amount of plasma. To overcome this, considering paid plasma donation, as in the United States, could be an option.

However, if foreign companies offer rewards to Indian plasma donors and export the collected plasma, in-depth discussions on the ethical dilemma of allowing paid donation in India are necessary.

Therefore, fundamental solutions need to be considered. To address the root causes of low plasma donation in India, an understanding of India's blood donation culture is crucial. For example, research should be conducted on how common blood donation is in India and the scale at which it occurs in different regions.

The low prevalence of plasma donation in India is likely due to cultural constraints. Therefore, the next research should explore factors such as cultural, religious, and social norms contributing to reluctance or hesitation towards plasma donation. Understanding the cultural differences between blood and plasma donation is essential. This analysis can help identify the reasons making plasma donation difficult in India and strategize ways to overcome them.

Regarding the option of collecting plasma through paid donation, in-depth research on ethical issues is essential. Discussions should be held on why paid plasma donation might be considered ethically problematic in India.

If introducing paid plasma donation, a specific reward system needs to be designed. Analyzing how the reward system could be accepted in Indian culture and considering ethical considerations is crucial.

Consideration of government intervention is necessary. Research on the role the

Indian government can play in overcoming cultural difficulties in plasma donation is needed. This involves designing regulations and support measures by the Indian government to activate plasma donation.

In this study, instead of directly providing rewards to plasma donors, it was recommended that the Indian government should collect taxes on the profits earned by foreign companies operating plasma centers and utilize them in the health insurance budget.

However, discussions are needed on the tax policy structure and rates for the plasma collected by foreign companies. Additionally, concrete planning is required on how the revenue obtained through this can contribute to the enhancement of India's health insurance budget.

Moreover, for effective utilization of this budget, transparent and ethical government policies and management are necessary. The Indian government should transparently manage the revenue generated through plasma donation, and effective policies should be established to allocate it to the health insurance budget. Emphasizing transparency and fairness in tax policies is crucial to specify India's policies on the plasma sourced by foreign companies.

In terms of the practical strengthening of India's health insurance system, discussions are needed on how the proposed policy can realistically contribute to the enhancement of India's health insurance system.

Through such discussions and additional research, a deep understanding of the cultural aspects of plasma donation in India can be gained, and strategic approaches tailored to local characteristics can be explored.

2. Balancing Plasma Export and Domestic Supply

The analysis results of this study are focused on improving India's plasma management system, with an emphasis on expanding the supply of global plasma-derived

medicine products. Therefore, excessive attention to this goal alone could hinder domestic supply in India due to the outflow of plasma from Indians.

According to the content of in-depth interviews, countries in the well-developed plasma management systems, such as the United States and Europe, legally allow the sale of surplus plasma to foreign countries after meeting domestic demand. In contrast, developing countries restrict the foreign sale of plasma. Therefore, in the case of India, it is recommended to collaborate with foreign companies to improve the collection and management system of plasma while specifying limitations on the export quantity of Indian plasma in the contract.

The quantity of domestic supply should consider India's economic capacity and health insurance budget. In other words, the amount of plasma supplied domestically should be calculated by assessing the budget that the Indian government can allocate to support Indian citizens, rather than setting the standard as the total amount of plasma needed by Indians.

For future research, it is recommended to calculate the expected health insurance budget that the Indian government could secure through this model. Additionally, deriving an appropriate quantity of domestic plasma supply is advised based on the expected health insurance budget.

In considering the ethical aspects of foreign companies collecting plasma from Indians and safeguarding the health of the Indian population, discussions on restricting the export sales of plasma and national management are essential. The planning should focus on formulating approaches that ensure the benefits of foreign companies' plasma collection for Indian citizens while avoiding potential threats to health.

From the perspective of sustainable plasma export and domestic supply stability, regulations and agreements are necessary to confirm the stability of domestic supply when exporting plasma. If India's domestic supply falls below a certain level, measures such as restricting plasma export or establishing contingency plans for specific emergencies should be implemented.

A thorough examination of the impact of plasma export on India's national health is required. Regulations should be introduced to limit exports if there is concern about potential harm to national health. Ethical guidelines related to this should prioritize the protection of the rights of plasma donors and recipients, considering the safety of the population as a top priority.

In preparation for scenarios of domestic supply shortages due to plasma export, it is crucial to explore ways to establish a balanced healthcare system. Developing realistic healthcare policies tailored to the Indian domestic environment is necessary to strengthen the national health system.

Through this comprehensive approach, the next study should plan effective strategies to maintain a balance between plasma export and domestic supply in order to protect national health and the interests of the citizens simultaneously.

V. Conclusion

India's plasma management system faces a complex landscape shaped by a myriad of factors, including regulatory constraints, economic capacity, and healthcare expenditure. Through an in-depth exploration of the system's strengths, weaknesses, opportunities, and threats (SWOT analysis), as well as a critical examination of global comparisons and economic considerations, several key conclusions emerge.

India's regulatory landscape, marked by constraints on the export of plasma and a lack of mandatory Nucleic Acid Testing (NAT), poses challenges for international collaboration. While international standards and third-party certifications can enhance reliability, the need for NAT mandates must be balanced with increased pharmaceutical costs and careful consideration of India's health insurance system.

The economic capacity of India, as reflected in healthcare expenditure and per capita GDP, presents substantial challenges. Despite efforts to align with models from developed countries, the significant disparity in resources remains a critical barrier. Budget constraints and the need for increased health expenditure create complexities in expanding healthcare insurance and supporting the production of plasma-derived medicine products.

India's health insurance system faces challenges in supporting plasma-derived pharmaceuticals due to their specialized nature and the prevalence of other pressing health issues. Balancing the allocation of resources between rare diseases and prevalent health concerns is a critical consideration.

Consequently, investing and strengthening collaboration in India are identified as crucial strategies for future success. In light of the research findings, the following recommendations have been proposed.

Firstly, the Indian government should permit the establishment of plasma collection centers by foreign companies with abundant financial resources and extensive experience in high-level plasma management systems to align with international standards.

Secondly, to attract outstanding foreign companies to India to establish plasma centers in India, it is necessary to amend Indian laws. In that case, it is necessary to consider allowing the restricted sale of plasma by Indians.

Thirdly, the Indian government should levy appropriate taxes on the revenue generated from the sale of Indian plasma by plasma collection centers established and operated by foreign companies within India. This budget should be utilized to strengthen the healthcare industry and enhance the medical insurance system in India. It should also be partially allocated to the domestic supply of plasma-derived medicine products in India. This budget must be managed transparently and ethically.

Fourthly, based on the budget secured through the aforementioned business model, the Indian government needs to calculate an adequate quantity of plasma supply for domestic use that it can support. Using this calculated amount as a benchmark, foreign plasma centers should be restricted from selling all Indian plasma abroad.

These recommendations are expected to facilitate successful collaboration between foreign companies and the Indian plasma market, contributing to the global expansion of Plasma-Derived Medicine Products supply. It is anticipated that this will pave the way for meeting the demand for plasma-derived pharmaceuticals sustainably and ethically.

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Appendix 1. Questionnaire of In-depth Interview to Korean

[수집 정보]

1. 면담대상자의 혈장유래의약품 제조사 근무 관련 일반적 특성 (근무년수, 연령, 직무 등)
2. 면담대상자가 근무하는 혈장유래의약품 제조사의 일반적 특성 (소재지 등)
3. 면담대상자의 인도 혈장유래의약품 사업 경험
4. 면담대상자의 인도에서 수집 및 관리한 혈장을 활용한 사업 경험
5. 면담대상자의 인도의 혈장 관리 시스템 개선에 대한 의견
6. 질문 유형은 공통질문과 인도 기업 재직 경험자와 한국 기업 재직 경험자로 구분한 개별질문으로 구분

[공통 질문]

1. 전반적 질문

- 인도의 혈장 수집 및 관리 체계의 현재 상태에 대해 어떻게 평가하십니까?
- 현재 인도의 혈장 수집 및 관리 시스템의 주요 과제는 무엇이 있을까요?
- 인도 혈장유래의약품의 건강보험제도를 설명 부탁 드립니다.

2. 혈장 수집과 관리 측면

- 인도에서 1회 혈장 수집양은 몇 ml인가요? 한번 혈장을 제공하면 언제 다시 혈장 제공이 가능한가요?
- 인도에서 기증자로부터 혈장을 수집하고 동결하는 시점을 몇 시간 내로 하도록 의무화하고 있나요? 의무화하고 있다면 몇 시간인가요? 의무는 없다면 일반적으로 몇 시간 내로 혈장을 동결하고 있나요?
- 인도 혈액원에서 혈장을 screening할 때 진행하는 test는 무엇이며 어떤 virus를 target으로 하나요?
- 인도에서 혈장의 보관온도와 운송온도 의무 조건이 있나요? 있다면 몇도 이하로 보

관하고 있나요? 의무 조건이 없다면 통상적으로 보관하는 온도는 몇도 이하인가요?
- 인도에서 통상적으로 사용하는 혈장 bag, 항응고인자, Apheresis Machine은 무엇을 사용하나요?
- 인도에서 Look-back system이 있나요? 있다면 어떻게 운영하고 있나요?
- 인도 혈액원에서 개별 donor에게 HIV, HBV, HCV의 NAT를 진행하면 인도에서 수집한 혈장을 외국 제조사에게 위탁 생산 맡겨서 공급량을 늘릴 수 있을텐데, 시행하지 않는 이유는 무엇이며, 어떻게 이를 극복할 수 있을까요?
- 인도의 혈장 관리 시스템 중에 아쉬운 점은 무엇이 있을까요?

3. 혈장유래의약품 생산 측면
- 인도의 연간 전체 분획할 수 있는 양은 몇 Liter 인지?
- 인도의 혈장유래의약품 공급을 확대해야 할 필요성이 있을까요? 있다면 이유는 무엇인가요?
- 인도의 혈장유래의약품 공급 확대를 위한 인프라 개발이 이루어 지고 있나요? 있다면 어떻게 이루어지고 있나요?
- 인도의 혈장유래의약품 공급을 확대하는데 어떤 도전과 어려움이 있나요?

4. 혈장유래의약품 산업
- 인도 혈장유래의약품 산업은 국제적으로 어떻게 평가 받고 있다고 생각하나요?
- 인도 혈장유래의약품 산업이 국제 시장에서 경쟁력을 가지려면 어떤 전략이 필요할까요?
- 환자가 혈장유래의약품 사용 비용에 부담을 갖지 않으려면 누가 어떤 노력을 해야 할까요?

[대상자별 개별 질문]
- 당신이 재직했던 혈장유래의약품 제조사의 연간 최대 생산 capacity는 몇 Liter 인가요?
- 한국의 혈장유래의약품을 인도로 수출할 때 어떤 어려움이 있었나요?

- 인도에서 수집하고 관리한 혈장을 활용해서 사업을 할 때 어떤 어려움이 있었나요?

Appendix 2. Questionnaire of In-depth Interview to Indian

[Information Collection]

1. General Attributes of PDMP Manufacturers Interviewees (Tenure, Age, Job Role, etc.)
2. General Attributes of the PDMP Manufacturer Where the Interviewee Works (Location, etc.)
3. Interviewee's Experience with the PDMP Industry in India
4. Interviewee's Experience with the Utilization of Collected and Managed Plasma in India
5. Interviewee's Opinions on Improving India's Plasma Management System
6. Question Types Differentiating Between Common Questions and Questions for Individuals with Experience in Indian or Korean Companies

[Common Questions]

1. General Questions

- How do you assess the current state of plasma collection and management systems in India?
- What are the key challenges of the current plasma collection and management system in India?
- Could you explain the health insurance system for PDMP in India?

2. Aspects of Plasma Collection and Management

- In India, what is the volume of plasma collected in one donation, and how soon can a donor provide plasma again after a previous donation?
- Is there an obligatory time frame within which India mandates the collection and freezing of plasma? If so, how long hours does it require?
- When screening plasma in India, which tests are conducted and which viruses do they target?

- Are there mandatory conditions regarding the storage and transport temperatures of plasma in India? If so, what temperature is mandated, or if there are no obligatory conditions, what are the usual storage temperatures?
- What types of bags, anticoagulants, and apheresis machines are commonly used for plasma in India?
- Does India have a look-back system for plasma management? If so, could you explain about it?
- Why is India not implementing NAT (Nucleic Acid Testing) for HIV, HBV, HCV in individual donors, which could increase the supply of plasma collected in India and outsourced for toll-fractionation to foreign manufacturers?
- What aspects of India's plasma management system do you find lacking or inadequate?

3. Aspects of PDMP Production
- What is the annual total fractionation capacity in India?
- Is there a need to expand the supply of PDMP in India? If so, what is the reason?
- Is there ongoing infrastructure development to expand the supply of PDMP in India? If so, how is it being conducted?
- What are the challenges and difficulties in expanding the supply of PDMP in India?

4. PDMP Industry
- How is the PDMP industry in India perceived internationally?
- What strategies should India's PDMP industry adopt to compete in the international market?
- To relieve patients from the financial burden of using PDMP, who should make efforts, and what kind of efforts are required?

[Individual Questions for Employees of Indian Companies]
- What is the annual maximum production capacity of the PDMP manufacturer where

you currently work (or used to work)?

- Do you have plans to increase the production capacity? If yes, why are you planning to increase it?
- When screening plasma at the PDMP manufacturer where you currently work (or used to work), what tests are conducted, and which viruses are targeted?
- What is the ratio of exports to domestic supplies of PDMP for the manufacturer where you currently work (or used to work)? What percentage of the total production volume is each?
- What efforts should be made to increase exports of PDMP made from Indian plasma?

Appendix 3. In-depth interviews Summary

1. Manufacturer A of Plasma-Derived Medicine Products in Republic of Korea

A provided an overview of the current status of India's plasma collection and management system. Currently, each hospital independently collects and manages blood on a weekly basis, lacking a central management system. A mentioned the diverse methods of blood collection and processing due to varying regulations by state governments.

Regarding the question about plasma collection amounts, A mentioned gender differences and explained that collecting blood and fractionating it into plasma typically yields an average of 150ml to 180ml. Donating source plasma in India usually results in 350-450ml. A also highlighted the absence of mandatory regulations regarding the time interval for donors to contribute plasma again, with varying management methods by state.

In response to questions about post-plasma collection procedures, A explained that procedures vary by state government, and precision tests like EIA may not be conducted in certain cases. Mandatory conditions for storage and transport are not clearly defined, and B stated a lack of detailed information on this aspect.

A described the diverse usage of plasma bags and collection devices by companies, including both local and foreign brands. Despite utilizing plasma collection and processing technology, challenges in standardization were emphasized due to differences in regulations and operational methods between state governments. A particularly highlighted the varying levels of standards, including the absence of mandatory HIV and other infectious disease tests for individual donors in India.

Concerning the storage and transport temperatures of plasma, A mentioned that some entities conduct their own validation and monitoring but pointed out the lack of consistent standards. A concluded by explaining that each company operates its own

business model in the Indian plasma industry. Despite shortcomings in validation through tests like EIA or NAT, comprehensive support from the central government for plasma collection and production is lacking. Additionally, A raised the issue of difficulty in exporting plasma abroad. When asked about regulations regarding the timing of collecting and connecting plasma, A noted that regulations vary by company or region, with a common practice being to collect plasma and refrigerate it within 72 hours.

2. Manufacturer B of Plasma-Derived Medicine Products in Republic of Korea

The conversation focused on strategies for enhancing the supply of plasma-derived pharmaceuticals by improving India's plasma management system. B, who worked for six years at a Korean Plasma-Derived Medicine Products manufacturer, currently global business development and exports to India.

Various topics were covered during the interview. B shared opinions on the current state of India's plasma collection and management system, highlighting inadequacies in ensuring the safety of plasma. Specifically, A pointed out shortcomings in the current system, especially in virus testing.

In India, virus testing is conducted through EIA tests, and B mentioned that NAT is not performed locally. B argued that additional tests are necessary for enhanced safety and raised concerns about the associated costs and budget implications.

Details regarding plasma collection in India, including information on storage and transportation temperatures, were discussed. Additionally, insights were shared on the international market evaluation and strategies to enhance competitiveness in the Plasma-Derived Medicine Products industry.

3. Manufacturer C of Plasma-Derived Medicine Products in India

Five companies, including Plasmagen, Hemarus, Reliance, Intas, and Virchow, are

manufacturers of Plasma-Derived Medicine Products in India, with a combined annual production capacity of approximately 1.3 million liters.

They highlighted the lack of centralization in India's plasma collection and management system as a major challenge. They emphasized the need for further fractionation and standardization in accordance with guidelines. While plasma collection is increasing, they identified the need for adjustments in logistics and pricing policies.

Regarding the time and process for plasma donation and collection, donors can contribute every three months. The donated plasma undergoes testing through Nucleic Acid Testing (NAT), and various products, including collection containers and anticoagulants, are sourced from both Indian and foreign companies.

As part of their strategy for international market entry, Manufacturer C stated that 35-40% of their current business occurs in the international market. However, they acknowledged the necessity for standards and quality improvement to expand further in the international market.

In terms of collaboration and standardization among participants in the international market, Manufacturer C highlighted the need for improvement in infrastructure and expectations. They also mentioned technical issues related to pricing policies, plasma management, distribution, and storage and transportation temperatures for plasma and Plasma-Derived Medicine Products.

4. Manufacturer D of Plasma-Derived Medicine Products in India

D, serving as the Business Development Manager for the South Asian and Indian markets, discussed plans for the production and import of plasma-related products in India. D addressed various aspects such as plasma collection, testing, processing, transportation, and pricing while responding to questions.

In terms of plasma collection, D mentioned that the maximum amount collected in a single donation in India is 850ml, and donors can contribute at a minimum interval of

15 days. Regarding plasma screening and safety management, D stated that plasma undergoes testing for various viruses, including HIV, HCV, HBsAg, malaria, and syphilis. However, Nucleic Acid Testing (NAT) is not mandatory.

Concerning plasma pricing, D mentioned that the price of plasma in India is lower than the global market, making it challenging to import and utilize plasma from external sources.

D provided information about India's plasma fractionation capacity, stating that there are five manufacturers in India with an annual processing capacity of approximately 1.3 million liters.

Discussing recent market trends, D highlighted that plasma collection in India is not well-organized, with numerous collaborators and existing competition. The price of collected plasma is determined through negotiations with collaborators, and the current market is becoming increasingly competitive.

D identified the primary challenge in the Indian plasma market as maintaining price competitiveness. Due to a significant number of patients in India not covered by government or insurance protection, a lower price is deemed necessary.

Regarding the safe transportation of plasma, D mentioned that specific temperatures are required for the transportation and storage of plasma. However, there are no predefined general rules, and attention is given to manage this aspect carefully.

Concerning the look-back system in India, D explained that the current system is not effective, making it difficult to obtain accurate product quality data. D emphasized the need for efforts to strengthen and enhance this system.